Energy use by individual office workers:
Psychological and contextual influences on behaviour

By

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Abstract

Research into energy demand in office buildings has tended to focus on building fabric or systems, or the organisation as a whole, rather than the actions or motivations of individual building occupants. This study applies an attitude-behaviour approach used more frequently with household or travel behaviours to energy demand behaviours by individual occupants in office settings. The approach is extended to include contextual factors such as behavioural control, organisational expectations and social influences. Comparisons are drawn between the office and home settings.

The study took place in the offices of two local authorities, Nottingham City Council and Nottinghamshire County Council, and included a questionnaire survey (n=819), semi-structured interviews (n=9), and building surveys (n=5). Behaviours examined included switching off lights, computers and computer monitors. Lighting behaviours were reported to be carried out more frequently than computer monitor behaviours in both the office and household settings.

Analysis of behaviours identified that they needed to be considered at a specific level, according to the equipment (lighting, computer monitors), setting (office, home), and triggers (finishing a task, leaving a room). The physical context of the behaviour was particularly important. Different levels of individual control over energy affected the performance of behaviours. No evidence was found to support the notion of spillover – that enacting one energy demand behaviour might lead to the enactment of further energy demand behaviours, including for similar behaviours performed in different settings (e.g. the office and the home).

Organisational, social and psychological/attitudinal influences on individual behaviour were also examined. Structural Equation Modelling examined influences proposed by the Theory of Planned Behaviour and Values-Beliefs-Norms Theory. Neither theory provided a strong explanation of the collected data. However, support was found for the Perceived Behavioural Control construct, while moral and value-led constructs had a small influence on behaviour.

This thesis provides recommendations for practitioners and policy makers seeking to reduce individual-level energy demand in office settings, and for future research into energy use in organisational settings. Recommendations include promoting energy saving as an aspect of professionalism, characterising energy demand behaviours specifically by setting and equipment, and recognising the importance of the social aspects of shared office environments.

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Chapter 1: Background

1.1 Introduction

This research identifies and examines factors that influence the energy demand behaviours of individual office-based workers. It draws comparisons between the performance of these behaviours in the office location and in a household setting. The study adapts and applies an approach previously used to examine individual behaviours and motivations in household settings, and in other domains such as travel mode choice, to energy demand by individual occupants in office settings. The approach uses attitude-behaviour models developed within environmental and social psychology to explore psychological/attitudinal factors such as personal norms, values and perceptions of control, and contextual factors such as social norms and actual control over energy demand behaviours. It examines the effect that these have on energy demand behaviours reported by individuals in office settings. To apply these methods to the office setting, the examination of contextual elements is broadened beyond the attitude-behaviour relationship to include organisational issues and the effect of the office being a shared social environment.

This chapter begins by introducing the background to the research, summarising challenges associated with the current demand for energy worldwide, the policy context within which this energy use occurs in the UK, and the particular challenges associated with reducing energy use in office settings (Section 1.2). Section 1.3 presents the aim and objectives of this research and introduces how these will be met. Section 1.4 provides background information on the characteristics of local authority employment, and on the two local authorities which are the focus for this study, Nottingham City Council and Nottinghamshire County Council. The structure of the thesis is outlined in Section 1.5.

1.2 Background to the study

Global demand for energy is increasing as a result of population growth, increased urbanisation and economic development, and is predicted to keep growing over the coming years (Asif and Muneer, 2007). Buildings account for between 20 and 40 per cent of all energy demand in developed countries (Pérez-Lombard et al., 2008). In the UK, non-domestic buildings account for around one quarter of total energy use (Brown et al., 2010), with office buildings using around 17 per cent of this (Pérez-Lombard et al., 2008). Reductions in energy demand in office buildings, then, can help to reduce overall demand for energy in the UK.

Energy demand can be reduced through efficiency actions that improve the fabric of buildings or the systems or equipment within, or by changing how occupants use those buildings and their energy systems. While researchers understand some of the influences on individual energy use in households, such as socio-demographic variables including household composition (Abrahamse and Steg, 2009), much less is known about individual energy use in other contexts such as office buildings (Lo et al., 2012). Previous research in office buildings has frequently taken a technical or building management perspective (e.g. Balaras et al., 2002; Ó Gallachóir et al., 2007), or has focused on the behaviour of building occupants from an organisational level of analysis (e.g. Bansal and Gao, 2006; Etzion, 2007; Schleich, 2009). Currently, only a small amount of research has examined energy use in office buildings from the level of the behaviour of the individual office worker (e.g. Scherbaum et al., 2008; Matthies et al., 2011; Lo et al., 2011).

