Summertime temperatures and thermal comfort in UK homes

Kevin Lomas, Principal investigator, Loughborough University
Tom Kane, PhD researcher, Loughborough University

Introduction

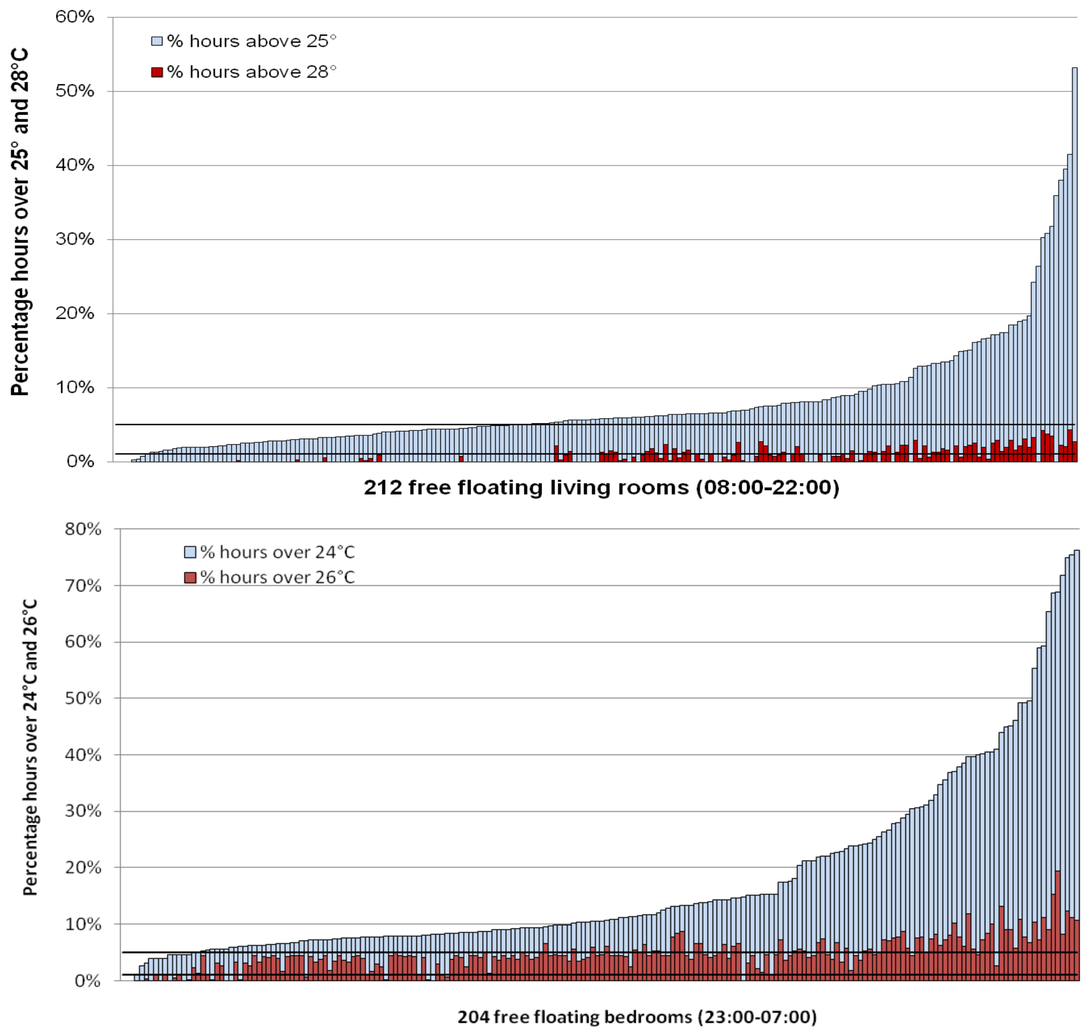
Summertime temperatures in homes are of increasing concern, even in the relatively mild climate of the UK, because very high indoor temperatures can be life-threatening and are likely to occur more often as global temperatures rise. Energy efficient refurbishment can increase overheating risk. It is important therefore to understanding what summertime temperatures are in UK homes and how these might be influenced by house type, construction and occupant characteristics. Hourly summertime temperatures from 268 homes in Leicester were used to study the overheating risk in UK homes and assess CIBSE's 'static' overheating criteria and the adaptive thermal comfort model described in BSEN15251.

