TRIGGERS BEHIND HUMAN-BUILDING INTERACTIONS FROM A USER PERSPECTIVE: RESULTS AND EFFECTIVENESS OF CAPTURING MOTIVATIONS IN REAL-TIME

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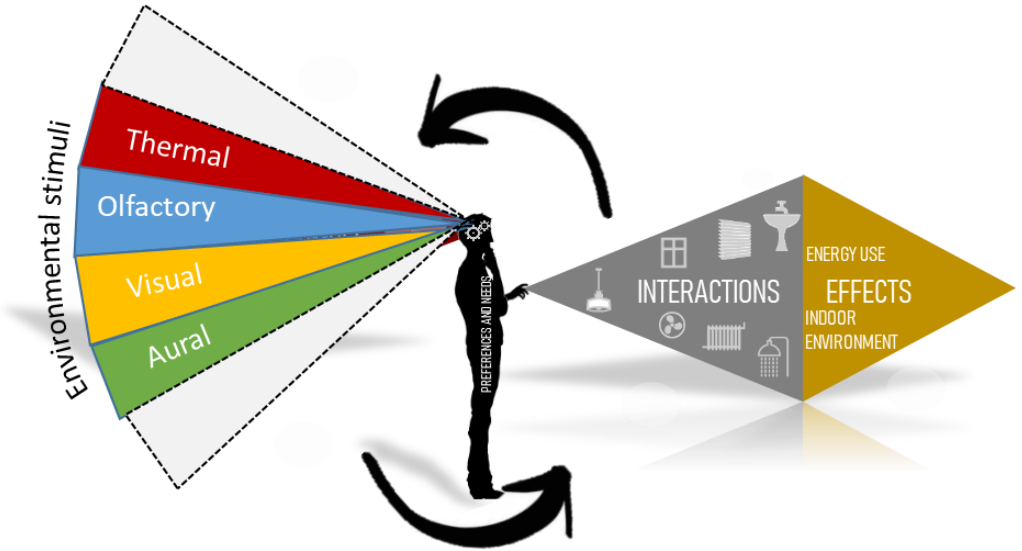
Introduction

- Although there have been significant advancements in the field of energy-related behavioural research in buildings, gaining a more **comprehensive and "multi-dimensional" understanding of drivers behind human-building interactions** is still needed to better incorporate the user perspective in building operation and design practice
- Increasing effort is being put on studying how the **combined effect of IEQ factors** may affect user **perception and behaviour** in occupied buildings

Oftentimes, the motivations behind actions are **derived solely from physical measurements** of the environment, which **might not always reflect the real triggers behind occupants' actions.**

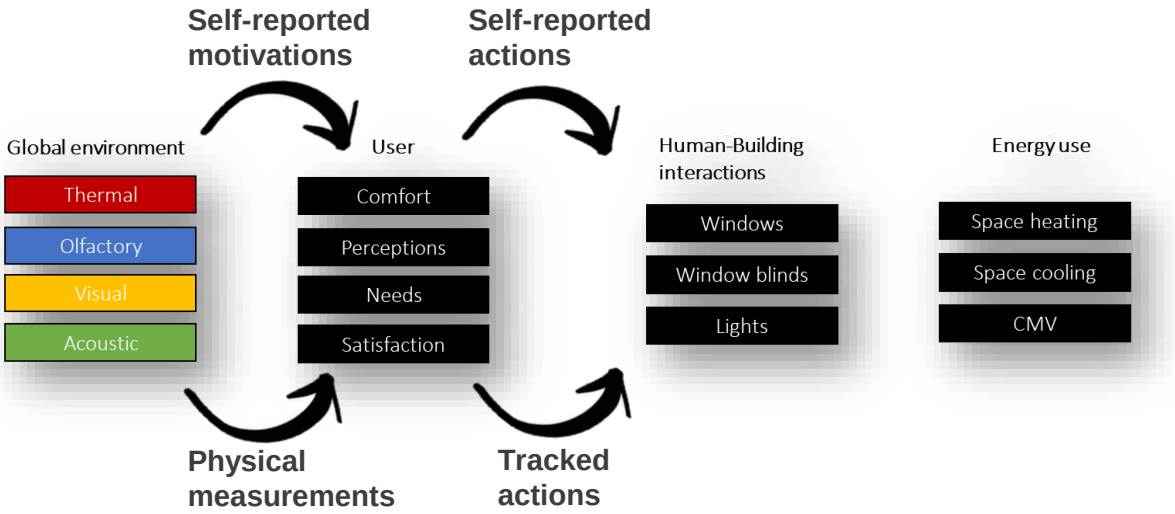
Requesting feedback directly from occupants might give valuable insights on the **perceived triggers for actions**, but might also increase the so-called **Hawthorne effect**, according to which the occupant's knowledge of being studied affects their natural behavior.



Objectives

- This paper provides early insights from the **eCOMBINE project** *("Interaction between energy use, COMfort, Behaviour and the Indoor environment)* aimed at developing an integrated approach to study the **cause-effect relationships between occupant behavior, combined indoor enivornmental factors, and energy in open plan offices**
- The aim of the study is to capture an extensive set of both **subjective and objective multi-domain variables** that are likely to drive building occupants' actions on environmental controls

In this study, we investigated the effectiveness of the newly developed **mobile application named "OBdrive"** aimed at **investigating triggers behind human-building interactions from a user perspective**

