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Context, control and the spillover of energy use behaviours between office and home settings

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ABSTRACT

This paper examines how office-based lighting and computer use behaviours relate to similar behaviours performed by the same individuals in a household setting. It contributes to the understanding of energy use behaviour in both household and organisational settings, and investigates the potential for the 'spillover' of behaviour from one context to another. A questionnaire survey was administered to office-based employees of two adjacent local government organisations ('City Council' and 'County Council') in the East Midlands region of the UK. The analysis demonstrates that the organisational or home setting is an important defining feature of the energy use behaviour. It also reveals that, while there were weak relationships across settings between behaviours sharing other taxonomic categories, such as equipment used and trigger for the behaviour, there was no evidence to support the existence of spillover effects across settings.

1. Introduction

In recent years, concern about environmental impacts and the cost, availability and security of energy supplies has led to heightened interest in ways to reduce energy use within buildings. For psychologists, work in this area has frequently focused on understanding the determinants of energy use behaviours, or on testing the effectiveness of intervention strategies aimed at changing behaviours (Abrahamse, Steg, Vlek, & Rothengatter, 2005). Much of the research into the determinants of energy use behaviours has focused on household settings (Abrahamse, Steg, Vlek, & Rothengatter, 2007; Owens & Driffill, 2008; Steg, Dreijerink, & Abrahamse, 2005). However, non-domestic buildings account for around one quarter of total UK energy use (Brown, Wright, Shukla, & Stuart, 2010), with local government buildings alone estimated to consume 26 billion kWh of energy annually (Carbon Trust, 2007). Interest is now growing in understanding energy use behaviours in non-domestic, organisational settings such as offices and other workplaces (Lo, Peters, & Kok, 2012; Matthies, Kastner, Klesse, & Wagner, 2011; Murtagh et al., 2013, in press; Scherbaum, Popovich, & Finlinson, 2008). At the same time, many behaviour change interventions include, explicitly or otherwise, the notion of 'spillover' – that encouraging people to take up one pro-environmental behaviour may lead them to take up further pro-environmental behaviours (Thøgersen & Ölander, 2003). By exploring how office-based lighting and computer use behaviours relate to similar behaviours performed by the same individuals in a household setting, this paper contributes to the understanding of energy use behaviour in both household and organisational settings, and investigates the potential for 'spillover' of behaviour from one context to another.

Energy saving behaviours such as turning off equipment when it is no longer in use are not necessarily motivated by pro-environmental intentions; they may be the result of, for example, habit or routine, organisational practice, a personal dislike of waste, or a fear of electrical faults. Literature exploring these behaviours from an environmental standpoint can nevertheless provide insights. Stern (2000) identifies and describes four classes of pro-environmental behaviour: environmental activism such as involvement in environmental organisations; non-activist public behaviour such as support for or acceptance of public policies; private-sphere environmentalism including the purchase, use and disposal of household products; and other environmentally-significant behaviour including behaviour within organisations. This classification distinguishes behaviours performed in household settings from those performed in organisational settings. In particular, it identifies that individuals may affect the environment

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by influencing organisations to which they belong, or by how they carry out their role within an organisation.

Much of the literature examining individual environmentally-significant behaviour focuses on behaviours that could be classed as private-sphere environmentalism: waste and recycling (e.g. Barr, 2007; Tudor, Barr, & Gilg, 2007), energy demand (e.g. Abrahamse et al., 2005) and travel mode choice (e.g. Anable & Gatersleben, 2005; Bamberg & Schmidt, 2003). For much of this research, the context of the behaviour is a household setting, where individual control over the performance of behaviours is likely to be relatively high. While even in households individuals do not have complete autonomy (their behaviour may be influenced or constrained by the people they live with, or by the finances, time or facilities available to them) it is still likely that an individual will have greater control over these behaviours in their own home than in an organisational setting such as an office. In offices, behaviours are shaped by the physical context of the office (the presence of controls over building systems or equipment), but also by the social context (the needs, expectations or norms of the people they share the office with) and by the organisational context (the policies and expectations of the organisation that employs them). However, many pro-environmental behaviours within organisational settings could fit into more than just Stern's (2000) fourth category of 'other behaviour including within organisations'. Non-activist public behaviour within an organisation could include support for a company's environmental policies, while private-sphere environmentalism choices could affect an employee's actions within the workplace. For such behaviours to be classified separately to similar behaviours performed in a household setting, the setting that the behaviour occurs within would need to be a defining feature of that behaviour.

A number of researchers have considered how environmentally-significant behaviours in one setting relate to similar behaviours in different settings. Barr, Shaw, Coles, and Prillwitz (2010) found that people tend to behave in a less pro-environmental manner when on holiday than when at home, often finding it difficult to transfer commitment to environmental action into other, more problematic contexts. The problematic aspects of other contexts are likely to vary according to the nature of the context in question. This is an area that has not yet been fully explored by researchers. However, it has been identified that the influencing factors most relevant to a particular behaviour are specific to each context (Stern, 2000). For example, Siero, Bakker, Dekker, and Van Den Burg (1996) argue that it is not possible to generalise from household energy saving behaviour to workplace energy saving behaviour because expenditure is experienced more directly by the household, while employees only benefit indirectly from financial benefits of energy saving at work. However, this suggests that cost is an overriding factor in the decision-making process, while other research has identified a wide range of factors that may influence environmentally-significant behaviour, including situational characteristics, prior awareness and experience of the behaviour, habits and routines, environmental beliefs and values, social and personal norms, and perceptions of behavioural control and self-efficacy (Bamberg & Möser, 2007; Barr, 2007; Clayton & Brook, 2005). Who pays for the energy used, then, is only one difference between the home and workplace settings, and not necessarily the decisive difference.

