



On target? Examining the effects of information displays on household energy and travel behaviour in Oxford, United Kingdom

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ABSTRACT

The energy literature is rich with information on the *targeted* effects of a behavioural intervention – numerous studies have examined if/how a particular energy behaviour changes over time. There has, however, been much less research on the *untargeted* effects of a behavioural intervention – limited studies have examined if/how a particular energy behaviour changes untargeted behaviour. More specifically, the relevant literature does not explicitly examine simultaneously *how* targeted and untargeted effects occur. The purpose of this paper is to examine the targeted and untargeted effects of an electricity display intervention on electricity, gas, and travel through a mixed methods (quantitative and qualitative) approach. The findings indicate that in a sample of 19 participants, 2 had no behavioural or attitudinal changes, 2 had changes in electricity only, 11 had changes in electricity and gas, and 4 had changes in electricity, gas, and travel. Reasons for this are explored through illustrative case studies. This is followed by a discussion and conclusion, where implications and areas of future research are identified.

1. Introduction

It is widely acknowledged that climate change is one of the greatest threats to mankind [1,2]. Scholars have acknowledged that changes to the energy mix are required [3]. Both supply and demand side actions are needed, and this paper focuses on demand side measures with a focus on behaviour – a valuable area of research in the energy sector [4] as up to 20% of household energy consumed in households can be reduced through behavioural changes [5].

The demand side literature is rich with information on the targeted effects of a behavioural intervention, for example the impact of easy to understand electricity bills on electricity usage [6,7]. There has, however, been much less research on the untargeted effects of a behavioural intervention. Limited studies have examined if/how a particular energy behaviour changes the untargeted behaviour of interest, for example the impact of easy to understand electricity bills on gas consumption.

Exploring targeted and untargeted effects is of value because it can examine the relationships between different types of behaviour. This information is relevant for energy research, practitioners, and policy perspectives as it can help illustrate any relationships between energy behaviours, identify whether some energy behaviours are more similar than others, and help shed insights in the demand side energy management and research [8].

Electricity displays can reduce electricity consumption – some studies have found changes between 3–13% [9,10]. While the impact that electricity displays on electricity behaviour is well documented, the impact that it has on other energy behaviours is less well known. The objective of this paper is to examine the targeted and untargeted effects of an electricity display across a wide set of behaviours through a socio technical, longitudinal, research perspective.

The paper is structured as follows: A) a relevant literature (including rebound effect, spillovers, and social networks) is made, together with commentary on the relevance it carries towards examining targeted and untargeted effects; B) a methodology that builds on the interdisciplinary literature is presented, C) the sample, results, and case studies are presented, and D) a discussion and conclusion for future research is provided.

2. Background

The spillover effect occurs when “a change in attitude and/or behaviour concerning a specific activity, produced by a targeted effort or otherwise, [which] may ‘spill over’ into related areas and, hence, become more general” [11, p. 56]. Self-perception theory explains the spillover phenomenon [12] though assuming that individuals use their behaviours as indicators of their own dispositions. From self-perception

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theory, Scott [13] has developed a spillover hypothesis. He stated that engaging in one behaviour can have two effects – first, it is likely to influence the behaviour that the individual is engaging in [14], and secondly, it is likely to influence other similar behaviours [15]. For example, if someone starts to recycle, this will influence their recycling behaviour – and secondly influence other environmentally related behaviours – leading to a spillover [16].

Similarly, the rebound effect is a phenomenon that occurs when an attempt to decrease energy consumption can lead to overall increase in consumption because of unanticipated or unintended consequences [17] – and this outcome has also been called ‘backfire’ [18,19]. While relevant, the research field has limited applications across fuels or behaviours [20].

One way to overcome the limitations highlighted in the spillover and rebound literature is by examining the social networks of individuals. Social network theory is a growing field of literature that is relevant to targeted and untargeted effects and behavioural change as social networks can prompt individuals to rethink their behaviours/guide individuals in their decision making processes. If an individual is uncertain about certain effects/decisions, the beliefs of others can play a role in decision making [21,22]. As Liu et al. highlight – “social network theory focuses on the role of social relationships in transmitting information, channeling personal or media influence, and enabling attitudinal or behavioural change” [23, p 1].