1.2.1 UK government policy at national and local levels

In 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was signed, leading to the establishment of the Kyoto Protocol (UNFCCC, 2013a) to agree an international response to the threat of climate change. Since then, and against a background of continued international negotiations around climate change, issues relating to energy generation and consumption have become more prominent. Four major concerns are the depletion of fossil fuel reserves, greenhouse gas emissions from fossil fuel use and their role in climate change, energy security concerns, and rising energy costs (Asif and Muneer, 2007). Concerns about climate change and about energy demand and supply have influenced government policy in the UK at national and local levels.

Prior to the election of the current Coalition government in the UK in 2010, the UK government's legislative and policy initiatives on energy issues included an Energy Act in 2008 to secure energy supplies, protect the environment and promote renewable and other technologies (DECC, n.d., a). The Energy Act was introduced alongside the Climate Change Act 2008, which set UK targets for reductions in emissions of greenhouse gases of 80% by 2050, with reductions in CO_2 emissions of at least 34% by 2020 against a 1990 baseline (DECC, n.d., b). These are challenging targets requiring significant action at national and local levels. Nationally, a number of organisations, such as the Carbon Trust and Energy Saving Trust, sought to promote and support action by businesses and by private households. At a more local level, many local authorities established partnerships with organisations, businesses and groups from the public, private and voluntary sectors, and developed climate change or carbon management strategies and action plans to target emissions reductions in their own areas.

In 2007, the then UK government produced a set of national indicators to measure local authority performance (Communities and Local Government, 2007). Most environmental sustainability indicators focused on local authorities' external roles, such as the provision of services or adaptation to climate change across the local authority area. One indicator, NI185, however, covered CO_2 reduction from internal operations. The Carbon Trust (2007) reported that local authority buildings annually consumed some 26 billion kWh of energy. By targeting reductions within their own estates, local authorities had the potential to make significant energy savings. In addition, the then UK government's Climate Change Strategy (HM Government, 2006) argued that the public sector, and in particular local authorities, should set a behavioural and strategic example to the private sector and to communities.

In 2010, a general election brought the Coalition government to power. The coalition agreement between the Conservative and Liberal Democrat parties (HM Government, 2010) set out the common goals for the new government and a commitment to meeting the emissions reduction targets set by the previous government was included. However, these used different mechanisms and a different focus for action. The Coalition government's plans for budget deficit reductions saw local authority budgets reduced and a scaling back of some areas of their activities. At the same time, the Coalition government proposed a Green Deal to support household, business and public sector investments in energy efficiency in buildings, and promoted technological developments such as smart grids and smart metering (DECC, 2012).

1.2.2 Energy demand in offices

Geller (2002) argues that there are two ways to reduce energy demand within buildings: i) alter the building's fabric or systems to make them more efficient; and ii) alter how the building is used by its occupants. These twin strategies of efficiency and curtailment imply different approaches. Geller (2002) argues that efficiency actions can achieve more and require only a one-off action, such as replacing a boiler with a more efficient model, while curtailment behaviours typically involve repeating 'inconvenient or sacrificial actions' and result in smaller individual energy savings. However, small individual savings repeated by large numbers of people can themselves become significant. Additionally, Steg and Vlek (2009) argue that efficiency savings tend to be overtaken by increases in consumption, suggesting a need to change behaviour to reduce overall consumption, while physical and technical innovations require individuals to accept, understand and use the innovations.

In households, the individual who decides to install a more efficient system is also likely to be a main user of that system. In office buildings, however, the building or facilities manager with responsibility for the maintenance and upgrading of building systems may not even be based in the building themselves. Efficiency actions such as replacing heating systems in office buildings may not involve the building's occupants, so that such actions are experienced more passively by individuals in an office setting than in a household setting. This passive experience can extend to the day-to-day management of building systems, in particular heating, cooling and ventilation. Control over such items can vary between offices, ranging from centrally-controlled systems managed by a Building Management System with no opportunity for individual or local control by office occupants, to decentralised systems where equipment, temperature and ventilation in individual rooms can be controlled by individual occupants.

The greater the level of local or individual control over such building systems, the more important the actions of individual occupants become for determining how much energy is used in that building. Individual control over energy-using equipment that is not part of an overall system, such as desk fans, photocopiers or even much computer equipment, can lead to different levels of energy use as a result of the behaviour of the individual using that equipment. Encouraging curtailment activities to save energy in office buildings therefore requires individual occupants to take an active role in energy saving. Identifying the factors that lead to differences in the enactment of such behaviours by individuals, then, becomes important for the management of energy demand within office buildings.

