

8B.5 OUTDOOR HUMAN THERMAL COMFORT IN MELBOURNE'S BOTANIC GARDENS

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BACKGROUND

Outdoor thermal comfort studies have mainly examined the perceptions of local residents (Harlan et al. 2006; Lin 2009; Spagnolo and de Dear 2003; Thorsson et al. 2004), so it is uncertain whether thermal comfort is perceived differently by tourists (Rutty and Scott 2014). In addition, cultural differences in thermal comfort perception are not well understood in tourism climatology. This study addresses this gap by examining whether overseas tourists perceive thermal comfort differently from local visitors in summer in Melbourne Australia.

METHODS

A Human thermal comfort survey was administered at four locations at the Royal Botanic Garden Melbourne for eight days in February 2014 ($n = 2198$). Concurrently two Campbell Scientific CR211X loggers and two Kestrel 4400 heat stress tracker were used to log weather conditions at 10-minute intervals. The weather parameters included air temperature, relative humidity, black globe temperature and wind speed. Apparent temperature (AT) was calculated using the following formula (Steadman 1994).

$$AT = Ta + 0.33 \times e - 0.70 \times ws_{10m} - 4$$

where:

Ta = Dry bulb temperature ($^{\circ}C$)

e = Water vapour pressure (hPa)

ws_{10m} = Wind speed (m/s) scale up to 10 m

$$ws_{10m} = ws_{xm} \times \text{LOG}(10/0.01) / \text{LOG}(x/0.01)$$

(Bröde et al. 2012)

$$e = rh / 100 \times 6.105 \times \exp(17.27 \times Ta / (237.7 + Ta))$$

where:

rh = relative humidity

After processing the data in SPSS 20, the study compared weather data with survey data to examine the thermal perception of visitors to the garden.

RESULTS AND DISCUSSION

The survey results indicate that visitors felt comfortable between 16.3 and 20.3 $^{\circ}C$ (apparent temperature). Figure 1 shows how different microclimates within the gardens affect visitors' thermal perception. The Fern Gully has a misting system and visitors perceived the Fern Gully to be cooler than other locations. In contrast, visitors felt hotter at the O-Gate between 24.4 and 32.3 $^{\circ}C$, which is the main entry and exit point of the garden. This response is likely due to visitors' longer exposure to the sun when they visited the garden.

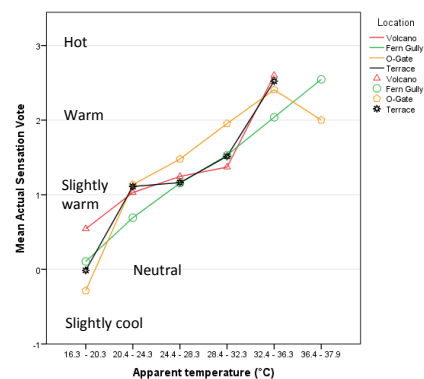


Figure 1: Visitors' thermal comfort in different garden locations

Figure 2 demonstrates the differences in thermal perception between visitors from different countries. European tourists generally felt hotter than other visitors possibly due to a lack of acclimatisation. Moreover, most visitors felt warm to hot after apparent temperature exceeded 32.4 $^{\circ}C$. The downward trend for North American tourists after 32.4 $^{\circ}C$ is due to a very small sample size ($n = 8$) and cannot therefore be considered a representative sample. The survey response reveals the differences in the expectation of local and overseas visitors, who mostly came from a Northern Hemisphere winter (USA, Europe) during the survey period. Although Chinese tourists also travelled from the Northern Hemisphere, it appears that they have different expectations compared with the European and

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North American tourists. In particular, when European tourists felt hot, 36.8% of them preferred no change, whereas the figure is 7.5% for Chinese tourists. As overseas visitors mainly receive the information about holiday destinations from sources such as travel agents and websites, their expectation of what is considered to be comfortable can be different from that of local Australians (Gómez Martín 2005). In particular, many tourists from the temperate regions travel to warmer places to seek sunny weather (Gómez Martín 2005; Rutty and Scott 2014).

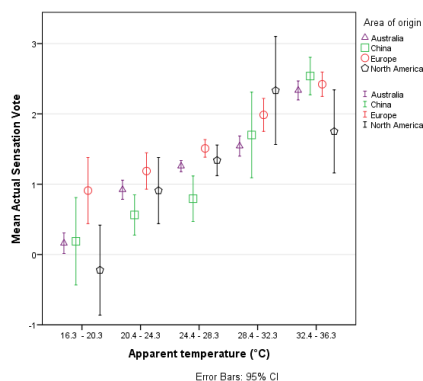


Figure 2: Visitors' thermal comfort measured by mean actual sensation vote (selected area of origin), stratified by 4 °C bin of apparent temperature

Chinese visitors wore more clothes than other visitors and European visitors wore the least amount of clothing (see Figure 3). It is possible that European visitors prefer to develop a suntan (Bränström et al. 2001), which is in contrast with Chinese visitors who prefer to avoid sunshine and solar UV radiation (Tung et al. 2014). Normally people who wear less clothing feel cooler (Liu et al. 2013), but this is not the case for the Europeans in this study (figure 2). Apart from inadequate acclimatization, it is likely that Europeans have greater body and muscle mass than Asians, which lead to higher metabolism (De Boer et al. 1988) and subsequently higher actual sensation vote. In short, clothing adaptation is another major factor in visitors' thermal comfort in the garden.

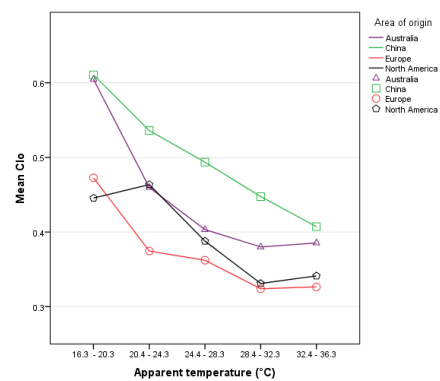


Figure 3: Visitors' clothing indicated by mean clothing insulation (clo), stratified by 4 °C bin of apparent temperature

CONCLUSION

This study indicates that foreign visitors have fundamentally different thermal preference and sensation compared with Australian visitors, especially during hot weather. Furthermore, this study provides useful information to improve tour planning and marketing to potential visitors from different countries. In light of the future rising temperature, this study can be used to inform garden landscape planning, and ultimately improve visitor comfort levels in hot weather.

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