The relevance that social network theory carries towards examining targeted and untargeted effects is that understanding the social experiences of individuals can help understand how behaviour and change may occur across multiple behaviours and help measure how targeted and untargeted effects occur (Table 1).

Qualitative analysis of the impact of electricity displays on individuals and households has been undertaken [6] but limited studies have examined other behaviours. Hargreaves et al. asked individuals about their experience with the display [24]. Some participants did note that while the monitor did give them information on energy use, “one thing that these devices haven’t told us is how to put our energy usage in the context of other things that we do like driving, flying, using

water, using gas” [24, p. 6117]. The objective of Hargreaves et al.’s study was to examine reactions to household energy displays, rather than untargeted effects, but this does reinforce the value of looking at multiple behaviours [24].

The influence of social networks on energy behaviours and the impact that it has on targeted and untargeted effects with electricity displays has not been studied. The intention of this paper is to develop a methodology that can achieve this and then apply it through a small scale exploratory study.

3. Methodology

Given the focus on targeted and untargeted behaviours, it is important to be clear on which behaviour(s) and policies provide the focus of this paper. Direct energy activities are behaviours/activities that lead to energy consumption and carbon emissions while in use (such as electricity use, heating, etc.), while indirect energy use are activities that lead to energy consumption and carbon emissions indirectly (food consumption, clothing decisions) [39]. Here the focus is on direct energy activities in household and transportation.

There are a variety of policy tools that can be used to change behaviour: providing information (voluntary change), economic incentives (fiscal), administrative changes (regulations), or physical [40].

Here the focus is on the role of information and voluntary change. The rationale for focusing on information as a tool is because of its value in behaviour change, its adoption across various contexts, and its use in demand side management. For example, the Department of Energy and Climate Change (DECC) and the Behavioural Insight Team has encouraged individuals to green their homes/use less energy by “focus[ing] on how we can use information more effectively to encourage people to be more energy efficient” [41, p. 5]. Additionally, they carry relevancy to UK policy as goals have been stated to install energy displays in all homes by 2020 [74,75].

Therefore, a display based system was used as an intervention as they are easy to use, affordable, accessible, and policy relevant. Electricity displays were used (and not gas) as gas was more

Table 1
Spillovers, Rebounds, and Social Parameters.

Field	Theories	Strengths	Limitations/Future Research/Further Reading
Rebound	Initially SCOT (social construct of technology) and then expanded	<ul style="list-style-type: none"> - Extensive research on rebounds within a certain fuel - There has been some research that has looked at how money saved one on fuel can lead to spending on other fuels [25] 	<ul style="list-style-type: none"> - “the rebound effect is too narrow and needs to be extended to cover co-benefits, negative side effects, and spillover effects” [25, pg. 85]; similar findings in Galvin and Gubernat [26] - Chitnis et al. [27] examined direct and indirect rebounds in the energy sector and argued for further research in the field - Most of the research looks at rebounds within a certain fuel and not across behaviours (electricity, gas, petrol, etc.) [20]
Spillover	Self-Perception Theory Cognitive Dissonance Theory	<ul style="list-style-type: none"> - Examines multiple behaviours simultaneously and can encompass positive or negative spill overs [28] - Can quantify whether or not a spillover has occurred 	<ul style="list-style-type: none"> - Exploring positive and negative spillovers simultaneously is of value and an area of future research [29] - Diverse theoretical underpinnings [30,12–14] and empirical assumptions^a [31,32–34] – which may explain mixed findings - Clear areas of future research are identified
Social Parameters	Social Network Theory Social Learning Theory	<ul style="list-style-type: none"> - Technological diffusion tends to pass through sociometric rather than spatial networks [35] - Jaeger and other scholars found that environmental action is more likely to take place if there are interpersonal rules/norms that favour such action, and the efficacy of message delivery is contingent on existence, density, and structure of social networks that promote such messages [36]. - Social learning [37] examines learning processes that occur for individuals or communities; in a case study, the findings indicated that those who read their electricity meters more regularly were more likely to install solar water heating or possess it [38]. 	<ul style="list-style-type: none"> - May not identify macro changes that influences behaviour

^a Thogersen and Olander’s [28] study examined behaviour, values, and ethical norms, while Bratt’s study [33] examined behaviour and attitudes (not values and norms).

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