Questions & Answers – Webinar: IEA EBC Annex 87: Energy and Indoor Environmental Quality Performance of Personalised Environmental Control Systems (PECS) | 12 December 2022 (16:30-18:00 CET)

Questions for Ongun Berk Kazanci (ICIEE/DTU, DK):

1. **Q:** Is comfort measured differently with desk (or floor) mounted personal ventilation systems compared to conventional HVAC, especially with regard to local air velocity and draft? If a condition would be considered an undesirable draft with conventional HVAC, would that air velocity be acceptable with PECS?

   A: People are more tolerant and tend to indicate higher satisfaction with the indoor environment when they have control over their surroundings. So it is likely that they will be more comfortable with a proper PECS than in a regular HVAC system. When an airflow creates discomfort (draft) or comfort depends on different factors including the overall thermal state of the body.

2. **Q:** What was the air temperature of the personal ventilation system?

   A: It will vary depending on the application. Usually isothermal or the supply air temperature will be lower than the room air.

3. **Q:** PEC seems to focus on air, heating and cooling. Are there any ongoing efforts to integrate HVAC, lighting, acoustics into one personalized control system?

   A: Yes, we are working on this at DTU. There are also a few existing systems that have tried this. Some of these are commercially available. Feel free to get in touch with me for more info.

4. **Q:** Do you also compare the LCA of personalized equipment and central HVAC?

   A: We are working on this.

Questions for Hui Zhang (UC-Berkeley, USA):

5. **Q:** Have you compared the effects between footwarmer and thick socks/indoor shoes?

   A: Footwarmer is actively heating local body parts that feel cold discomfort and need to be warmed, it creates a pleasant sensation. Thick socks/indoor shoes are good that help to avoid the foot cold discomfort happening. I haven't done a study to compare them myself, but I believe they both are effective, and the thick socks and indoor shoes are more practical. My study was carried out in an office environment. When we lowered their office ambient temperature setpoints, cool hands and cool feet discomfort were the main challenges to deal with. People were wearing their normal shoes. So, providing footwarmers is effective and efficient.

6. **Q:** The work in the field of feet that perceive heat is very interesting. Do you think it is key to warm up these areas to provide comfort, or it is just a matter of making the thermal sensation "faster", so at the end even worming up the feet, without prioritizing any specific area, is fine?

   A: The human body is equipped with functions to cope with ambient temperatures which are not ideal. However, often in office or residential environments, we are dealing with environments not too far from neutral. We are trying to extend the indoor temperature setpoint range to save HVAC energy. In this temperature range, our body can keep the

heat balance, but local body parts' cool discomfort needs to be addressed. So, the footwarmer satisfies this need, to improve occupants' perception, and as you said - in a fast way. However, in severe cold environments, the whole-body would be cold, and we do need to take care of keeping the entire body warm.

7. **Q:** You indicate that the hands and feet are the coldest parts of the body in cold conditions, so I was wondering how participants' hands feel when they use the foot warmer in cold conditions. In your field study, does merely using foot warmer provide sufficient whole-body thermal comfort in cold conditions?

   A: In my study, I only provided the footwarmer. Yes, you are right, hand cold indeed was a source of discomfort. We do need to address cool hand discomfort. I myself tried different studies and built different apparatuses. There is a company in Denmark that manufactures hand warmers.

Questions for Sabine Hoffmann (Technical University of Kaiserslautern, DE):

8. **Q:** In your experiments, were the individual users dressed up according to their personal comfort preferences or did they all use the same clothing levels?

   A: We conducted a field study in which we did not control people's clothing level. They were dressed up to their personal comfort level.

9. **Q:** Is it likely that physiological adaptation over a period might increase the acceptability of space temperatures under 19°C without footwarmers?

   A: First of all, I am not an expert in middle or long-term adaptation to indoor temperature conditions and other people are more qualified to answer the question. I believe that a physiological adaptation might be possible to some extent. An important factor will probably be whether people are allowed to compensate for cold extremities through other means such as increasing the metabolic rate through walking around or working in a standing position. An increased intake of hot beverages or food could be another potential way to compensate for cold conditions, but extremities might be affected relatively late by this measure. Most likely people will try to increase the insulation level of feet (warm socks and shoes, maybe heating insoles), which is more difficult with hands given the constraints of today's office work (typing, mouse).

10. **Q:** I was wondering what the key commercial barriers are.

    A: I would like to refer to the commentary published here: https://www.buildingsandcities.org/insights/commentaries/personal-comfort-systems-lessons.html

Questions for Joon-Ho Choi (University of Southern California, USA):

11. **Q:** Given Alliesthesia, and aiming to avoid severe discomfort rather than to provide comfort, is close automatic control of wearables necessary, or even desirable?

    A: A wearable would not be able to replace the whole HVAC system, but it could be applied as an alternative or supplementary system for the existing. Regarding a close automatic control, any automatic control system should come with any overridable option for an effective control since the user is the best one who understands the user's needs precisely. Such feedback can be accommodated in a Machine Learning system so the control gets smarter and smarter by reading and understanding the context of the user's thermal needs.