Where connections have been found between behaviours performed in household and organisational settings, prior experience of the behaviour has been shown to be important. Studies of waste and recycling behaviour found that office workers who actively recycled at home were more likely to recycle paper (Lee, De Young, & Marans, 1995) and textiles (Daneshvary, Daneshvary, & Schwer, 1998) at work than colleagues who did little home recycling, while a sample of hospital workers reported recycling similar items in the workplace to those they recycled at home (Tudor et al., 2007). Tudor et al. (2007) suggest that similarities between specific recycling items may act as a cue to prompt the behaviour in each location. Barr (2007) suggests that the link identified by Daneshvary et al. (1998) between behavioural experiences in one setting and action in another implies a 'behavioural snowball effect', with participation in one behaviour leading to uptake of others.

This has also been identified as a 'spillover' effect in the context of behaviour change interventions (Thøgersen & Ölander, 2003). Much of the evidence suggesting the existence of a spillover effect is correlational (Barr, Gilg, & Ford, 2005; Poortinga, Whitmarsh, & Suffolk, 2013; Thøgersen & Noblet, 2012; Whitmarsh & O'Neill, 2010), with evidence that correlations between behaviours increase with the similarity (Bratt, 1999) and the perceived similarity (Thøgersen, 2004) of the behaviours. Thøgersen and Noblet (2012) argue that behaviours in the same taxonomic categories (time and place of behaviour, skills employed etc.) tend to be more strongly correlated than behaviours within different taxonomic categories. For similar behaviours in household and organisational settings, however, it is not clear whether prior experience of the behaviour in one setting will encourage the performance of the behaviour in the other setting, leading to spillover effects, or whether differences between the household and organisational contexts will lead to differences in the performance of the behaviour.

This question is important because the concept of spillover is influential in the design of many public behaviour change campaigns, which encourage people to take small steps to mitigate environmental impacts in the hope that small actions will lead to more and larger pro-environmental actions (Thøgersen & Crompton, 2009). If such an effect does exist and can be encouraged across contexts, this could add to the potential influence of behaviour change campaigns, with workplace-based campaigns able to influence home behaviours and vice versa. However, Nye and Hargreaves (2010) argue that different mechanisms drive behaviour change in workplace and household settings, with normative influences particularly influential in the workplace. Furthermore, the notion of spillover is problematic. Thøgersen and Noblet (2012) criticise behaviour change programmes and policies that attempt to trigger spillover, arguing that there is little evidence that 'wedge' or 'catalyst' behaviours lead to large behavioural changes, beyond a weak 'foot in the door' effect. This effect suggests that performing pro-environmental behaviours can 'prepare the ground' for acceptance of more far-reaching pro-environmental changes, but that this is likely to only work when the original behaviours are considered pro-environmental, rather than common, socially mandated or providing individual benefits (Poortinga et al., 2013; Thøgersen & Noblet, 2012). This is problematic in organisational settings such as offices, where other considerations such as carrying out tasks related to the job role, meeting the expectations of the employing organisation or interacting with colleagues in a shared environment may lead to multiple or competing motivations.

This paper, then, addresses two questions:

1. Is there a fundamental difference between energy use behaviours performed in the organisational setting of an office and energy use behaviours performed in a household setting?
2. Does the performance of an energy use behaviour in the organisational setting of an office spill over to influence the performance of related behaviours in a household setting?

These questions are addressed by examining responses to a questionnaire survey on lighting and computer use in office and

household settings. This allows the connections between the performance of similar behaviours by the same individuals across organisational and household settings to be examined.

2. Methods

2.1. The study

This paper discusses responses to a questionnaire survey administered to office-based employees of two adjacent local government organisations ('City Council' and 'County Council') in the East Midlands region of the UK. The independence of the study from the Councils and the confidentiality of responses given were emphasised in the invitation to take part and in the questionnaire's introductory text. Results of the study were shared with the Councils, but only at an aggregate level once the analysis was complete.

Responses were examined in two stages. Stage one investigated whether there was a fundamental difference between energy use behaviours performed in an office setting and in a household setting. Stage two investigated whether there was evidence for the spillover of energy use behaviours from the office to the household setting.

Respondents from the City Council ($n = 337$) were based in a single modern open-plan office building with predominantly centrally-controlled or automated lighting (hereafter 'City Central Building'). Respondents from the County Council ($n = 296$) were based in 32 separate office buildings, but with 226 respondents concentrated in four main buildings. The remaining respondents were mostly based in small offices within specialist buildings such as libraries and children's centres. Most of the County Council respondents (259 of 296) reported that they had some individual-level control over lighting within their office building.

In stage one, all respondents were included. In stage two, the 337 responses from the City Central Building (19% of the 1785 occupants) were compared with the largest group of responses from a single building within the County Council sample ($n = 144$, 32% of the 450 occupants). This building (hereafter 'County Individual Building') was an older office building where occupants had a higher level of individual control over lighting than in the City Central Building. While occupants of the City Central Building were only able to turn lights off in meeting rooms, occupants of the County Individual Building were able to turn lights off in meeting rooms, toilets, and open plan offices (using light switch cords hanging from ceilings above the desks). Including the full County Council sample for stage one rather than just those included in stage two gave a larger sample (296 rather than 144), which was better for conducting Principal Components Analysis (Field, 2009). Limiting the County Council sample in stage two to those from the County Individual building meant that levels of individual control over energy use were consistent across the whole of each sample.

2.2. Survey design

The questionnaire was administered as a web-based survey, with respondents invited to take part via all-staff emails and through advertising on each organisation's intranet. The wording of these invitations was provided by the researchers and emphasised their independence from the Councils, although the all-staff emails themselves were sent by an employee from each Council's Sustainability team. Sections in the questionnaire covered socio-demographics, self-reported lighting and computer use in the office and in the home setting, and a selection of attitude-behaviour items. This included items measuring constructs taken from the Theory of Planned Behaviour (Ajzen, 1991). In this paper, these were used to identify how variables measuring different aspects of behaviours in the office and home settings grouped together; an investigation of the relationships between constructs proposed by the Theory of Planned Behaviour is not presented here (Littleford, 2013).

