



## Original research article

## Do psychological factors relate to energy saving behaviours in inefficient and damp homes? A study among English social housing residents

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## ABSTRACT

Social housing residents are vulnerable to rising energy costs. Reductions in energy use through behaviour change may be part of the solution but require an insight into the factors that relate to energy saving behaviour in this context. This paper responds to recent calls for an integrated approach to studying energy saving behaviours, investigating psychological (i.e. attitudes; perceived behavioural control; subjective norms), contextual (i.e. dwelling energy efficiency; problems with condensation, damp and mould), and socio-demographic factors (i.e. gender; age) together. Data was collected using a cross-sectional survey among social housing residents in South-West England. Dwelling characteristics were not found to add to explaining heating related and other energy saving behaviours beyond well-known psychological and socio-demographic factors. The results did suggest that the presence of condensation, damp and mould was associated with more frequent heating-related energy saving behaviours, but not other energy saving behaviours. Furthermore, a moderation effect was found whereby subjective norms appeared to relate more strongly to heating-related energy saving behaviours when people live in energy efficient homes. The study illustrates the value of an integrated approach in understanding the complex interactions between contextual factors, psychological factors and energy saving behaviour and offers opportunities for future research.

## 1. Introduction

The demand for social housing is rising [1], new social housing programmes are starting in a number of countries and the number of households on waiting lists across Europe is increasing [2]. This sector of housing offers subsidised rent for people on a low-income and social housing residents tend to be under constant financial pressure [3,4]. Fuel poverty, also referred to as energy poverty, is an especially pressing problem in the social housing sector [1]. Almost 25% of low-income households in Europe are unable to keep their home adequately warm [2], and, in the UK, fuel poverty affects approximately one in ten households living in social housing [5]. Fuel poor households struggle to keep their homes comfortably warm as a result of a combination of factors (e.g. low household income; high energy costs; poor energy efficiency of the home; [6]). Consequently, many low-income households also experience damp and cold conditions at home, as they cannot afford to heat their home comfortably and adequately in winter [7–9]. In recent years, energy efficiency of the social housing stock has improved

[1], but many housing problems (e.g. cold housing, damp, mould, condensation) tend to be more common among social housing tenants than among owner-occupiers [10]. Thus social housing residents are especially vulnerable to rising energy costs, but the sector is often overlooked when it comes to the research on residential energy use [11,12].

Reductions in energy use through energy efficiency improvements and behaviour change have been identified by some researchers as an opportunity to reduce financial concerns and improve housing conditions for social housing residents [13–16]. Previous research outside the social housing sector has emphasised that addressing the behavioural dimension of domestic energy use in particular offers the potential for significant energy savings in the short term [17]. In fact, occupant behaviour is thought to be one of the reasons why a building's energy use can be up to 40% above expectations [18]. Technical solutions alone may not be effective in reducing energy consumption, especially if they are not embedded in people's daily behaviour and energy understanding [19–21]. Strenuous efforts are now underway, notably by

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the International Energy Agency, to define and quantify occupant behaviour from the technical/engineering perspective (see <https://www.annex66.org/>), and, in an important complementary effort, from a behavioural/societal perspective (see <http://www.ieadsm.org/task/task-24-phase-2/>).

To encourage energy saving behaviour (ESB) specifically in the social housing sector we need to examine the factors that relate to the energy behaviours which households currently engage in. Increasing our understanding of the drivers and barriers to behaviour can aid in designing more effective energy conservation measures [22]. When referring to energy saving behaviours in this paper we refer to everyday curtailment actions, or “everyday actions in energy use that require either no or minimal structural adjustment” ([23], p. 1426). A distinction is often made between contextual and psychological factors, or objective and subjective factors, when examining determinants of energy saving behaviours [24,25]. Psychological factors are diverse and can represent, amongst others, individual beliefs and perceptions. Contextual factors are also a heterogeneous category and can include physical-structural conditions (e.g. dwelling characteristics), socio-demographic characteristics, cultural and economic aspects [25,26]. While traditional environmental psychological approaches to studying ESB tend to focus on the individual, contextual influences on behaviour receive less attention [16]. Calls have been made for a more integrated approach, investigating psychological and contextual factors together, to account for the complexity of household energy use characterised by different contextual influences, decision types and psychological variables [22,27]. According to Stephenson et al. [28], cognitive factors (e.g. beliefs and understandings), the material culture (e.g. technologies and buildings), and energy practices (e.g. activities and processes) all underlie consumer energy behaviour and are highly interactive. Studying these different components together in diverse contexts may open up opportunities to modify energy behaviours more effectively [28]. Specifically, there is a need to bring together engineering and social sciences to tackle the complexity of energy saving behaviours, and start to move away from a fragmented, disciplinary approach [16]. Thus, attention needs to be focused on studying energy-related behaviours at the intersection point between these two sciences [29]. Literature on the factors that relate to energy saving behaviours in low-income households is especially limited [30]. In a step towards this integrated approach, the current paper brings together social science literature on the theory of planned behaviour (i.e. attitudes, perceived behavioural control, subjective norms) with the building engineering literature on energy efficiency and condensation, damp and mould problems (together: CDM problems), and literature from both fields on socio-demographics (i.e. gender and age), specifically in the context of energy saving behaviour in social housing residents. The focus on these two dwelling characteristics follows from the prevalence of fuel poverty and associated CDM problems in the social housing sector. Using data from a cross-sectional survey, the current research examines the extent to which these dwelling characteristics add to explaining energy saving behaviours beyond well-known psychological and socio-demographic factors. The research will also build on and add to previous studies and models that have started to explore the complex interactions between psychological and contextual factors in the context of energy saving behaviours.