The numbers of UK employees who could be classed as office workers is difficult to assess, as statistics are not collected nationally for this categorisation. However, the Office for National Statistics (NOMIS, n.d.) reports that in June 2012 some 3.2 million people in the UK were employed in administrative or secretarial work, and a further 2.9 million were employed as managers, directors or senior officials, most of whom were likely to be office-based. A further 5.6 million people were categorised as 'professional' and 4 million as 'associate professional and technical', a large proportion of whom would also be office-based. These categories do not include other sectors where many employees also may be office-based, such as sales or customer services. While it is not possible to quantify the exact numbers of office-based workers in the UK from these statistics, a conservative estimation suggests that more than ten million people could be classed as office-based workers. With such large numbers nationally, even small savings on an individual level could lead to sizeable aggregate reductions in energy demand.

Given that energy demand reduction within buildings is an important priority, understanding the common influences on the energy use behaviours of such large numbers of individuals would

provide valuable evidence to support policies and interventions to reduce this energy demand. To date, much of the research examining individual energy demand has focused on households (Steg et al., 2005; Abrahamse et al., 2007; Owens and Driffill, 2008), with only limited numbers of studies within organisational settings (Siero et al., 1996; Scherbaum et al., 2008; Nye and Hargreaves, 2010). Whether the factors that influence energy use behaviours in the household setting also have the same influence on behaviours in an office setting is not yet fully understood. This research, then, will investigate the particular influences on energy use behaviours in an office setting, and the relationships between those behaviours and energy use behaviours performed in the household setting.

1.3 Aim and objectives

The overall aim of this research is to examine the factors that influence the individual energy demand behaviours of office-based workers. This will be addressed through four objectives:

1. To identify contextual, organisational, social and psychological/attitudinal influences on individual energy use in office settings.
2. To investigate the connections between similar individual energy use behaviours performed in the office and home settings.
3. To examine the roles of actual and perceived control over energy use for the performance of individual energy use behaviours.
4. To apply social psychological models of individual behaviour and evaluate their ability to explain individual energy use behaviours in office settings.
5. To make recommendations for future policy and research.

The first objective concerns the identification of variables influencing the performance of energy demand behaviours in an office setting. From a standpoint within environmental psychology, the main types of variables include attitudinal factors (such as norms, beliefs and values), external or contextual factors (including the physical office environment and its control systems), personal capabilities, and habits (Stern, 2000). Given the office setting of this research, the effect of organisational factors such as employee perceptions of organisational commitment to energy saving or expectations of employee behaviour are also examined. Additionally, social effects arising from the shared nature of the office environment are examined. These influences are explored through a range of methods, including building surveys, questionnaire surveys and semi-structured interviews.

The second objective expands the investigation of influences on individual energy demand to include behaviours performed in a household context. The questionnaire survey asks questions that draw direct comparison between attitudes and behaviours in each context, and the subsequent interviews explore these comparisons in greater depth. This allows the research to explore the differences that setting can make to attitudes and behaviours, and so to illuminate the findings in the office context that are the primary focus of the study.

The third objective concerns questions of control over individual energy demand behaviours, including both actual control and perceptions of control over those behaviours. This objective brings together the physical aspects of the context of the behaviours with the social and psychological aspects of that context. While the building surveys identify the different levels of physical control available to the respondents across the range of buildings examined, the questionnaire survey and semi-structured interviews explore the effects of actual and perceived control on attitudes and behaviour.

The fourth objective examines the application of social psychological models of individual behaviour to energy use behaviours in the office and home settings. This identifies which influencing factors are particularly important to the performance of these behaviours, and how the influencing factors relate to each other. Statistical analysis of questionnaire data assesses how well the social psychological models explain the reported performance of behaviours by identifying how well the chosen social psychological models of behaviour fit the data.

The fifth objective identifies the importance of drawing out the implications of this research for practice, policy and future research. While the findings of this research will be useful for the two local authorities who took part in the study, and for other local authorities also seeking to reduce energy demand in office buildings, exploring the public sector context of this research will enable implications for organisations in both the public and private sectors to be identified. The findings can inform future policy to support reductions in energy demand in office settings across the economy. With only a limited amount of research previously conducted in this area, the findings of this research will set out an agenda for future research in this increasingly important field.

