Thermal Comfort and Product Evaluation

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In any work setting we seek freedom from distraction in order to remain focussed on our tasks. Unwanted distraction can arrive from many elements of the work environment, social, technological, psychological, environmental, work process issues, and things that we physically contact. One component of the physical environment that is highly subject to individual differences is thermal comfort. When thermal comfort does not meet expectations, it is often outside of the immediate control of the individual to quickly attain the desired level of comfort.

Thermal Comfort Explained

Thermal comfort in the natural and built environment has been under study for many years. The body of research has shown us that individual perception of comfort is influenced by seven major factors. Four are environmental in nature and three are based on individual conditions (Konz, ASHRAE). The environmental factors include 1) air temperature – the value we read on a thermometer, 2) relative humidity, 3) radiant temperature – sources of cold or hot, like cool air near a window or heat from a fireplace, and 4) air movement. The individual factors include 5) a person's activity level, 6) their duration of exposure to a setting, and 7) their clothing.

The Institute for Environmental Research at Kansas State University has been interested in measuring thermal comfort for over 30 years. Dr. Frederick Rohles, Jr., and Dr. Mohammad Hosni are professors working within the Institute for Environmental Research. It is their belief that when evaluating thermal comfort of items contacting the human body, a proven and standardized procedure must be used. The four environmental factors listed above must be controlled and stable. Likewise the individual factors must be carefully prescribed to ensure unbiased results. The length of exposure to a controlled environment is important because research has demonstrated that individuals take two hours to adapt to a thermal setting. Lastly, subjective responses must be captured when measuring thermal comfort. How a person feels cannot be taken out of the equation when considering the thermal comfort of a product.

It should be noted that subjective evaluation measures have proven to be highly reliable. This method is in contrast to the objective approach which measures core body temperature or skin temperature. Rohles and Hosni emphasize that temperatures produced on or in the body do not correlate with feelings of comfort when testing in a neutral or thermally non-stressful setting, such as at "room" temperature.

Evaluating a Chair

The typical office work environment is filled with many items that we physically contact, but none so intimately as our chair. For a chair to feel comfortable day-in and day-out, it must be responsive to many human needs. One of those needs is the ability to conform to body contours with support materials that allow a person's body-surface to dissipate moisture. Research conducted by Adams *et al.* showed that level of comfort decreased when moisture could not evaporate from the skin. An important property of foam is its ability to transport water vapor away from its surface. Foam has this capacity to dissipate moisture even when it is compressed (Deibschlag et al.). When upholstered foam is used in chairs it maintains the ability to dissipate moisture from a person's skin.

Feelings of thermal comfort are subjective, especially when the temperature ranges between 68 and 78 degrees, common indoor temperatures. At 72 degrees some people will report feeling cold, others warm. For this reason it is unlikely that all people will react positively or negatively in one type of chair versus another. To test this hypothesis, Drs. Rohles and Hosni conducted a Steelcase commissioned study that assessed the thermal comfort of 108 people as they performed office related tasks for two hours. The environment was controlled for heat and humidity. Two temperatures, 68 degrees and 72 degrees were tested, both at 50 percent relative humidity. Evaluators sat on three chairs representing the state of the art in current fabrics, upholstery, design and adjustable features. Two of the chairs, Leap and Criterion, were designed with upholstered cushions and the third offered a mesh support fabric.

Each chair was rated for thermal comfort and the comfort of seven body areas: thighs, low back, sitting bones, neck, wrists, feet/ankles and arms. The results show that each chair contributed equally to the thermal comfort of users. To say it another way, no chair was rated higher than the others. Furthermore, whether the seven body areas were assessed individually or as a whole, the results showed no significant differences in rated comfort of the three chairs.**

Thermal Comfort in Action

The thermal comfort of foam and fabric chair coverings in comparison to open weave mesh has now been seriously evaluated. One hundred and eight people have reported their experience that foam and fabric coverings provide an equal level of comfort as mesh type coverings. The perception that mesh is more comfortable can no longer be supported.

One goal of product design is supporting human capabilities without disrupting the balance between worker and job performance. Maintaining thermal comfort reduces the chance for one type of distraction that often leads to interruption of work flow.

References

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** A full technical paper authored by Rohles, F.H. and Hosni, M.H., of this study will be available after a formal presentation at the annual HFES meeting (2000).