



# A literature review on driving factors and contextual events influencing occupants' behaviours in buildings



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## ABSTRACT

The present paper illustrates the results of a literature review on occupants' behaviours, assessing the actions' drivers. There is no general agreement about the reasons people interact with building systems or the driving factors that trigger their decisions. Even if lot of researchers focus on this target, they usually analyse one or two actions, while no survey makes a comprehensive investigation. Windows, lights, blinds, air-conditioning, thermostat, fans and doors patterns are investigated in different building uses (offices, houses and schools). The analysis is split in three parts: 1) evaluating the influence of environmental parameters 2) and time-related events (e.g. arrivals and departures) and 3) describing the variables adopted in behavioural models. The results suggest that not only environmental factors play a key role in the use of building systems but also contextual factors, as well as routine and habits, largely affect occupants' behaviours. Behavioural models are becoming more and more complex and comprehensive to better reproduce the human component. Considering the principal driving factors inside the behavioural models would bring a double benefit: improving the results of building simulation programs and assisting designers during the project of energy-saving and comfortable buildings.

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**1. Introduction**

In recent years many researchers direct their efforts in studying human-building interaction [1]. Environmental, contextual and personal parameters have been analysed to find the triggers for users' actions on building systems. The increasing interest is related to the consequences the occupants' actions have on building consumptions. In fact, the consumptions difference among buildings with same physical features is mainly related to occupancy patterns, users' lifestyle, comfort preferences and interaction with building systems [2–6].

Occupants' behaviours and preferences have a deep consequence also in relation to building energy performance simulation (BEPS) [7]. Researchers usually found a gap comparing simulated and real energy consumptions and they assessed that occupants' behaviours is one of the main reason that causes this difference [8–13]. Yan et al. [14], in a comprehensive review of occupant behaviour modelling, highlighted that the adoption of standard schedules to reproduce users' behaviours, incorrectly represents human-building dynamic interaction. Moreover, the relative impact of occupants on building energy performance increased at the decreasing of energy use [15]. For these reasons, including the stochastic aspect of occupants' behaviours into building energy performance simulation software, would lead to better predictions of the buildings' final energy consumptions, especially for low energy ones.

The first step to achieve more accurate results from simulation programs and to design comfortable and energy-saving buildings is to understand the aims and the reasons that trigger users inside buildings. This objective materialises in identifying the driving factors for users' actions and their variation range.

Many researchers divided the driving factors in different groups. In a comprehensive analysis of human behaviours in residential buildings, Peng et al. [16] classified behaviours in the following three categories:

1. Environmentally related: actions driven by environmental parameters;
2. Time related: actions repeated in certain time-lapses;
3. Random: actions depending on uncertain not quantifiable factors.

In relation to a single action further categories were established. Inkarojrit [17], analysing the blind usage, assessed that there are four types of stimulus. In addition to those environmentally related, the author identified physiological (e.g. individual sensitivity to brightness), psychological (e.g. needs for privacy or view) and social (e.g. organization policy) factors. While in a window opening

review, Fabi et al. [18] included the fifth category of contextual factors (e.g. orientation, building insulation). In Fig. 1 are summarized the categories that influence occupants' behaviour.

Despite the differences between the studies, it is evident that some categories are recurring. The physical aspect is cited by all the authors, confirming that the physical environment largely affects occupants' actions. Beside the environmental component, many other factors have been identified as influencing (contextual, physiological and psychological) [15], but they are often reported as fragmented and rough information, because of the difficulty in investigating, quantifying and correlating them [19]. On the contrary, environmental variables, occupancy patterns and time-related events are objective factors, which can be easily recorded and compared between different studies, also in the perspective of a universal research framework [20]. For these reasons the present review focuses only on environmental and time-related factors. Starting from the triggers identified by Hong et al. [21], the analysis was complemented by the novelties in this research field, with the aim to find out the most influencing factors for each adaptive action.

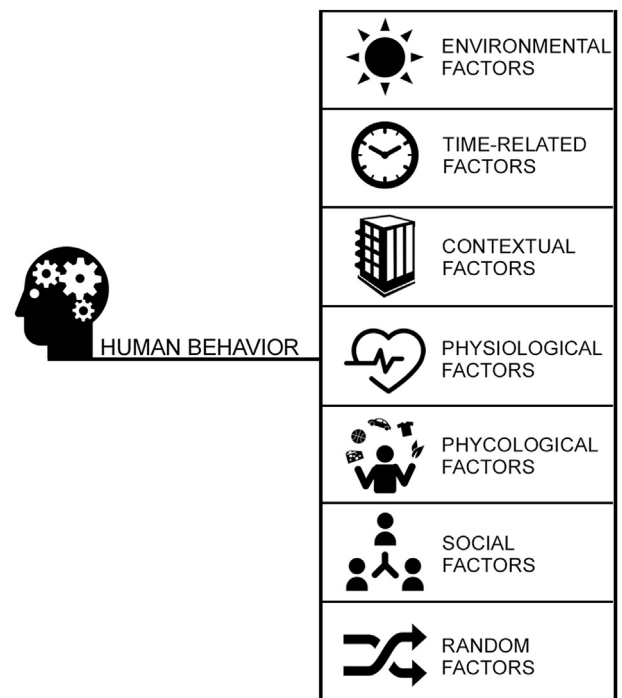


Fig. 1. Definition of the categories that influence the energy human behavior inside buildings.

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