1.4 The setting of the study

This research took place among office workers employed by two local authorities, Nottingham City Council and Nottinghamshire County Council (also referred to as ‘the City Council’ and ‘the County Council’). The study included a range of buildings providing office accommodation, but

particular focus was placed on the City Council's Loxley House and the County Council's Trent Bridge House and County Hall Complex.

This section provides some background to the nature of employment in local authorities, and also to the particular settings of Nottingham and the two participating Councils. Such background information is useful not only to provide a context for the research described here, but also to help identify how the findings in this research might generalise to other offices, in other parts of the public sector or in the private sector.

1.4.1 Characteristics of local authority employment

Local authority employees fulfil a range of different employment roles. With many of these roles relating to the provision of front-line public services, a large proportion of them are not office-based. Neither national nor local data on the demographic make-up of local authority employees distinguish between office-based and non-office based roles, and this makes it difficult to identify how representative a sample of office-based local authority employees is of the whole population. However, a report produced by the New Policy Institute on behalf of the Unison public-sector union to examine pay in local government (Kenway et al., 2012) does provide some useful data on the different jobs carried out by local authority employees. Figure 1.2 presents analysis from this report that divides local government roles into professional, managerial, clerical and manual classifications, and compares the proportions in each classification with proportions seen in other parts of the public sector (including the National Health Service, teachers, the police, emergency services, and civil servants) and with the private sector.

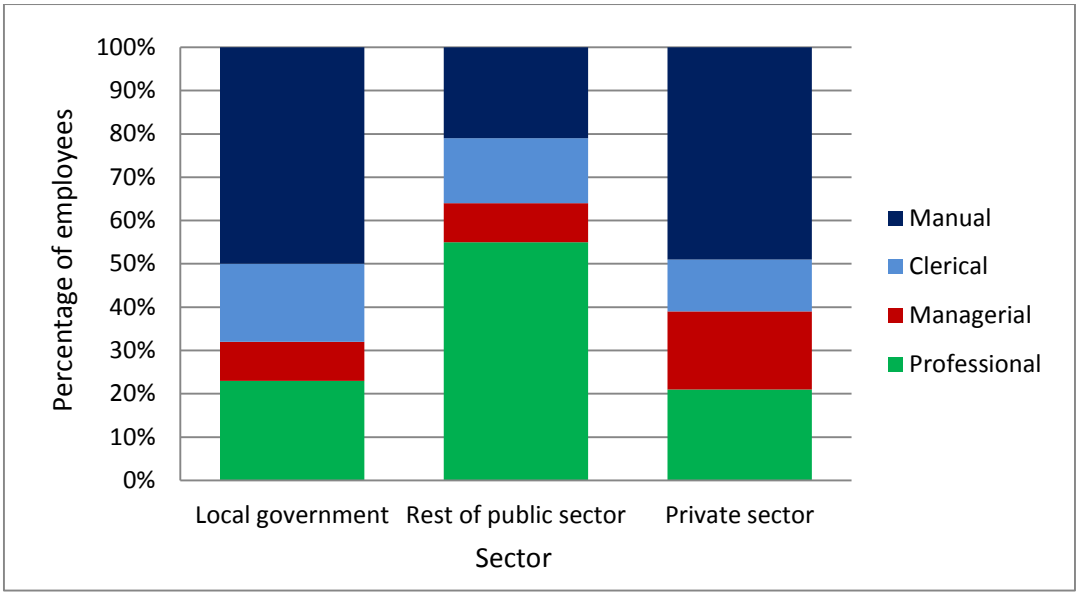


Figure 1.2 *Proportion of manual, clerical, managerial and professional workers in local government, the rest of the public sector, and the private sector (Source: Kenway et al., 2012)*

Kenway et al. (2012) characterise manual work in local government as frequently being 'front-line' roles delivering services, with the work often being physically and emotionally demanding, and lacking a career structure. These roles include carers, caterers, cleaners, refuse collectors and maintenance workers. By this analysis, around 50% of local authority employees can be classified as manual workers. The remaining 50% are classified as professional, managerial or clerical, and most of these are likely to be office-based, even if their roles also involve regular site or home visits. However, the 'managerial' classification, in particular, could include a proportion of managers of 'manual' teams who are not office-based, so it is still not possible to be certain of the overall proportion of office-based employees.

It is also interesting to note that comparisons with the rest of the public sector and with the private sector suggests that the spread of local government roles is closer to the private sector than to the rest of the public sector. One reason for this is the dominance of healthcare roles in the rest of the public sector, with large numbers of doctors, nurses and other healthcare professionals reflected in the large proportion of employees in the 'professional' category. Whether the similarities seen between the make-up of employment categories in local government and the private sector are also found in other areas, such as workplace energy demand and individual employee behaviour, cannot be identified from this data.