Office behaviours examined relate to lighting and computer use. These behaviours had quite a small impact in terms of the amount of energy the appliances consumed, or the potential energy savings that could be made through changes in individual behaviour. However, individual office occupants had a greater level of control over the use of computers and lighting than they did over other building systems that consumed more energy, particularly heating and cooling. In the City Central building, temperature was controlled by a Building Management System, with no opportunity for individual control. In the County Individual building, the heating system could be controlled on each floor but worked poorly, with large fluctuations in internal temperature in different parts of the building making this a contentious issue. These circumstances meant that no comparisons could be drawn between office and home heating behaviours for participants from the City Central building as they could not control heating in the office, while participants in the County Individual building's heating behaviours were dominated by experiences of discomfort, making it unlikely that meaningful comparisons could be drawn with their heating behaviours at home. Furthermore, the agreement reached with the two Councils participating in the study was to focus on behaviours within the office buildings, so other energy intensive behaviours such as driving were outside the scope of the study. The study aimed to develop insights into behaviour in the office and home settings, and behaviours that were commonly performed in both settings, such as using lighting and computer equipment, allowed the study to identify processes and relationships across settings, even if the behaviours in question were not the most energy intensive behaviours performed in each setting.

Respondents from the County Council were asked to report their performance of three lighting behaviours: turning office lights off when they were not needed, turning meeting room lights off when they leave the room empty, and turning toilet lights off when leaving them unoccupied. In the City Central Building, office and toilet lights were controlled centrally by the Building Management System, but occupants were able to turn off lights in meeting rooms, so were only asked about these. All respondents had the same level of individual control over their computer use, and were asked about three computer-related behaviours: turning off the computer when they finished for the day, turning off the computer monitor when they finished for the day, and turning off the computer monitor when away from their desk for more than ten minutes. Respondents were asked how often they performed each behaviour, with five response categories: Never, Rarely, Half the time, Frequently, and Always.

Home behaviours examined in the questionnaire were chosen for their similarities to the office behaviours. All were asked how often they performed two lighting-related and two-computer related behaviours, and again were given five response categories. The two lighting behaviours were turning off lights in a room when they weren't needed, and turning off lights in a room when leaving the room empty; these matched the wording of the office lights and meeting room lights questions respectively. The two computer-related behaviours were turning off the home computer when finished using it, and turning off the computer monitor when away for more than ten minutes. The first question referred to 'when finished using it' rather than 'when finished for the day' used in the office setting, reflecting that in the office context the occupant left the vicinity of the computer at the end of the working day (by going home), but in the home context was more likely to remain in the

same environment. The question about turning off the computer monitor when away for more than ten minutes matched the wording in the office setting. An additional item in the Home setting stated 'I turn the main TV off fully instead of leaving on standby'; while this was similar to the computer-related behaviours (turning off the equipment when it was finished with), there was no direct comparison in the Office setting.

Respondents were also asked to state their level of agreement with a range of attitudinal statements, on a five-point scale ('Strongly disagree' to 'Strongly agree'). These included items measuring constructs within the Theory of Planned Behaviour (Ajzen, 1991), and additional items relevant to the household and organisational settings. The constructs from the Theory of Planned Behaviour were Attitude towards the behaviour (ATT), Subjective Norm (SN) and Perceived Behavioural Control (PBC). These were measured at a behaviour and setting-specific level, with six items measuring ATT for each behaviour in the Office setting, six in the Home setting, six measuring SN in the Office setting and four in the Home setting, and two measuring PBC in each of the Office and Home settings. Further attitude statements related to the respondent's sense of their own responsibility for saving energy at work and at home, their sense of moral obligation to save energy in each setting, and whether they saw reducing the Council's energy use as 'good' or 'important'. Additional items addressed the respondent's perceptions of the organisation's expectations of its employees, the organisation's commitment to energy conservation, and the importance placed on energy conservation by senior management.

2.3. Statistical analysis

In stage one, Principal Components Analysis (PCA) was conducted on reported behaviours in both settings, and on responses to items measuring constructs within the Theory of Planned Behaviour. Direct Oblimin rotation, an oblique rotation method, was used, as it could not be assumed that the variables were fully independent. The analysis was conducted separately on the City Council ($n = 337$) and County Council ($n = 296$) samples; as the non-normal distribution of the results for many variables limited the generalisability of the findings from a single sample, results from two separate samples helped to confirm the findings (Field, 2009).

Stage two used the whole of the City Council sample ($n = 337$) based in the City Central Building, and a sub-set of the County Council sample ($n = 144$) based in the County Individual Building. A non-parametric correlation technique, Spearman's rho, was utilised to identify significant associations between office and home based attitudes and behaviours within each sample. Subsequently, hierarchical multiple regression was used to identify significant differences between the two samples in both the office and home settings. This allowed differences in the gender make-up of each sample to be controlled for, enabling the analysis to better identify effects resulting from differences in the office buildings the respondents were based in. If such differences existed in the office setting but not in the home setting, this could indicate that behaviour was not spilling over between the two settings.

3. Results

3.1. Characteristics of the samples

Table 1 presents demographic details about the samples (including for the sub-sample of the County Individual Building, taken from the County Council sample). For most demographic items, the proportions of respondents in each category were similar across all of the samples. Most respondents were full time employees who were not in a managerial role and were owner-occupiers of their home. The largest difference between samples was in the gender split, with females making up 57.9% of the City Council/City Central Building sample, but only 39.6% of the County Individual Building sample, possibly reflecting a difference in the kinds of departments based in each building. While the City Central Building housed the majority of the City Council's office-based employees, the County Individual Building housed a sub-section of the County Council's office-based employees and included some technical services (highways, transport) which have been noted nationally to be dominated by men, with women making up only 5% of senior local government roles in highway services and 9% in transport across the UK (LocalGov.co.uk, 2008).

