

## **Occupants Have a False Idea of Comfortable Summer Season Temperatures**

Sami Karjalainen<sup>1</sup> and Raino Vastamäki<sup>2</sup>

<sup>1</sup>VTT, Finland

<sup>2</sup>Adage Corporation, Finland

*Corresponding email: Sami.karjalainen@vtt.fi*

### **SUMMARY**

Thermal comfort studies and standards show that room temperatures should be higher in the warmer season than in the colder season. An interview survey with a sample size of 3,094 people was performed in Finland. The respondents were asked to state the Celsius values of room temperature they prefer in the winter and summer season in living room at home. The results show that people have a false idea of comfortable temperatures. 41% of the respondents think that room temperature should be lower in the summer season than in the winter season. 22% think that room temperature should be 19 °C or below in the summer season. Their principal idea behind this assumption is that the warm outdoor temperature should be compensated by cool room temperature. Only 15% of people have the correct idea: comfortable room temperature is higher in the summer season than in the winter season. The false idea may lead to unnecessary use of energy.

### **INTRODUCTION**

When there is a lack of information, occupants develop own theories about how systems work and use these theories in controlling and adjusting their environments [1]. Kempton [2] presents a well-known example of that. He analysed folk theories for home heating control and found two common theories of how a thermostat works: a feedback theory and a valve theory. In the feedback theory thermostat senses room temperature, but in the valve theory, which is not understood, a thermostat dial is like a gas pedal and controls the amount of heat. The valve theory may lead users to adjust thermostats very often. In a study on use of room air conditioners [3], it was found that the operation of them was governed by multiple overlapping systems of belief and preferences concerning health, thermal comfort, folk theories about how air conditioners function, etc., in addition to economic factors. Diamond and Moezzi [4] have created a list of myths about people, energy and buildings.

Thermal comfort studies [5] and standards [6-7] show that room temperatures should be higher in the warmer season than in the colder season (line A in Fig. 1). There are two main reasons for that: the changes in clothing insulation related to the outdoor temperature [8] and adaptive relationship of comfortable room temperature with the mean monthly outdoor air temperature [8-11].

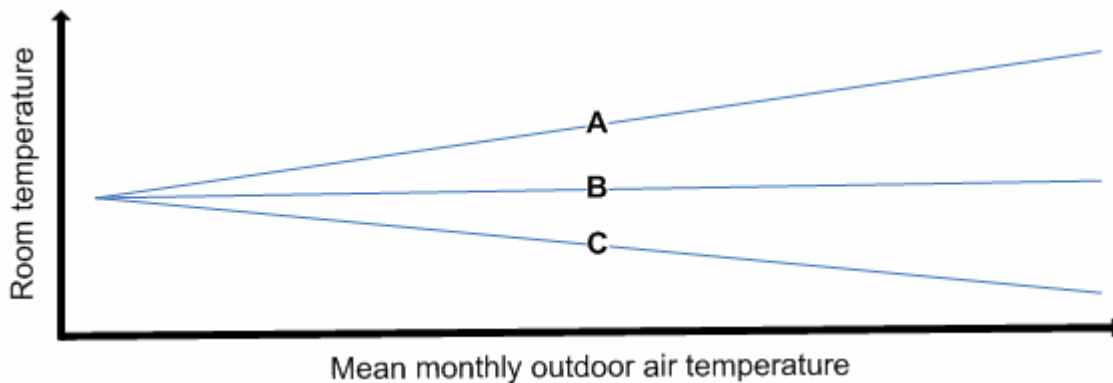


Figure 1. Three theories of how comfortable room temperature is related to mean monthly outdoor temperature, simplified.

Vastamäki et al. [12] found that office occupants have false mental models related to comfortable indoor temperature. About one-third of office occupants think that comfortable indoor temperature is lower in the summer season than in the winter season (line C in Fig. 1). More than one-third thinks that the comfortable temperature is not related to the season (line B). Neither of these views is supported by comfort criteria of the thermal comfort models. The study was realised in five European countries (Finland, Sweden, France, Italy and the Netherlands) with a total number of 735 respondents.

