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Does perception of automation undermine pro-environmental behaviour? Findings from three everyday settings

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ABSTRACT

The global deployment of technology to aid mitigation of climate change has great potential but the realisation of much of this potential depends on behavioural response. A culturally pervasive reliance on and belief in technology raises the risk that dependence on technology will hamper human actions of mitigation. Theory suggests that 'green' behaviour may be undermined by automated technology but empirical investigation has been lacking. We examined the effect of the prospect of automation on three everyday behaviours with environmental impact. Based on evidence from observational and experimental studies, we demonstrated that the prospect of automation can undermine even simple actions for sustainability. Further, we examined the process by which automated technology influences behaviour and suggest that automation may impair personal responsibility for action.

1. Introduction

The deployment of technology to counter climate change is in many respects a paradox. Despite the increasing demands for energy due to the advances of technology, technology is also part of the solution. Global wind energy capacity has almost tripled in the past five years, with major construction programmes for wind turbines in place in India, Brazil, Mexico, South Africa and many other countries (GWEC, 2014). Germany has already succeeded in generating more than 50% of its electricity demand through solar energy in June 2014 (Vidal, 2014) and demand response based on smart metering rollout has been argued to have the potential to achieve 25–50% of the EU's 2020 target for CO_2 reduction (CapGemini, 2008).

Reliance on technology is culturally pervasive. The popular press frequently emphasises the power and potential of science and technology to save humanity, in presenting the topic of global warming and climate change. A generalised and universal faith in technology is well-documented (Hogan, 2011; Litfin, 2003; Ramakrishnan, 2002) and such discourses are perhaps inevitably drawn upon in facing the challenges of global warming. Commentators have seen a turn towards ecological modernisation in policy, in which technological innovation is expected to lead to reduced environmental impact even as environmental protection pressures (social and economic) drive technological development (Mol & Sonnenfeld, 2000). Research on responses to climate change amongst the general public has confirmed the prevalence of technological fix discourses "both as a hope and as an expectation" (Stoll-Kleemann, O'Riordan, & Jaeger, 2001). Belief in technology has been described as an ideology with "an element of the magical" that fulfils existential needs (Dickinson, 2009, p. 7). So belief in technological solutions as a panacea for climate change and energy challenges provides psychological as well as potential physical benefits, to the general public and policy makers alike.

But concerns have been raised about the consequences of such faith in technology. Voices of warning have argued that reliance on technology may undermine progress on reducing greenhouse gas emissions (Ridgwell, Freeman, & Lampitt, 2012): technology touted as a solution may divert effort from individual action to mitigate environmental impact. It is this proposition that the current research investigated, specifically, does the prospect of automated technology undermine people's pro-environmental behaviour? By pro-environmental behaviour, we mean actions which reduce adverse environmental impact, whether intentionally or not.

Why does it matter whether automation hinders people's 'green' behaviour when an automated technical solution will

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ensure sustainable outcomes? For several reasons, technology cannot achieve fully optimal solutions: technical, economic and psycho-social challenges persist. Take the case of automated lighting systems – a relatively well-understood and simple domain in which automation is being introduced to increase energy efficiency. Technical challenges remain: in-building light levels drop exponentially with distance from windows (Littlefair, 1996) so how can optimal light and energy efficiency be achieved in a multi-occupancy office for workers at the windows and those deep within the floor plan served by the same lighting circuit? Economic challenges remain: despite the potential benefit in energy reduction offered by enhanced lighting technology, the investment and payback period are perceived as barriers to deployment in offices (DECC, 2012). Psycho-social challenges remain: in the home, how can automation aimed at energy efficiency deal with switching on lights for cheer on a gloomy day, for feelings of security, for a welcome for visitors? Thus despite the enormous potential benefits which technology offers, technical, economic and psycho-social challenges limit the extent to which automation can achieve optimal pro-environmental efficiency. Human behaviour remains crucially important, alongside technological solutions, to minimise wasteful, energy-inefficient actions. In many cases, the realisation of significant mitigation depends not only on the technology but also on behavioural responses. People have to accept wind farms, buy electric vehicles, use the home heating thermostat effectively, change consumption in response to signals on the smart meter display device and enable sleep mode on appliances: "The technology itself does not change behaviour" (Faber, Schroten, Bles, Sevenster, & Markowska, 2012, p. 44). For achievement of the planned benefits of technology for climate change mitigation, behaviour is clearly important.