Table 1
Demographics of the City Council/City Central Building, County Council and County Individual Building samples.

Item	Categories	City Council/City Central Building		County Council		County Individual Building	
		n	%[a]	*n*	%[a]	*n*	%[a]
Gender	Female	195	57.9	139	48.8	57	39.6
	Male	142	42.1	146	51.2	87	60.4
	Total	337	100	285	100	144	100
Age	24 and under	13	3.9	4	1.4	1	0.7
	25–34	76	22.6	65	23.0	32	22.5
	35–44	88	26.1	71	25.2	35	24.6
	45–54	105	31.2	97	34.4	53	37.3
	55–64	41	12.2	43	15.2	19	13.4
	65 and over	14	4.2	2	0.7	2	1.4
	Total	337	100	282	100	142	100
Full or Part time	Full time	296	88.1	254	89.4	131	91.6
	Part time	40	11.9	30	10.6	12	8.4
	Total	336	100	284	100	143	100
Manager	Yes	101	30.1	65	22.9	38	26.4
	No	234	69.9	219	77.1	106	73.6
	Total	335	100	284	100	144	100
People in household	Live alone	62	19.5	53	20.4	24	18.5
	Adults only	177	55.7	138	53.1	70	53.8
	With children	79	24.8	69	26.5	36	27.7
	Total	318	100	260	100	130	100
Housing tenure	Owner-occupier	264	84.9	228	88.7	118	90.1
	Renter	47	15.1	29	11.3	13	9.9
	Total	311	100	257	100	131	100

[a] % of responses given to that question.

3.2. Stage one: the distinction between behaviour in the office and home settings

Table 2 presents summary statistics for each of the self-reported behaviours included in the questionnaire for respondents from both Councils. High levels of performance were reported for all behaviours apart from turning off computer monitors when away in both the office and home settings.

The highest reported performances of behaviours came in the office setting. There was a near-universal performance of turning off a computer at the end of the day, with 97.3% (City Council) and 96.8% (County Council) of respondents reporting that they 'Frequently' or 'Always' performed this behaviour. These high levels of reported enactment are a useful finding but resulted in too little variance in results to be used in stage two of the analysis. Reported performance of turning meeting room lights off was slightly lower, with 93.8% (City Council) and 90.6% (County Council) selecting 'Frequently' or 'Always'. Turning office lights off when they were not needed, which only the County Council respondents were able to perform, was reported much less frequently (74.1% 'Frequently' or 'Always').

Table 2
Reported performance of behaviours in office and home settings.

Setting	Behaviour	City Council			County Council		
		n	Mean	SD	*n*	Mean	SD
Office	Office lights[a]	–	–	–	259	3.95	1.145
	Meeting room lights	289	4.63	.781	233	4.45	.875
	Computer end of day	334	4.96	.321	285	4.89	.545
	Monitor at end of day	334	4.25	1.366	285	4.81	.680
	Monitor when away	334	1.89	1.227	285	2.00	1.327
Home	Lights when not needed	316	4.45	.902	261	4.56	.790
	Lights when room empty	315	4.30	.945	264	4.35	.983
	Computer when finished	305	4.31	1.099	254	4.15	1.216
	Monitor when away	280	2.67	1.507	225	2.77	1.555
	TV off not on standby	302	3.78	1.542	251	3.95	1.486

[a] Office lights not included for City Council as respondents were unable to control office lights individually.

Respondents from the County Council consistently reported a more frequent performance (albeit to a small extent) of each office-based computer-related behaviour, while respondents from the City Council reported slightly higher frequencies of performance of turning off meeting room lights. However, the overall patterns of computer-related behaviours in the office setting were similar for both Councils, with high reported frequencies of turning off computers and monitors at the end of the day, but low reported frequencies of turning off monitors when away for more than ten minutes.

Turning off monitors when away for more than ten minutes was performed less frequently in the office than at home, with 14.1% (City Council) and 16.8% (County Council) reporting that they 'Frequently' or 'Always' turned off their monitor when away more than ten minutes in the office, but 32.8% (City Council) and 36.0% (County Council) reporting the same in the home setting. However, turning off the computer when finished using it at home was performed less often than the equivalent, near-universal office behaviour of turning off the computer at the end of the day, with 83.9% (City Council) and 79.5% (County Council) reporting that they 'Frequently' or 'Always' turned off the home computer. This suggests that there is a difference in reported performance between similar behaviours in the office and home settings.

To explore this further, Principal Components Analysis (PCA) was conducted to identify how the reported behaviours grouped together. Table 3 presents the results of the first PCA, conducted on the reported performance of nine behaviours (four in the office and five at home) in the County Council sample. All factor loadings above .3 (or below −.3) are presented, with loadings used in factor identification in bold. Data was excluded pairwise to minimise losses due to missing responses, providing a sample of between 216 and 285 for each behaviour. The PCA was conducted using Direct Oblimin rotation, and identified three components with eigenvalues above 1, explaining 29.3%, 14.8% and 12.6% of the variance respectively. The items clustering on the same components suggest that component 1 represents Home behaviours, component 2 represents Computer Monitor behaviours, and component 3 represents Office Lighting behaviours. The Home behaviours component had a reasonably strong reliability, $\alpha = .644$, but the components for Monitor behaviours ($\alpha = .598$) and, particularly, Office lighting behaviours ($\alpha = .421$) were weaker. These components are made up of a small number of items, which has been noted to weaken the results of Cronbach's α tests for the internal reliability of a scale (Field, 2009).

PCA was also conducted on items measuring behaviour in the City Council sample, using the same parameters. Initial testing revealed low levels of correlation and communality for three variables in this sample: turning off meeting room lights, turning off the home computer, and turning the main TV of fully instead of leaving on standby. These were excluded from the analysis, leaving only four items to test. Despite this, the City Council sample provided some support for the factor structure identified in the County Council sample, identifying components representing Home behaviours (Home lights when not needed and Home lights when leave room empty, eigenvalue 1.938, 48.5% of variance, $\alpha = .843$) and Monitor behaviours (Office monitor when away from desk and Home monitor when away from desk, eigenvalue 1.204, 30.1% variance, $\alpha = .575$).