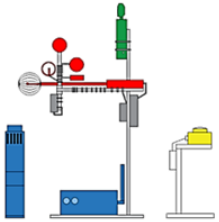


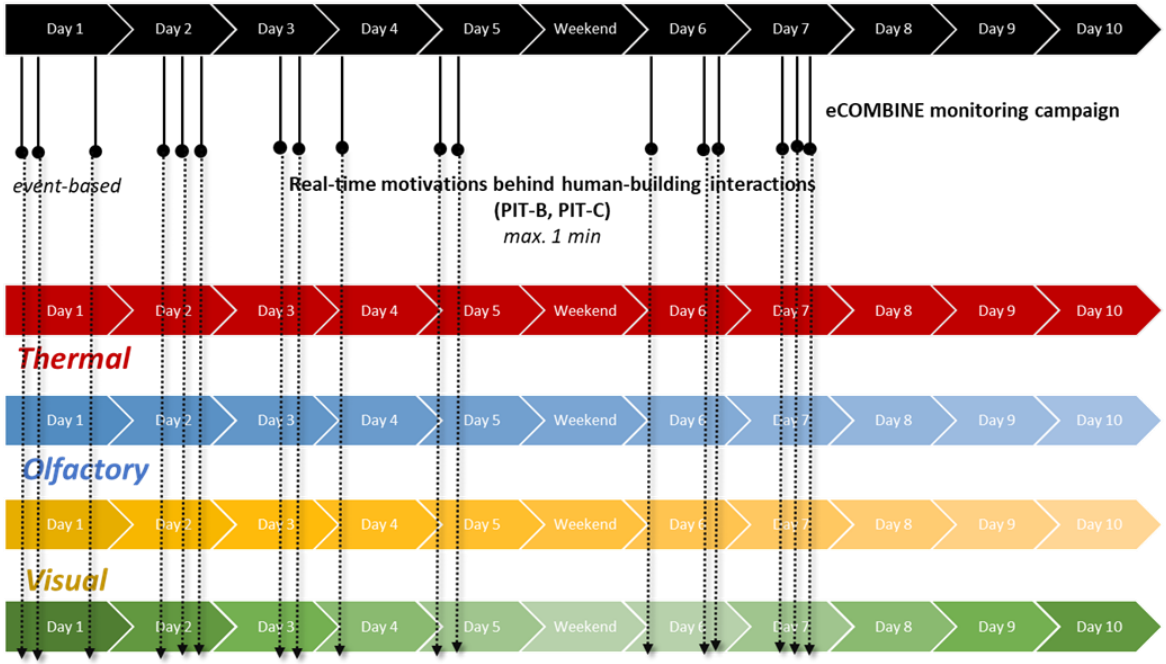
Methodology

The developed eCOMBINE strategy relies on a **mixed experimental approach** that **combines environmental measurements** in the office space **with subjective responses** from the building occupants.

Subjective data collection

Objective data collection





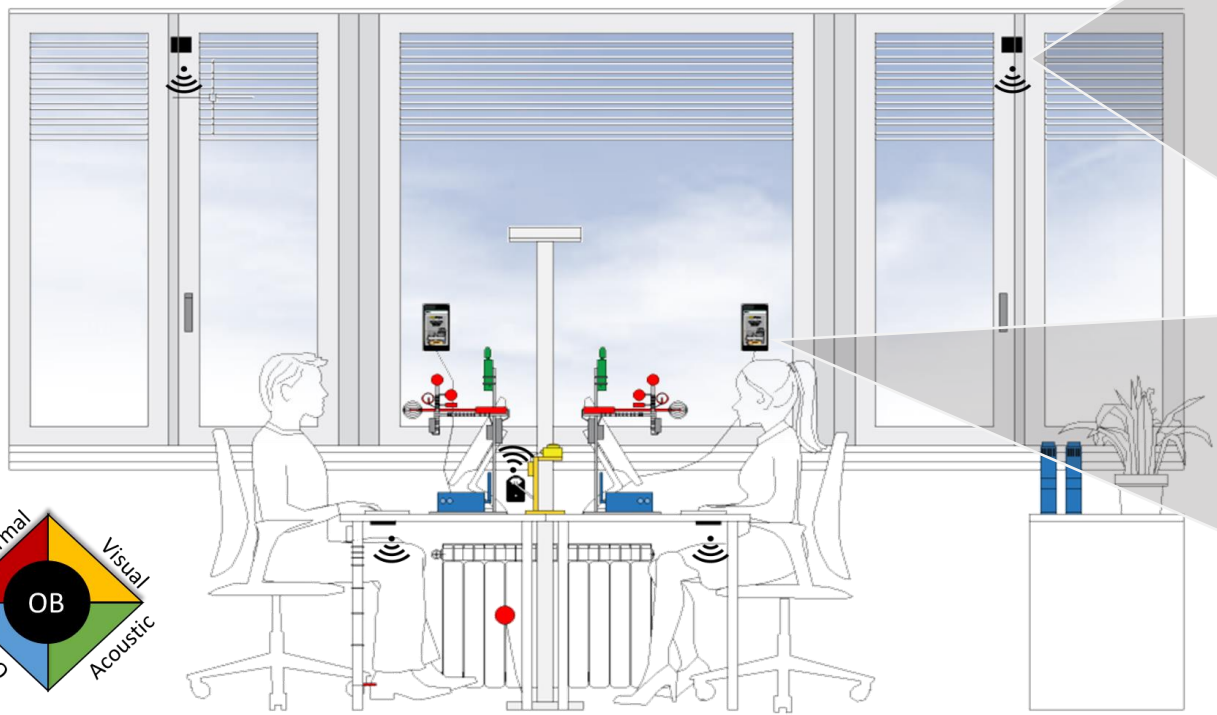
Case study building

1. *Open space office: 96 m²*
2. *Open space office: 85 m²*
3. *Shared office space: 61 m²*
4. *Reception area: 61 m²*
5. *Cafeteria and kitchen area: 40 m²*
6. *Conference room (29 m²)*
7. *Small meeting rooms and separate spaces*

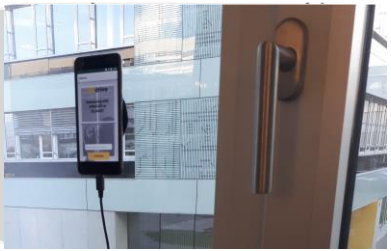
- fifth floor of a six-storey commercial building located in **Geneva, Switzerland**
- mixed-mode ventilation (mechanical ventilation not working during heating season)
- access to **operable casement windows or external shades** within 5m (16.4 ft) from desks (**both freely and only manually operable** by the occupants)
- **radiators** for heating (no control by occupants)
- dimmable fluorescent free-standing luminaires shared by two desks (automatic control)
- **31 participants** (65% male, 55% age group 22-34, activity “mainly writing and typing on my PC”)