Specifically, the literature suggests that psychological factors can lead to behaviour change when certain contextual variables provide incentives or disincentives [31]. For instance, environmental concerns may only lead to reduced car use if alternative modes of transport are available [22]. In a similar vein, contextual factors may shape opportunities and constraints for energy use [32]. This puts forward a potential moderating role [22] of dwelling characteristics upon the relationship between psychological factors and energy behaviours. Stated differently, this paper will examine whether the relationship between psychological variables from the theory of planned behaviour and energy saving behaviour depends on a dwelling's energy efficiency level

and the presence of condensation, damp and/or mould problems.

Before further outlining the specific research questions, this paper provides a short literature review discussing previous research from the social science and building research literature on selected relevant psychological and contextual factors and their link to energy behaviours. Then the results of a cross-sectional survey among social housing residents are presented and discussed.

### 1.1. Psychological factors: attitudes, perceived control and subjective norms

Many psychological factors influence energy (saving) behaviours, and it is not within the scope of this paper to provide a conclusive list. Instead, the paper focuses on one of the most commonly used theories in the environmental psychological domain [33]: the theory of planned behaviour (TPB; [34]). As the aim of this paper is to investigate the role of specific dwelling characteristics relative to psychological and socio-demographic variables, this commonly used psychological theory was selected as a starting point. The TPB has received strong empirical support for explaining a variety of pro-environmental behaviours [33]. In a study on energy conservation intentions in low-income households, TPB variables were found to explain almost half of the variance in intentions [30]. In fact, the study showed that the predictive power of socio-demographics (i.e. age, gender, household size and house ownership) and other contextual factors (i.e. climate zones) disappeared when TPB variables, as well as other psychological variables, were added to the model. Chen et al. [30] state that this finding highlights the importance of considering the psychological variables involved in energy saving behaviours.

The TPB is a general model of deliberate behaviour [33] and suggests that behaviour follows an intention to engage in specific behaviour. These intentions in turn depend on attitudes towards the behaviour, perceived behavioural control, and subjective norms related to the behaviour. Attitudes can be defined as “the extent to which engaging in the behaviour is evaluated as positively or negatively” ([35], p. 186). In the aforementioned study on low-income households [30], attitudes towards energy saving were found to be the strongest predictor of energy conservation intentions. Other studies have also identified a link between environmental [23] and energy conservation [32] attitudes and energy saving behaviour. However, research by Martinsson et al. [24] seems to suggest that for self-reported energy saving behaviour, environmental attitudes might a better predictor in high-income households compared to low-income households.

Perceived behavioural control reflects the “perceived possibility to perform the behaviour” ([35], p. 187). Due to the invisibility of energy, individuals tend to find it difficult to perceive a clear relationship between their behaviour and household energy use [25]. As a result, individuals may feel that they do not have control over the energy use in their home. This sense of helplessness with regards to energy consumption can provide a barrier to engaging in energy saving behaviour [36]. Furthermore, a feeling of perceived behavioural control, or self-efficacy has been identified as having a strong influence on energy saving behaviour [25,32]. If people feel they can take action to reduce their energy consumption they feel more committed to engaging in energy saving behaviour, and are more likely to do so [25].

Finally, subjective norms are described as “the extent to which a person believes that important others would approve or disapprove of the behaviour” ([35], p. 186). Through observing and interacting with others, people form beliefs on the acceptable energy behaviours in the household [37]. If people who share the same house have dissimilar ideas on energy use, this can lead to conflict and frustration and present a barrier to engaging in energy saving behaviours [36]. In fact, research has shown that subjective norms help determine personal beliefs around the positive outcomes of saving energy [25]. Support for the relationship between subjective norms and energy saving behaviour is mixed, and it has been suggested that certain conditions need to be in place for subjective norms to have an effect [38]. For instance, when

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