Table 3
Pattern Matrix for Principal Components Analysis of behaviours reported by County Council sample. (All factor loadings above .3 (or below −.3) are presented, with loadings used in factor identification in bold.)

Behaviour	*n*	1. Home behaviours	2. Monitor behaviours	3. Office light behaviours
Home lights off when not needed	261	**.871**		
Home lights off when room empty	264	**.736**		
Home computer off when finished	254	**.671**		
Home TV off not left on standby	251	**.576**		
Office monitor when away from desk	285		**.901**	
Home monitor when away from desk	225		**.768**	
Office toilet lights when unoccupied	216			**.849**
Meeting room lights leave empty	233			**.671**
Office lights off when not needed	259			**.461**
Eigenvalues		*2.640*	*1.332*	*1.135*
% variance		*29.3*	*14.8*	*12.6*
Cronbach's α		*.644*	*.598*	*.421*

The results of these PCA support the presence of a stable factor structure and identify that behaviours group together at a specific level, based on the type of equipment (lighting, computer monitor). For the lighting behaviours, these also grouped according to the setting that the behaviour occurs within, providing some evidence that energy demand behaviours performed in an office setting are different to energy demand behaviours performed in a home setting. However, it was not possible to see whether this was also true for the computer monitors as there were too few items to form separate components in each setting.

For this reason, further PCA (again using Direct Oblimin rotation) were conducted using responses to items measuring constructs within the Theory of Planned Behaviour. Using these statements gave a larger number of measured items for each behaviour. Statements measured ATT Attitude towards the behaviour, SN Subjective Norm and PBC Perceived Behavioural Control, using multiple statements tailored to each behaviour in each setting. Each sample was asked about four behaviours. As the City Council sample had no individual control over office lighting, they were asked about turning off meeting room lights when leaving the room empty, while the County Council sample was asked about turning off office lights when they weren't needed. The other behaviours were the same for both samples: turning off computer monitors when away for more than ten minutes in both the office and home settings, and turning off home lights when they were not needed. Table 4 presents the results of the PCA conducted on the City Council sample.

The analysis identified 11 components with eigenvalues over 1, explaining between 2.7% and 21.5% of the variance. Most components clustered around items relating to the same equipment,

Theory of Planned Behaviour construct and setting for the behaviour. Where the components were not consistent with this (components 7, 8, 10 and 11), they reflected a weakness in the measurement of the Perceived Behavioural Control construct, which was only measured with two items for each behaviour, with one of those items being reverse-worded. The greater number of items relating to each specific behaviour in this analysis reveals a distinction between monitor behaviours in the office and home setting that could not be identified in the PCA of behaviours. For all of the behaviours presented here, then, setting is a defining feature on which the components cluster.

The analysis also reveals similarities between behaviours performed in the same setting. Component 4 combines items measuring the Subjective Norm (SN) for both switching off home monitors and switching off home lighting, although the factor loadings form distinct groupings by equipment within that component. This suggests that the relationship between the Subjective Norm and the reported performance of the behaviours is similar for both pieces of equipment in the home setting. However, the influence of SN in the office setting appears to be different, with SN statements for computer monitor and lighting behaviours in the office setting clustering separately from each other and from their equivalents in the home setting.

A Principal Components Analysis was also conducted using responses from the County Council sample, and the results supported those found for the City Council sample. In the County Council sample, 9 components were identified, accounting for between 3.0% and 17.4% of the variance, with similar patterns of clustering according to construct, equipment and setting for each specific behaviour. The results of Principal Components Analysis for both samples support the contention that behaviours in the office and home setting are different, even when the other taxonomic categories relating to those behaviours (e.g. equipment, action, trigger for the action) are very similar.

3.3. Stage two: connections and spillover between office and home settings

Stage one of this analysis identified that the setting in which an energy use behaviour occurs is an important factor in defining that behaviour. Stage two examines relationships between energy use behaviours in the office and home setting, and explores whether

Table 4
Pattern Matrix for Principal Components Analysis of responses to behaviour-specific statements in the City Council sample. (All factor loadings above .3 (or below −.3) are presented, with loadings used in factor identification in bold.)

Behaviour	1	2	3	4	5	6	7	8	9	10	11
Home mon. ATT worthwhile	**.890**										
Home mon. ATT appropriate	**.887**										
Home mon. ATT satisfying	**.808**										.302
Home mon. ATT convenient	**.727**										
Home mon. ATT help save	**.460**						.379			.332	
Office mon. SN work with should		**.823**									
Office mon. SN important should		**.821**									
Office mon. SN work with do		**.808**									
Office mon. SN management should		**.763**									
Office mon. SN management do		**.691**									
Meeting light SN management should			**.770**								
Meeting light SN work with should			**.720**								
Meeting light SN important should			**.709**								
Meeting light SN work with do			**.630**								
Meeting light SN management do			**.626**								
Meeting light SN important would			**.568**								
Home light SN live with do				**.898**							
Home light SN important do				**.888**							
Home light SN important should				**.869**							
Home light SN live with should				**.843**							
Home mon. SN important should				**.443**		.332					
Home mon. SN live with do				**.442**		.353					
Home mon. SN important do				**.439**		.367					
Meeting light ATT appropriate					**−.962**						
Meeting light ATT worthwhile					**−.940**						
Office mon. ATT worthwhile						**−.913**					
Office mon. ATT appropriate						**−.889**					
Office mon. ATT convenient						**−.727**					
Office mon. ATT satisfying						**−.726**					.325
Office mon. ATT help save						**−.530**					
Meeting light PBC up to me							**.739**				
Office mon. PBC up to me							**.691**			.334	
Home mon. PBC difficult (R)								**.731**			
Office mon. PBC difficult (R)								**.650**			
Home light ATT worthwhile									**.885**		
Home light ATT appropriate									**.881**		
Home light ATT convenient								.303	**.535**		.518
Home mon. PBC up to me										**.709**	
Home lights PBC up to me										**.692**	
Home lights ATT help hhold save										**.587**	
Meeting lights ATT convenient					−.318						**.701**
Meeting lights ATT satisfying											**.668**
Home lights ATT satisfying											**.581**
Eigenvalues	*9.265*	*3.883*	*3.796*	*3.047*	*2.241*	*1.909*	*1.705*	*1.559*	*1.396*	*1.193*	*1.148*
% of variance	*21.5*	*9.0*	*8.8*	*7.1*	*5.2*	*4.4*	*3.9*	*3.6*	*3.2*	*2.8*	*2.7*
Cronbach's alpha	*.903*	*.857*	*.792*	*.905*	*.676*	*.855*	*.579*	*.437*	*.780*	*.657*	*.730*