2 weeks during heating season (17-28 February 2020)

Experimental setup



Window state loggers



Mobile app OBdrive

OBdrive - information flow

START

1 USER IDENTIFICATION

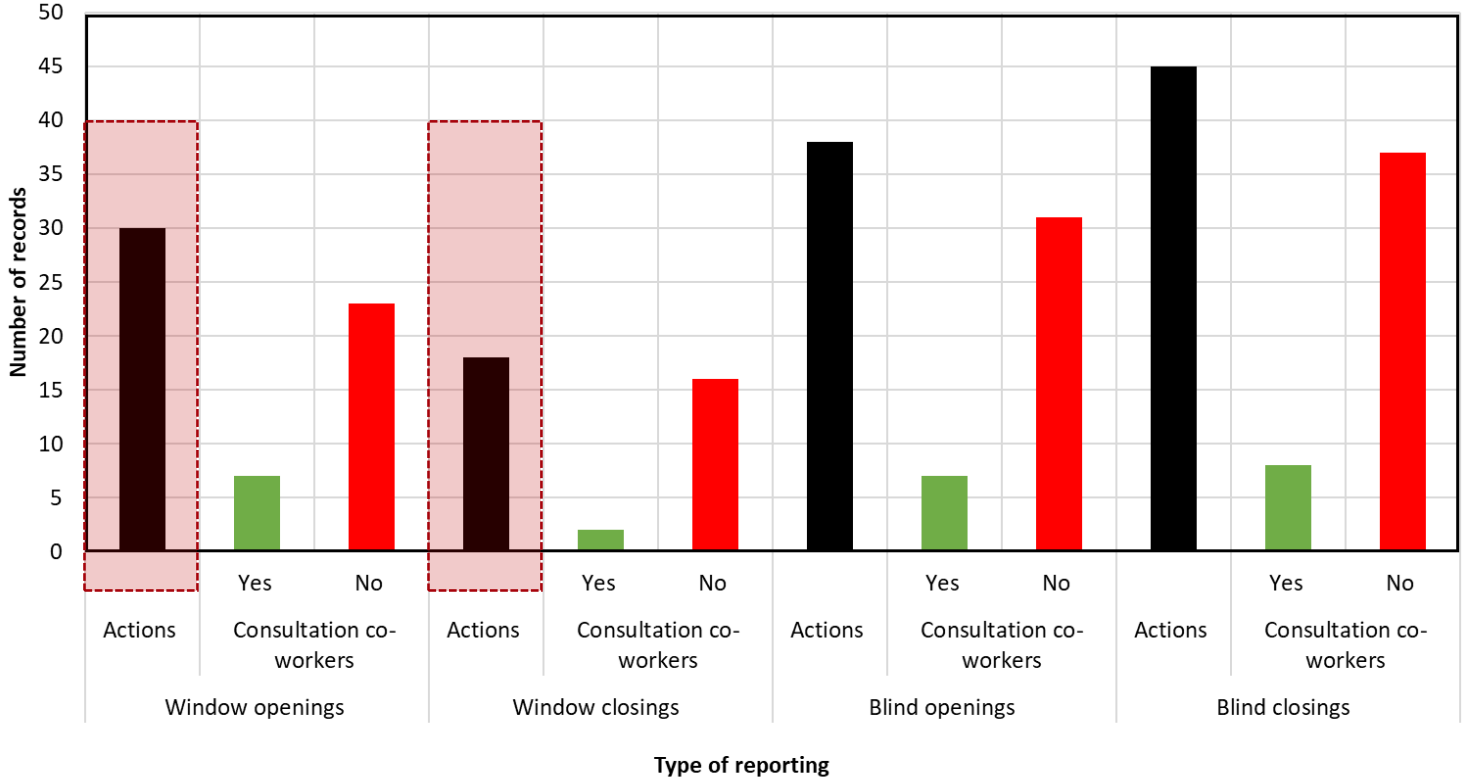
2 TYPE OF CONTROL ACTION

3 MOTIVATION BEHIND ACTION

4 GROUP DYNAMICS

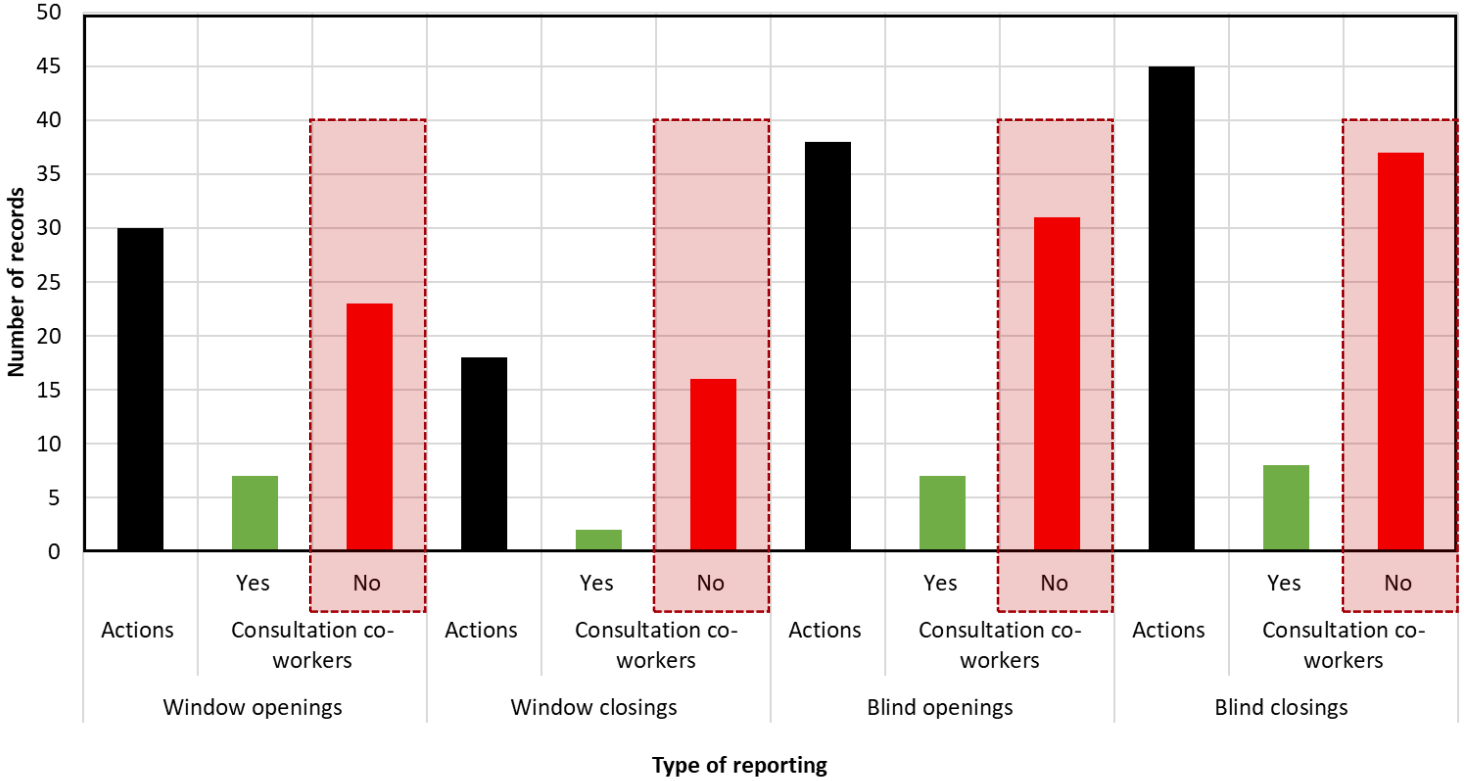