Temperature measurements

Room temperatures measured in 230 homes from 1st July to 31st August are the focus of this study. During this period, the external temperature in Leicester varied from 7.9°C to a peak of 29.7°C. The start of the monitoring period was hot. Beginning on 28th June, the average daily temperature exceeded 19°C for five successive days reaching 24.1°C on 1st July, but fell back to 18.8°C on 3rd July. Thereafter, it was below 19°C for all but one day during the rest of the monitoring period.

CIBSE overheating criteria

The number of hours where temperatures exceeded CIBSE's limits of 24°C and 26°C in the unheated (free floating) bedrooms and 25°C and 28°C in the free floating living rooms were counted.

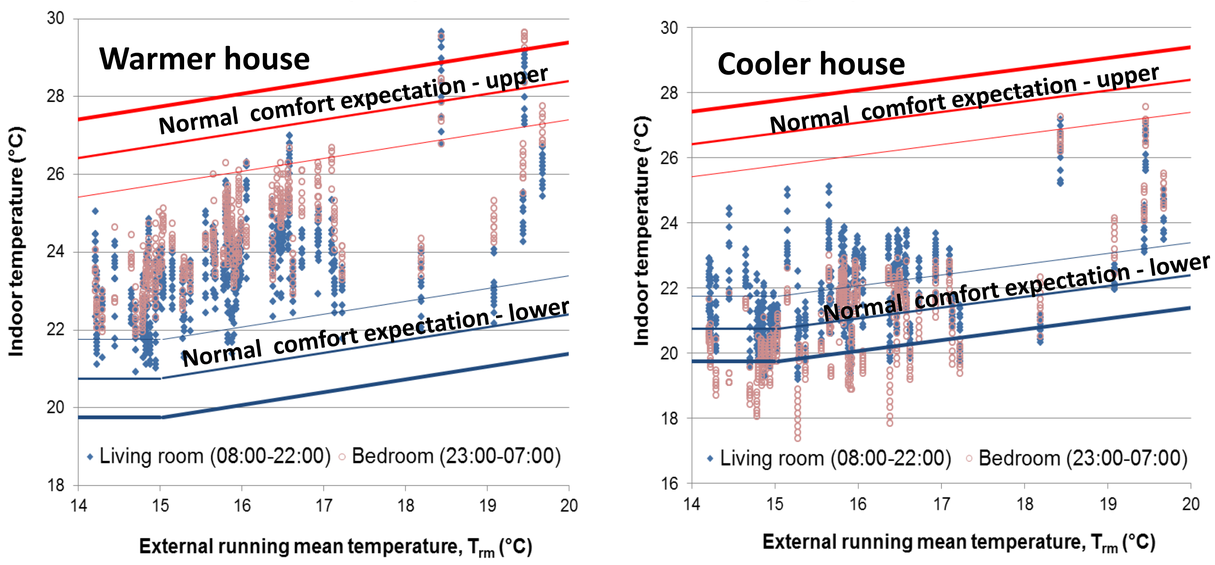


The statistical analyses revealed that there were significantly more flats than other house types with more than 1% of hours over 28°C ($p < 0.05$) and more than 5% of hours over 25°C ($p < 0.1$). This aligns with observations of previous researchers and comments in the national heat wave plan.