In the present study, ideas on comfortable indoor temperatures were studied among occupants in Finnish homes. In this paper, preferred room temperature refers to an occupant's idea of comfortable room temperature. Comfortable room temperature is what thermal comfort studies and standards see as comfortable.

## METHODS

Inhabitants' ideas of comfortable indoor temperatures were studied using a quantitative interview survey with a nationally representative sample. The interview survey focused on thermal comfort and use of thermostats. In this paper, only the results concerning comfortable indoor temperatures are presented.

The interviews for the survey were carried out by telephone (computer assisted telephone interview, CATI). In the interviews, the respondents were asked to state the Celsius values of room temperature they prefer in their living room at home. The Celsius values were asked separately for the winter and summer season.

The target group of the study was the population of Finland. A random sample of the Finnish population aged between 15 and 74 was selected with quotas set according to gender, age and province. The total number of respondents was 3,094. A well-known Finnish data collection agency (Taloustutkimus Oy) was responsible for the practical realisation of the telephone interviews according to its quality system.

The climate in Finland is marked by cold winters and warm summers. The mean annual outdoor temperature varies between +6 °C in the southwest and -2 °C in the northernmost part of the country. The warmest month is typically July, with mean temperature between +14 and +18 °C in most parts of the country. Daily maximum temperatures can reach +30 °C in

July. The coldest months are January and February, with mean temperatures between  $-4^{\circ}\text{C}$  in the south and  $-15^{\circ}\text{C}$  in the north.

## RESULTS

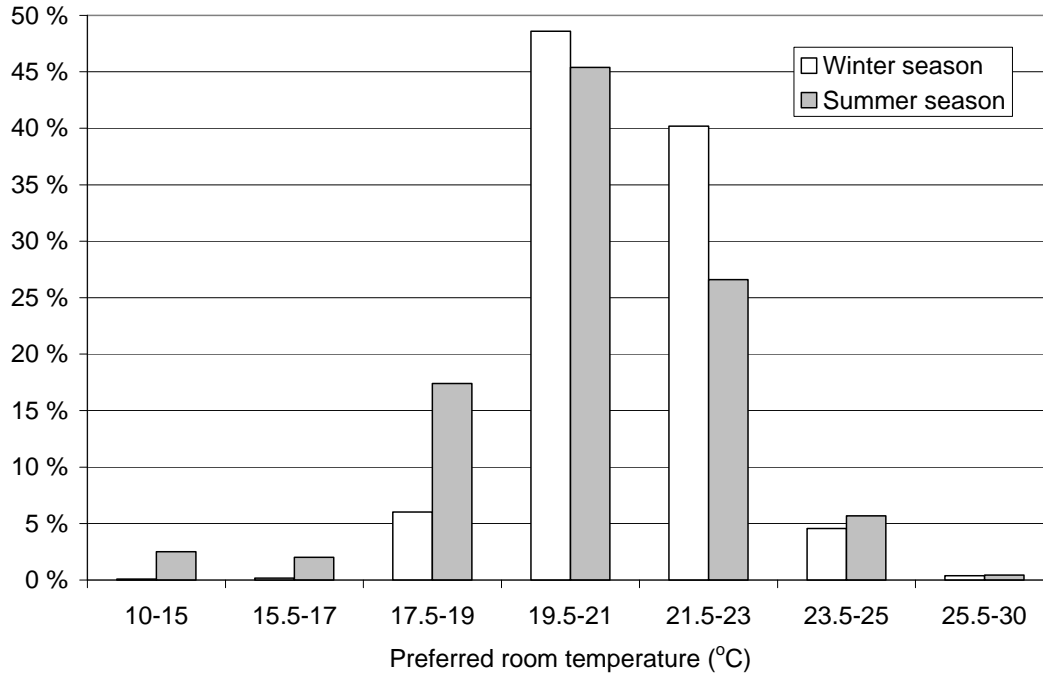


Figure 2. Preferred room temperatures in the winter and summer season in living room at home.  $N = 3064$ .