SUBMIT

Results – Reporting of actions



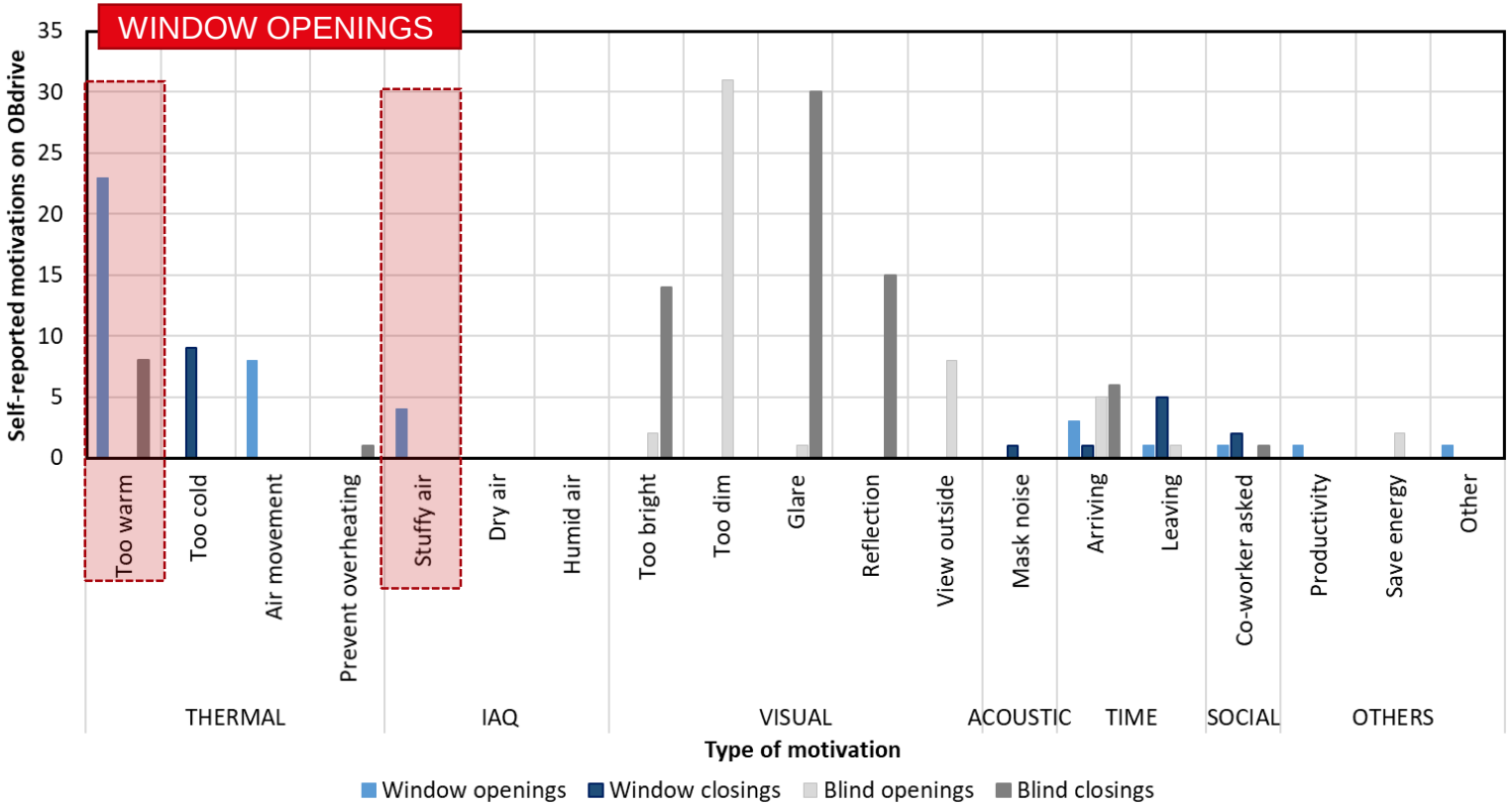
The users used the application more constantly during window opening actions rather than closing actions

Results – Consultance with co-workers



Most of the times participants did not consult co-workers before interacting with controls