there is evidence of the spillover of behaviour between the two settings. The analysis focuses on two specific buildings, the City Central Building with high levels of centralised control over lighting through a Building Management System, and the County Individual Building with a higher level of individual occupant control over lighting, including light switch cords hanging from ceilings above individual desks. Correlations were calculated using the non-parametric Spearman's rho. Table 5 presents the results of the correlations for the samples from both buildings.

A large number of significant correlations (r) were identified, reflecting the high levels of reported performance for most behaviours. There was a greater number of significant correlations ($p < .05$) between behaviours in the same setting (17) than in different settings (12); of the most highly significant ($p < .01$), 13 were in the same setting and five in different settings. However, the setting was not the only distinguishing feature. There were also a greater number of significant correlations between behaviours in the office and home settings for the County Individual Building (9) than for the City Central Building (3). Excluding the office lighting behaviour that only the County Individual occupants could perform reduced this to a difference of seven to three.

The relationships between the office-based behaviour of turning off meeting room lights and the four home behaviours were the clearest difference between the two samples, with all four correlations for the City Central Building non-significant and for the County Individual Building highly significant. The meeting room lighting behaviour in County Individual Building correlated with all of the home-based behaviours, while the meeting room lighting behaviour in City Central Building did not correlate significantly with their performance of the home behaviours. Effect sizes were calculated using r^2, indicating the proportion of variance in the ranked data explained by the correlation. The effect sizes for the correlations for County Individual Building were small, explaining between 3% (Home lights when not needed) and 9% (Home computer when finished) of shared variance in the ranks. Nevertheless, this highlights the lower level of individual control over lighting in the City Central Building than in the County Individual Building. However, the correlations for turning office lights off when not needed, which only respondents in County Individual Building could perform, were only significant for two of the four home-based behaviours (Home lights when not needed, and Home computer when finished). The correlation with the other home lighting behaviour, Home lights when empty, was not significant. This suggests that the correlation is not only related to the type of equipment (lights, computer monitors), but also to the triggers for behaviour (when not needed, when leaving a room empty).

Given this, it is of no surprise that the strongest correlation between behaviours in different settings in both samples was between the office-based and home-based versions of turning off the computer monitor when away for more than ten minutes, explaining 12.2% of the variance for City Central Building and 9.6% of the variance for County Individual Building. These effect sizes are quite small, but nevertheless significant. In both locations, the behaviours share the type of equipment and the triggers for the behaviour. The second biggest effect size between locations for County Individual Building (explaining 9% of the variance) was between turning meeting room lights off when leaving the room empty, and turning the home computer off when finished using it. These are different types of equipment, but could arguably share a trigger of their use having finished. However, this relationship is non-significant for the City Central Building, suggesting that other differences between the samples are influencing reported behaviour.

To investigate some possible differences between the samples from each building, responses to a number of statements measuring attitudes and organisational factors were examined using hierarchical multiple regression. As the gender make-up of each sample was markedly different, this method of analysis allowed the effects of gender to be controlled for when identifying relationships with the building that respondents were based in. Table 6 presents the results of the regression analysis, revealing that, once gender was controlled for, significant differences between the two samples were found for two of the three office-based behaviours and for three of the four office-based attitude statements. Once gender was controlled for, the building that the respondent was based in did not have a significant relationship with any of the three organisational variables measured.

Significant differences were seen for nine of the ten variables examined, although all were small effects; the largest, for the attitude item 'Reducing the Council's energy use is a good thing', accounted for just 5% of the variance.

Significant relationships between reported behaviours and the building that the respondents were based in were found for two of the three office-based behaviours. Respondents in the County

Table 5
Correlations between office and home behaviours for respondents from the City Central and County Individual buildings.

Behaviour	Building	n	1. Office lights	2. Meeting room lights	3. Home lights not needed	4. Home lights empty	5. Office monitor finished	6. Office monitor away	7. Home computer finished	8. Home monitor away
1. Office lights off when	Central	–	–	–	–	–	–	–	–	–
not needed[a]	Individual	141	1.00	.25**	.27**	.14	.15	−.06	.22*	.11
2. Meeting room lights	Central	289		1.00	.12	.08	.02	.01	.12	.12
off when leave empty	Individual	120		1.00	.17*	.23*	.15	.23**	.30**	.23*
3. Home lights off when	Central	316			1.00	.66**	.07	.10	.41**	.23**
not needed	Individual	130			1.00	.55**	.16	−.06	.54**	.30**
4. Home lights off when	Central	315				1.00	.12*	.15**	.25**	.17**
leave room empty	Individual	132				1.00	.15	.16	.19*	.21*
5. Office monitor off	Central	334					1.00	.33**	.08	.13*
when finished for the day	Individual	144					1.00	.15	.02	.21*
6. Office monitor off	Central	334						1.00	.08	.35**
when away ten minutes	Individual	144						1.00	.06	.31**
7. Home computer off	Central	305							1.00	.27**
when finished using it	Individual	128							1.00	.25**
8. Home monitor off	Central	280								1.00
when away ten minutes	Individual	113								1.00

Spearman's rho (r). * Correlation significant at $p < .05$ (2-tailed). ** Correlation significant at $p < .01$ (2-tailed).
[a] Asked only of County Individual Building as occupants of City Central Building had no individual control over office lights.