The respondents were asked to state the Celsius values of room temperature they prefer in the winter and summer season in living room. The results are shown in Fig. 2. 89% of the respondents say they prefer a temperature between  $19.5$  and  $23^{\circ}\text{C}$  in the winter season. There is more deviation in the summer season temperatures: 22% think that room temperature should be  $19^{\circ}\text{C}$  or below. A mean value for the preferred winter season temperature is  $21.2^{\circ}\text{C}$  and for the preferred summer season temperature it is  $20.5^{\circ}\text{C}$ .

41% of the respondents think that room temperature should be lower in the summer season than in the winter season (Fig. 3). Only 15% of people have the correct idea: comfortable room temperature is higher in the summer season than in the winter season.

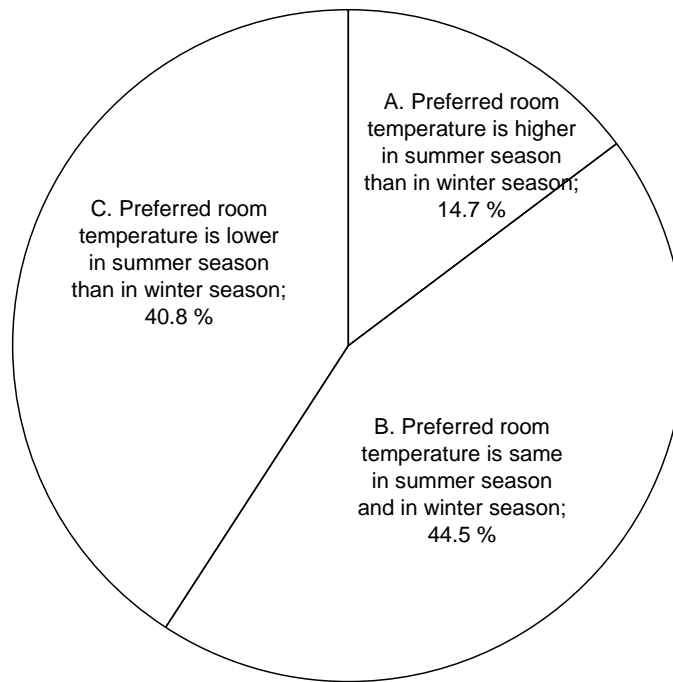


Figure 3. Influence of season on preferred room temperatures in living room at home. N= 3000.

## **DISCUSSION**

41% of the respondents think that room temperature should be lower in the summer season than in the winter season. Their idea behind this assumption is that the warm outdoor temperature should be compensated by cool room temperature: “If it is hot outside, I don’t like hot inside”. Occupants would feel very cold in the summer season, if room temperatures would be in the level most of them suggest.

The respondents of the present study were occupants in residential buildings in Finland. The results are consistent with the office occupant study [12] performed in five European countries. Occupants in offices do not typically have thermometers, but at homes they often do. However, they do not seem to have learned the Celsius values of comfortable temperatures.

The false idea regarding comfortable summer season temperatures may have energy implications. If occupants adjust temperature to, for example, 18 °C in a building with a mechanical cooling system, it leads to unnecessary use of energy. People should be educated about the values of comfortable temperatures in the summer season.

Occupants’ ideas about comfortable room temperatures were studied as a part of usability research of temperature controls. Developers of heating and cooling controls should be aware of the misconceptions of occupants. Temperature controls should be designed to advise occupants on comfortable temperatures.

Future studies should investigate occupants’ ideas about comfortable room temperatures in more detail. It would be valuable to know whether occupants think that the room temperature should vary according to different winter season outdoor temperatures (for example, –20 °C and 0 °C) since it has energy implications.

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