Results – Self-reported motivations behind actions



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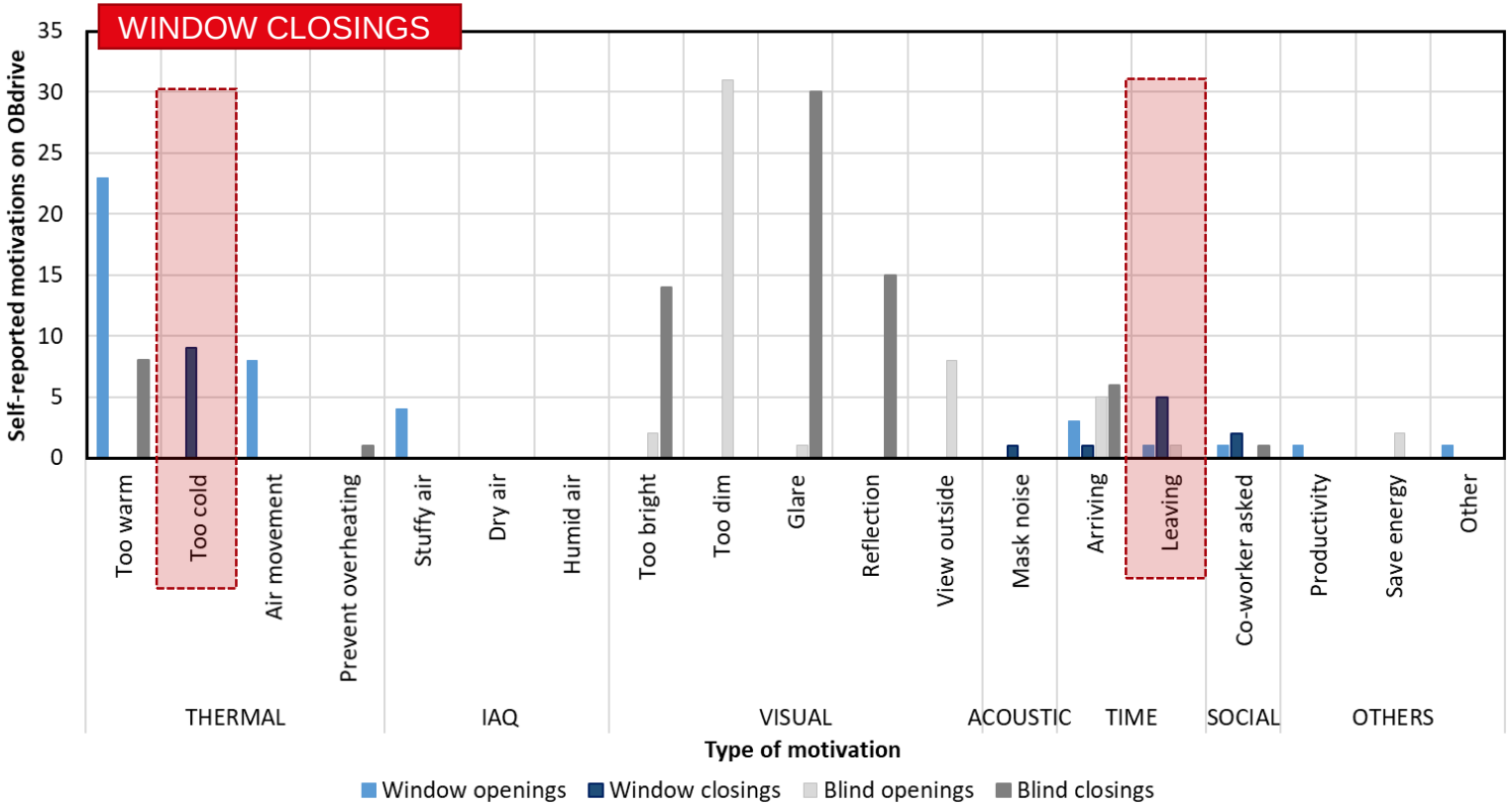

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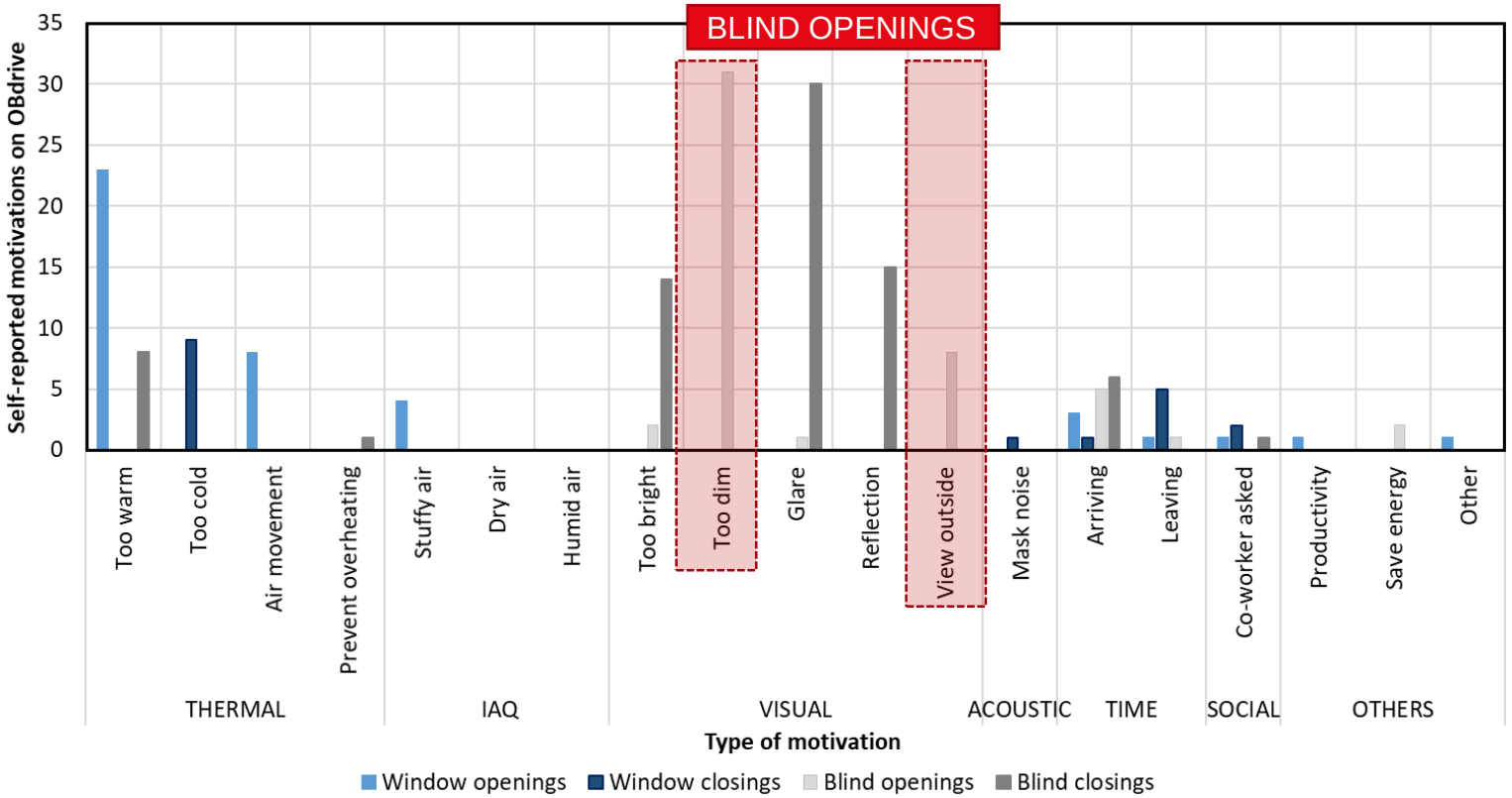