Much research has looked at why behaviour has not already become more environmentally friendly. Factors contributing to the status quo of limited pro-environmental action include economic and physical contexts, and lack of information as well as psychological factors, such as habits, values and social norms (Cialdini, Reno, & Kallgren, 1990; de Groot & Steg, 2010; Jackson, 2009; Strbac, 2008; Verplanken, Aarts, van Knippenberg, & Moonen, 1998). User-friendliness or appeal of particular technologies has been explored (e.g. Hargreaves, Nye, & Burgess, 2010) but there is a deeper level at which technology may be problematic. We argue that a reliance on technology may in fact hinder mitigation behaviours and may undermine motivation towards pro-environmental behaviour.

Economic studies have shown that technological improvements may have adverse effects on people's behaviour. Enhancements to energy efficiency can induce increased demand for energy services, a phenomenon termed 'rebound' (Khazzoom, 1980), and increased demand can even surpass the gains in efficiency or 'backfire' (Saunders, 1992). In transport, for example, there is evidence of a relationship between improved fuel efficiency and increasing number of kilometres driven (Hymel, Small, & Van Dener, 2010). In the domestic setting, energy abatement behaviours such as reducing the heating thermostat setting have been shown to result in an overall rebound effect of 34%, which ranged from 12% to backfire (>100%) (Druckman, Chitnis, Sorrell, & Jackson, 2011). From an economic perspective, it appears that the introduction of technical solutions may result in rebound.

From a psychological perspective, the potential influence of automated systems on human behaviour has been examined in safety-critical systems (e.g. Goddard, Roudsari, & Wyatt, 2012; Mosier, Skitka, Burdick, & Heers, 1998) though such research has tended to focus on the mechanics of attention. Little research has examined the influence of automated systems on human behaviour more generally in everyday life, that is, in non-critical settings where attention may not be the salient cognitive process. Previous research in the discipline of human–computer interaction has focused on how we can use technology better: we wanted to examine the question of what pervasive automated technology does to our impulses towards pro-environmental behaviour.

We chose three domains from everyday life for study: lifts (elevators), automatic doors and lighting. We explicitly link such behaviours with environmental impact. In general, although gains in energy efficiency have resulted in each product consuming relatively less power, the pervasiveness of these and other technologies continue to drive increasing energy demands – the paradox described earlier. The domains selected for study can be seen to exemplify technologies which require relatively little energy but cumulatively, through their ubiquity, have substantial power requirements. Our primary objective was to determine if the prospect of automation undermined behaviour in these domains. Having found evidence supporting the influence of automation on behaviour, we additionally conducted an exploratory study to test a theoretically based hypothesis on the psychological process underlying the effect. We now briefly outline the theoretical background to the final study.

Two theoretical perspectives suggest that dependence on technology may indeed reduce attempts at pro-environmental behaviour. First, the norm activation model of pro-environmental behaviour (Schwartz, 1977) proposes that a feeling of moral obligation or a 'personal norm' influences environmentally-friendly intention and behaviour. A personal norm for 'green' action is in turn influenced by a sense of responsibility to act (de Groot & Steg, 2009). From this theoretical perspective, if automation reduces or removes a personal sense of responsibility, the likelihood of the outcome behaviour is undermined. Second, people tend to conserve effort – human action is purposeful rather than random and potentially wasted (Richter, 2013). If a task can be done by automated technology, individuals may simply allow the technology to complete the task in order to conserve effort. Thus the psychological processes by which automation may undermine behaviour is by weakening the responsibility to act or by triggering the drive to conserve effort or through both mechanisms.

In summary, our primary research question investigated the perception of automation on three everyday behaviours:

> In the contexts of calling a lift, exiting a door and switching off lights, is individual behaviour undermined by the prospect of automation?

Our subsidiary question, theoretically-based and aiming to explore the psychological processes involved, was:

> If so, in terms of process, does the prospect of automation influence both personal responsibility and effort?

Our research approach was in four stages. Stages I, II and III investigated the primary research question to provide empirical evidence of the influence on behaviour of the prospect of automation. The final Stage IV was an exploratory study to suggest a potential underlying process:

> Stage I Conduct field studies to assess if automation undermines behaviour in real-life contexts.
> Stage II Establish a robust baseline behaviour which can be manipulated under laboratory conditions.
> Stage III Conduct controlled study on the baseline behaviour to assess if it is undermined by automation.
> Stage IV Conduct survey studies to test if both responsibility and effort are influenced by automation.