Table 6
Regression analysis for building and gender effects on office-based reported behaviours, attitudes and organisational factors.

	Variable	Model	R^2	*b*	*t*
Office behaviours	Turn meeting room lights off when leaving the room empty	1: Building	.013	−.112	−2.28*
		2: Building	.013	−.117	−2.34*
		Gender		.027	.544
	Turn the computer monitor off at the end of the day	1: Building	.040	.201	4.48***
		2: Building	.040	.203	4.44***
		Gender		−.013	−.29
	Turn monitor off when away from desk more than ten minutes	1: Building	.005	.067	1.47
		2: Building	.037	.037	.80
		Gender		.183	4.00***
Office attitudes	Saving energy at work is not my responsibility (reverse-worded)	1: Building	.001	.033	.70
		2: Building	.005	.124	.49
		Gender		.061	1.26
	I should do what I can to help the Council save energy	1: Building	.020	.23	2.98**
		2: Building	.034	.26	3.38**
		Gender		−.18	−2.57*
	Reducing the Council's energy use is a good thing	1: Building	.050	−.22	−4.94***
		2: Building	.051	−.22	−4.78***
		Gender		−.02	−.53
	It is important to reduce the Council's energy use	1: Building	.015	−.12	.096
		2: Building	.019	−.11	.096
		Gender		−.07	−.01
Organisational factors	People who work for the Council are expected to try to conserve energy	1: Building	.001	.034	.72
		2: Building	.013	.052	1.11
		Gender		−.111	−2.36*
	The Council is committed to saving energy	1: Building	.002	−.044	−.94
		2: Building	.023	−.019	−.40
		Gender		−.147	−3.16**
	Senior management see conserving energy as an important priority	1: Building	.005	−.068	−1.45
		2: Building	.028	−.042	−.91
		Gender		−.155	−3.33**

*$p < .05$, **$p < .01$, ***$p < .001$, Building (1 City Central, 2 County Individual), Gender (1 Female, 2 Male).

Individual Building were significantly more likely to report turning off their monitor at the end of the day than respondents in the City Central Building (explaining 4% of the variance). Conversely, respondents in the City Central Building were significantly more likely to report turning off meeting room lights, although this only accounted for 1% of the variance.

Significant relationships were also found between the building the respondents were based in and their responses to three attitude statements. Respondents in the City Central Building were more likely to agree that reducing the Council's energy use was 'a good thing' (explaining 5% of variance) and 'important' (2%), while respondents in the County Individual Building were more likely to agree that they 'should do what they can' to help the Council save energy (2%). The remaining attitude statement, 'I should do what I can to help the Council save energy', was significantly related to both gender and the building the respondent was based in; the building alone explained 2% of variance, rising to 3% once gender was accounted for, revealing that women and respondents in the County Individual Building were more likely to agree. These results distinguish between an assigned responsibility to act ('not my responsibility'), a moral sense of obligation to act ('should do what I can'), and an assessment of the value of acting ('important' and 'a good thing'). Differences in behaviours across the two buildings were accompanied by differences in the respondents' sense of moral obligation to act (with respondents in County Individual Building feeling this more strongly) and their assessment of the value of acting (with respondents in City Central Building feeling this more strongly).

Gender alone accounted for differences between the samples found in three variables, with women being significantly more likely to agree that Council employees were expected to try to conserve energy (explaining 1% of variance), that the organisation was committed to saving energy (2%), and that senior management saw this as a priority (3%). As the two samples originate from different organisations, these three statements were designed to examine whether organisational differences accounted for differences between the samples, measuring respondents' perceptions of organisational commitment to energy saving. The first, 'People who work for the Council are expected to try to conserve energy', measured perceptions of the expectations placed on respondents by the organisation. The second, 'The Council is committed to saving energy', measured perceptions of the organisation's commitment to saving energy. The third, 'Senior management see conserving energy as an important priority', measured perceptions of the importance of energy saving to the organisation's leadership. Responses to these statements were not as positive as for attitudes and behaviours. For the first two statements, most respondents selected either '3 = Neither agree nor disagree' (City Central Building, 36.2% and 26.1%; County Individual Building, 35.3% and 39.1%) or '4 = Tend to agree' (City Central Building, 39.9% and 44.2%; County Individual Building, 35.3% and 39.1%). For the third statement, responses were even more ambivalent, with 46.3% (City Central Building) and 42.0% (County Individual Building) selecting '3 = Neither agree nor disagree'. While the results did identify small differences relating to gender, the results did not distinguish between the two buildings, suggesting that the respondents' perceptions of their organisation's commitment to energy saving did not explain differences between the two samples' office-based attitudes and behaviours.

To test whether differences between responses from each building carried over into the home setting, respondents were also asked to report on home-based behaviours and respond to home-based attitude statements. Hierarchical multiple regression was again conducted on the results to test whether the building the respondent was based in or their gender was related to their responses (Table 7).

Only one variable was found to be significantly related to either the building or gender. Women and those based in the County Individual Building were significantly more likely to agree with the attitude statement 'I should do what I can to save energy at home', explaining 3% of variance. However, gender had a greater effect than the building, which alone accounted for just 1% of variance. The results reveal that, while there were significant differences between the two samples for attitudes and behaviours in the office, there were no significant differences for behaviours at home, and only one small difference on attitudes at home. If there had been significant differences in behaviours reported in the home setting consistent with those seen in the office setting, this would have provided some evidence of factors influencing behaviour across different settings. Instead, no evidence has been found to support the existence of spillover effects between behaviours reported in the office and home settings, beyond weak correlations between behaviours, and only small evidence of consistency in attitudes across settings.