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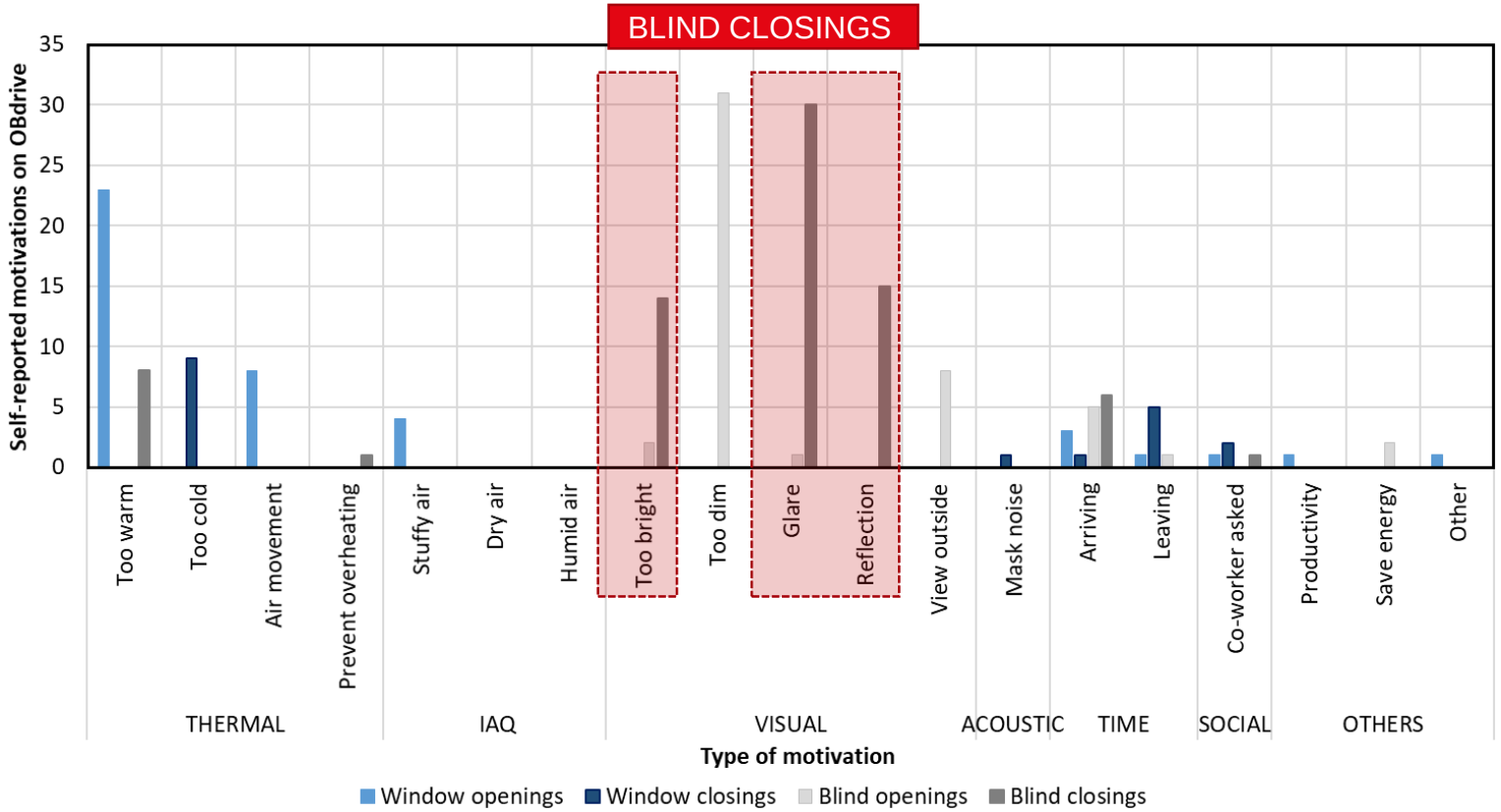