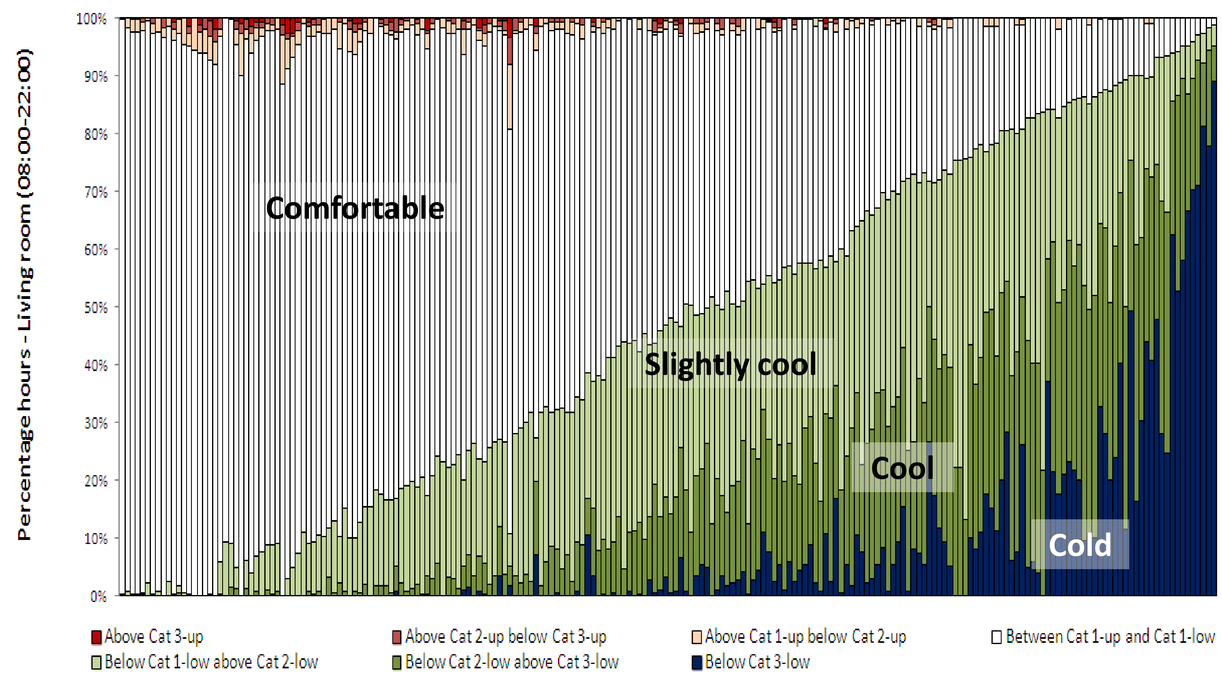
Around 15% of bedrooms had temperatures over 26°C, which is deemed to be a temperature that inhibits sleep, for more than 30% of the summer night-time hours.

BSEN15251 thermal comfort model

Plotting the measured hourly temperatures against the running mean of the daily average external temperature, as demanded by BSEN15251, produces vertical strings of values for each day. There are eight values for the bedroom (each hour from 23.00 to 07.00) and 16 for each living room (from 08.00 to 22.00). Examples are plotted below for a warmer house (left) and a cooler house (right).



The results for all living rooms (below) clearly show an overriding tendency for cool, rather than warm, temperatures during the monitoring period; temperatures that for nearly all homes would be classed as uncomfortable using the BSEN15251 criterion. This contrasts strongly with the impression given by the CIBSE criteria.



Just one living room and five bedrooms had more than 5% of hours with temperatures above the normal comfort expectations (Category II). In contrast, there were 64% of living rooms and 71% of bedrooms in which temperatures were below normal comfort expectations more than 5% of the time. There were, however, significantly fewer cool bedrooms and living rooms in flats than in other home types.

Conclusions

This study indicates that the adaptive thermal comfort model is much more useful and insightful for assessing indoor thermal comfort in homes than the CIBSE method. But, occupants of UK homes appear to tolerate much lower indoor temperatures, at least during cool summer weather, than anticipated by the BSEN15251 adaptive comfort standard. Flats experience warmer indoor temperatures than houses and so may be more susceptible to overheating in warm weather.

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