4. Discussion and conclusions

This paper addressed two questions that explore the relationships between energy use behaviours performed in office and home settings.

Firstly, the paper examined whether there was a fundamental difference between energy use behaviours performed in the organisational setting of an office and in the home. Using Principal

Table 7
Regression analysis for building and gender effects on home-based reported behaviours and attitudes.

Variable	Model	R^2	b	t
Turn lights off at home when leave a room empty	1: Building	.000	.019	.40
	2: Building	.002	.026	.54
	Gender		−.044	−.92
Turn lights off at home when they're not needed	1: Building	.006	.075	1.58
	2: Building	.006	.078	1.63
	Gender		−.021	−.44
Turn home computer off when finished using it	1: Building	.001	−.026	−.53
	2: Building	.006	−.013	−.27
	Gender		−.073	−1.50
Turn home monitor off when away more than ten minutes	1: Building	.005	.069	1.37
	2: Building	.010	.055	1.08
	Gender		.073	1.42
Saving energy at home is my responsibility	1: Building	.000	.005	.096
	2: Building	.000	.005	.096
	Gender		.000	−.01
I should do what I can to save energy at home	1: Building	.009	.096	2.01
	2: Building	.031	.120	2.51*
	Gender		−.148	−3.11**

*$p < .05$, **$p < .01$, ***$p < .001$, Building (1 City Central, 2 County Individual), Gender (1 Female, 2 Male).

Components Analysis (PCA), it was found that factor loadings grouped energy use behaviours according to similarities in the equipment involved, the trigger for the behaviour, and the setting that the behaviour took place within. Furthermore, even where the energy use behaviours in each setting involved the same action and the same trigger for performing the action, the factor loadings still clearly distinguished between settings. This suggests that the organisational or home setting is an important defining feature of the energy use behaviour.

The second stage of the paper examined relationships between the energy use behaviours performed in the office and the home setting, and whether this provided any evidence for the spillover of energy use behaviours between settings. A greater number of correlations between behaviours were found within the same setting than was found across different settings. Correlations were found between behaviours that shared the same type of equipment (lighting, computer monitors) and triggers for the behaviour (leaving a room, finishing using the equipment) as well as the setting for the behaviour. The strongest correlation across settings was found for turning off a computer monitor when away more than ten minutes, with the behaviours sharing the same type of equipment and trigger for the behaviour in each setting. The correlations identify that relationships between behaviours are strongest when they share defining features; the PCA analyses identify that setting is a particularly important defining feature. This suggests that spillover effects across settings would be most likely to occur where other taxonomic categories (equipment, trigger for the behaviour) were similar. However, this study did not identify evidence of such an effect.

Indeed, differences between the behaviours reported by respondents across the two buildings provided a further opportunity to identify connections between behaviours in different settings, but again did not find evidence of spillover. Respondents from the City Central Building were significantly more likely to report turning off meeting room lights than respondents from the County Individual Building, while those from the County Individual Building were significantly more likely to report turning off their computer monitor at the end of the day. However, no significant differences were found between the two samples for reported behaviours in the home setting; the causes of differences in reported behaviour in the office setting did not carry over into the home setting.

The correlations revealed further differences between the behaviours reported by respondents from each office building. There was a greater number of correlations between all behaviours reported by respondents from the County Individual Building than by respondents from the City Central Building. Across settings, this difference was particularly marked, with the office behaviour of turning off meeting room lights correlating significantly with all four home behaviours for County Individual respondents, but with no home behaviours for City Central respondents. The main difference identified between these buildings was the level of individual control that occupants had over lighting, with those in the County Individual Building having a higher level of control. The greater number of correlations between office and home behaviours for respondents from the County Individual Building suggests that people behave more consistently across settings when they have greater control over their own behaviour. However, in settings such as offices, individual control is more than just physical control; it is also normative, reflecting the influence of an environment shared with colleagues and shaped by the expectations of the employing organisation.

Connections between behaviours across settings, then, depend on the features of the behaviours in question (equipment, trigger for the behaviour) and on the nature of the context, both physical and normative. With setting an important defining feature of behaviour, and with the different constraints created by different types of setting shaping the behaviours reported, any spillover effects between behaviours in different settings seem likely to be weak at best. This has implications for the design of behaviour change interventions, suggesting that they will be most effective when they recognise the specific features of the target behaviours – the equipment involved, the triggers for the performance of the behaviour, and most importantly, the nature of the setting that the behaviour occurs within. Interventions within organisational settings such as offices, this suggests, cannot be expected to result in behaviour change within households (and vice versa), unless other defining features of the target behaviours (equipment, trigger for the behaviour) are very similar.

One reservation about these findings does need to be noted, however. The level of performance of each behaviour reported by respondents was very high, resulting in data that was skewed and low levels of variance in the data. This limits the level of variance in the home setting that could be explained using the data from the office setting, and could potentially have masked further effects between settings. The high levels of correlation between behaviours in different settings could be a sign of the existence of such effects. Further research in this area could address some of the limitations of this study, by identifying behaviours with greater variance that may reveal effects not seen in the data presented here. Further research could also compare behaviours in different office buildings within the same organisations rather than between two similar organisations to eliminate any effects originating from differences in organisational culture that have not been identified here. Research that compared the results of behaviour change interventions in different settings would also be able to identify further evidence for the existence, or otherwise, of a spillover effect between contexts.

There is also potential for research to usefully focus on how similar behaviours need to be in each setting for influences on the performance of one behaviour to also influence the performance of a behaviour in a different context. The research presented in this paper has highlighted the importance of identifying the defining features that make behaviours similar. Further work is needed to understand how such defining features interact with context and action to create triggers for the performance of behaviours, in order to understand the influence that the type of

setting has on the performance of individual energy demand behaviours.

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