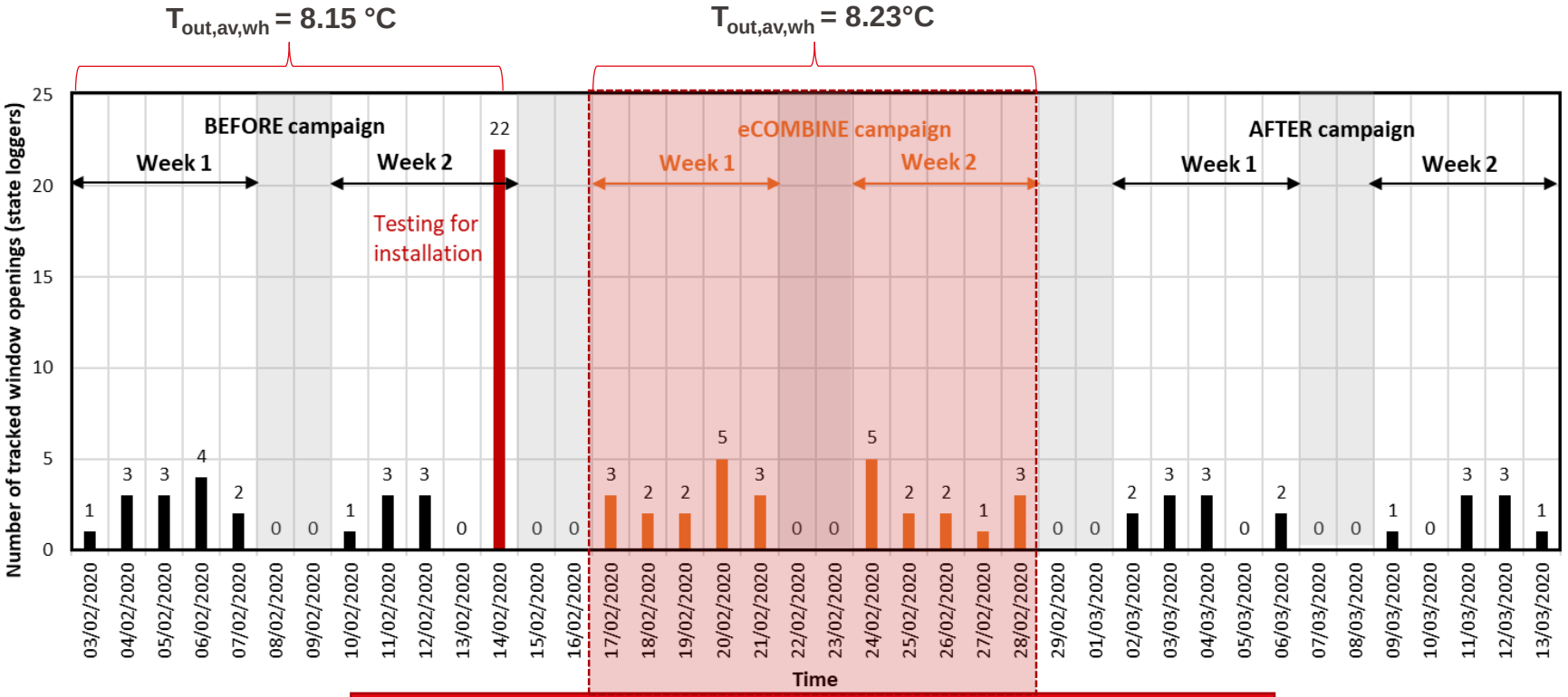
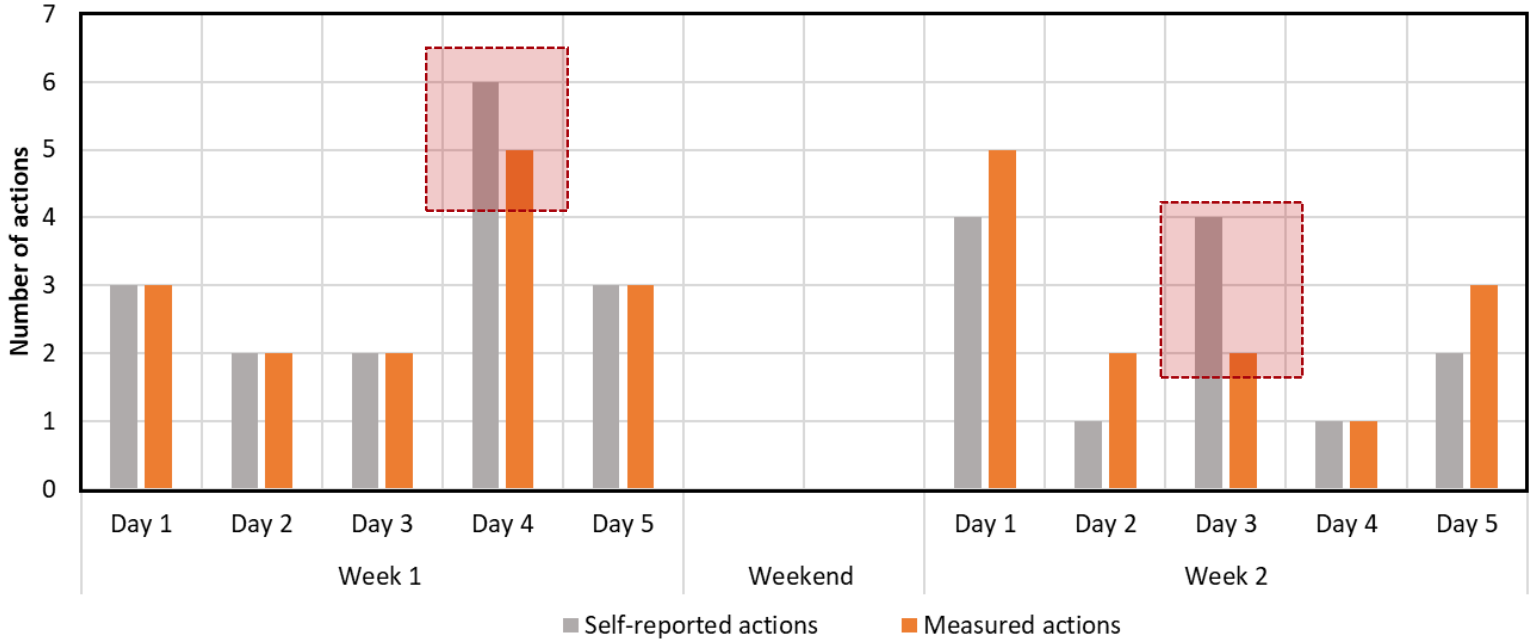


