WHITE PAPER

MESH VS. UPHOLSTERY: TESTING THE THERMAL COMFORT FACTOR OF OFFICE CHAIRS

An Ergonomic Study

Paul Allie, Steelcase, Inc.

Too warm? Too cool? Just right? Thermal comfort depends on many factors. A research study has proven that the materials used to construct your chair—mesh versus upholstery—isn't one of those factors.

Distractions negatively impact productivity. Being uncomfortable temperature-wise can easily sidetrack attention and compromise feelings of wellbeing.

But achieving thermal comfort in shared environments is a challenge because people's perceptions and preferences vary greatly.

It's often perceived that a mesh seat is cooler and, therefore, more comfortable than upholstered seating. But is that really true? Can a material make a difference in people's thermal comfort?

To answer that question, Steelcase commissioned a research project with scientists at the Institute for Environmental Research at Kansas State University. The project involved 108 people and three different chairs—two were upholstered and one was suspension mesh. The research was conducted in a carefully controlled environment, using proven, standardized procedures to determine optimal thermal comfort.

The results showed that upholstered and mesh chairs contribute equally to the thermal comfort of users. None of the three chairs was rated higher than the others. The claim that mesh is more cooling than upholstery for seating products has not been supported by science. Superior thermal comfort, therefore, is not a proven benefit of suspension mesh.

Understanding the various factors of thermal comfort and the cooling properties of upholstery provides further insights into these findings.

METHODOLOGY: UNDERSTANDING THERMAL COMFORT

Along with scientists at other universities as well as researchers at companies such as DuPont and Nike, professors at the Institute for Environmental Research at Kansas State University have been studying thermal comfort for decades. Their work has confirmed that thermal comfort depends on seven factors. These include:

Environmental factors

- Air temperature
- Relative humidity
- Radiant temperature, such as cool air near a window
- Air movement

Individual factors

- Activity level
- Duration of exposure to a setting
- Clothing

In any study of thermal comfort, the environmental factors must be controlled and stable. Likewise, the individual factors of activity level, duration and clothing must be carefully prescribed to ensure unbiased results. The duration of the experiment is important because research has proven that it takes people up to two hours to adapt to a setting – coming inside on a hot day, for example. Physical factors, such as body mass, gender, age and overall fitness are variables, and so the number of participants must be large enough and selected randomly to assure valid results.

How a person feels is recognized as a vitally important dimension of comfort, and people in the same environment can have very different feelings about their comfort levels.

Some studies of thermal comfort compare performance on tasks at different air temperatures, but don't measure the human dimension. Other studies involve measuring body or skin temperatures. Recent research has proven, however, that body temperature doesn't necessarily correlate with feelings of comfort in thermally non-stressful settings (i.e., temperatures within the range of 68-78 degrees), making it an unreliable metric for comfort in those conditions.

For these reasons, personal evaluations are widely regarded as a highly reliable metric for thermal comfort.

RESULTS & INSIGHTS: MOISTURE DISSIPATION IN UPHOLSTERY

People's level of comfort decreases when moisture can't evaporate from their skin. This fact has important implications for materials that touch the human body.

The advantages of moisture-wicking fabrics for cooling are well known among athletes and people who exercise regularly. Moisture-wicking fabric is a popular choice for workout clothes because it pulls moisture away from the skin and keeps people comfortable. It's also used in clothing for people who want to look fresh and unwrinkled in hot and humid conditions or while traveling.

Upholstered chairs are constructed of foam cores covered with fabric. As a moisture-absorbing material, an important property of foam is its ability to transport water vapor away from its surface. Foam has the capacity to dissipate moisture even when it's compressed. An upholstered chair has the ability to conform to body contours and pull moisture away, producing a cooling effect.

Although air circulation around the body may be slightly greater in a mesh chair, mesh doesn't have the moisture dissipating features of upholstery. The research findings proved that a mesh chair has no significant thermal comfort advantages compared to an upholstered chair. Both materials can keep the body comfortably cooled, in different ways.

An upholstered chair has the ability to conform to body contours and pull moisture away, producing a cooling effect.

Seating Thermal Comfort Study, Key Facts

- Conducted by researchers at the Institute for Environmental Research, Kansas State University
- 108 people performed office tasks for two hours in a controlled environment
- Two temperatures—68 degrees and 72 degrees—were tested, both at 50 percent relative humidity
- Participants sat on three state-of-the-art task chairs, all with adjustability features
- Two chairs were upholstered, one was constructed of suspension mesh
- The researchers asked participants questions about their comfort in the chairs after two hours
- Each chair was rated for overall thermal comfort and the comfort of seven body areas: thighs, low back, sit bones, neck, wrists, feet/ankles and arms
- None of the three chairs was rated higher than the others, proving mesh chairs don't provide superior thermal comfort

THE BOTTOM LINE: COMFORT MATTERS

Most people spend 50-80 percent of their workday sitting down, and they have more direct and frequent contact with a task chair than any other furniture in the office. For a chair to be comfortable, it must respond to many human needs, including thermal comfort. Maintaining thermal comfort reduces distractions that interrupt workflow and also contributes positively to wellbeing at work.

User-centered research projects, such as the thermal comfort study, are foundational for gaining insights into the science of seating and using those insights to design products that enhance people's capabilities at work.

REFERENCES

Adams, T., M.A. Steinmetz, S.R. Heisey, K.R. Holmes, and P.E. Greenman. "Physiologic Basis for Skin Properties in Palpatory Physical Diagnosis." *Journal of the American Osteopathic Association*, 81. 1982.

Allie, Paul, "Thermal Comfort and Product Evaluation." Steelcase 2006.

ASHRAE. "Thermal Conditions for Human Occupancy." ASHRAE/ANSI Standard 55-92. American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta. (1992).

Diebschlag, W., F. Heidinger, B. Kurz and R. Heiberger. "Recommendation for Ergonomic and Climatic Physiological Vehicle Seat Design," SAE 880055. Warrendale, PA: Society of Automotive Engineers, Inc. 1988.

Konz, S. *Work Design: Industrial Ergonomics*. Lancaster, CA. Grid Publishing, Inc. 1983.

Rohles, F.H. and R.J Krohn. "Thermal Comfort as Applied by Chair Style and Covering." Proceedings of the 26th Annual Meeting of the Human Factors Society, Seattle, WA. 1982.

100 Steelcase

Call 800.333.9939 or visit steelcase.com

facebook.com/steelcase

twitter.com/steelcase

youtube.com/steelcasetv