Results – Actions before/during/after the campaign



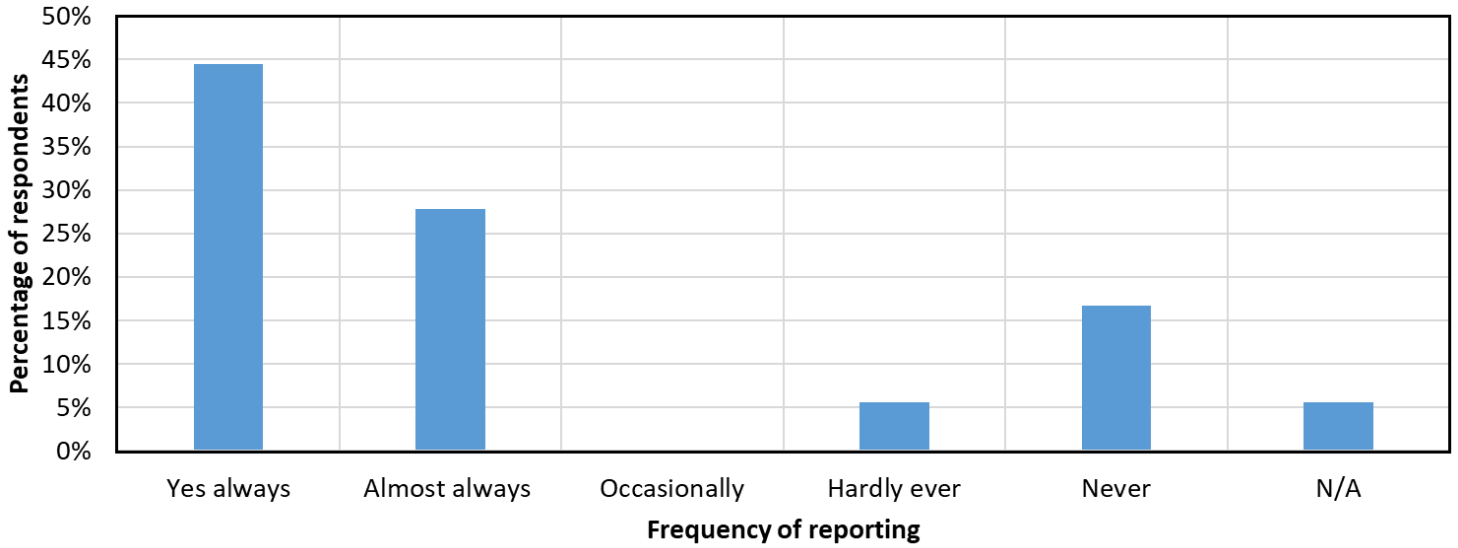
A slight but not significant increase of window opening actions can be observed during the interactive monitoring phase (which could also be triggered by a wide range of other influencing factors).

Results – Measured vs. self-reported actions



11% (3 out of 28) of the self-reported actions were not captured by the window state loggers

Results – Self-reported frequency of reporting

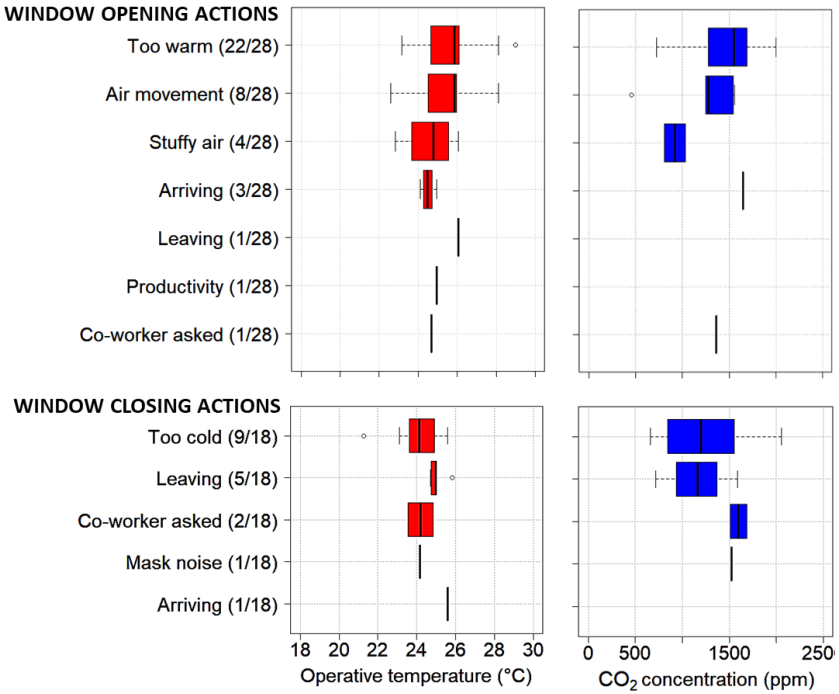


Answers to the post-campaign survey question: *"Over the last two week, how often did you report your interactions on the mobile phones installed close to windows and blinds?"* –

ca. ***70%*** *of the respondents answered that they have* ***"always" or "almost always"*** *reported their actions on the phones*

Conclusive remarks

- We found the OBdrive app to be a **helpful tool to investigate perceived motivations** behind human-building interactions without significantly altering the behaviour of occupants. The motivations can **be compared to physical measurements** of the environment, typically used to predict behavioural patterns.
- The self-reported actions on the phones **can be used to check the objective measured actions by window operation sensing solutions, and vice-versa.** This allows for obtaining more precise information on window control actions when sensors fail due to connection issues to the gateway
- the outcomes of this paper are based on data collected in one eCOMBINE campaign only, which implies that this study has an **explorative purpose.** The results will be completed and analyzed in combination with physical measurements (e.g. environmental data) as well as data from other eCOMBINE pilot case studies



Source: Barthelmes, V.M, Karmann, C., Serrano, V., Chatterjee, A., Andersen, M., Licina, D., Khovalyg, D. (2021) Global Environmental Stimuli and Human-Building Interaction in Open Space Offices: A Swiss Case Study. ASHRAE Transactions 2021.

Thanks for your attention!

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