1.4.2 Nottingham City and Nottinghamshire County Councils

Nottingham City Council and Nottinghamshire County Council are the two organisations selected to be the focus of this research. They are both local authorities, each covering part of the county of Nottinghamshire in the East Midlands region of the United Kingdom. Nottingham City Council is an urban authority in the south of the county. Nottinghamshire County Council covers the area surrounding the city, forming a doughnut shape around it, and extends across the rest of the county, covering a mix of urban and rural areas.

Nottingham City Council is a unitary authority, providing all of the local government services within its boundaries. The City Council area is within the conurbation of Greater Nottingham. While 667,100 people lived in Greater Nottingham in 2009, only 300,800 of those lived within the smaller boundaries of the Nottingham City Council area (Nottingham City Council, 2012c). Both prior to and since the local government elections in May 2011, Nottingham City Council has been under the political control of the Labour Party. In 2011, the City Council employed 12,069 people, all primarily based within the boundaries of the City Council area.

Nottinghamshire County Council governs the whole of Nottinghamshire apart from the area within the City Council's boundaries. As a County Council, some services (notably housing, waste and recycling collection, Council Tax collection, and some direct services such as leisure centres) are provided by seven smaller Borough Councils, which operate independently of the County Council. The County Council directly provides a wide range of services, including schools, social care and social services, libraries, transport and statutory services (Nottinghamshire County Council, 2012). Since the local government elections in 2009, the County Council has been under the political control of the Conservative Party. The County Council is the eleventh largest local authority in the UK, and in 2011 employed 23,404 people to provide services to a population of around 785,800 people (Nottinghamshire County Council, 2012). Its administrative headquarters are in West Bridgford, within the Greater Nottingham conurbation and close to the geographical boundary with the Nottingham City Council area.

Both Nottingham City and Nottinghamshire County Councils have publicly stated their commitment as organisations to the general principles of sustainable development, to tackling climate change adaptation and mitigation, and to problems around energy demand and generation, through a range of policies and strategies adopted over recent years. For Nottingham City Council, this has led to the development of strategic documents addressing the issues internally to the organisation as well as externally for the city itself. In 2009 a Carbon Management Plan was published, and subsequently an Energy Strategy for 2010-2050 was also developed (Nottingham

City Council, 2012a). These focused on the Council's internal energy demand and emissions, with an overall target of the authority becoming carbon neutral by 2020. Annual Greenhouse Gas Emissions reports are produced to track how well the Council is meeting its targets. Reducing building running costs, including energy demand, from within Council operations lay behind the move in 2009 to consolidate many office-based functions into one large, modern office building, Loxley House, allowing the closure and disposal of several old and poorly-performing buildings, with estimated savings to the Council of around £1 million per year (This is Nottingham, 2009). Additionally, the City Council also developed a Community Climate Change Strategy 2012-2020, as part of the One Nottingham strategic partnership (Nottingham City Council, 2012b), with a target of reducing the city as a whole's carbon footprint by 26% by 2020, from a 2005 baseline. The Community Climate Change Strategy addresses reducing emissions and adapting to climate change across the city, including setting out specific actions for each electoral ward to reduce emissions, based on demographics and energy consumption.

For the County Council, there is less focus on reducing energy use and emission externally to the organisation's activities, partly because the strategic partnerships, which are the vehicle for this work for the City Council, in the County area are led by the seven Borough Councils rather than the County Council. Like the City Council, the County Council has produced a Carbon Management Plan to manage emissions from internal Council operations, and produces an annual Greenhouse Gas Emissions Report (Nottinghamshire County Council, 2013). The Carbon Management Plan, produced in 2009, sets a target of a minimum reduction in greenhouse gas emissions of 1% per year from a 1998 baseline, which would bring it into line with national targets for 2050, and a stretch target of 2% emissions reduction for the five years following the 2009 launch of the Plan. In addition to improving the efficiency and operations of buildings, the Plan also targets street lighting, transport and waste to achieve these reductions.

Since the development of the Plan, however, there has been a change in political leadership both at a national and local level, with national and local administrations both focusing on financial savings to meet cuts in the budgets. As a result, an Environmental Champions scheme which ran in the main County Council office buildings, encouraging pro-environmental activities particularly around waste and recycling behaviours but also including some promotion of energy efficiency, was cancelled a few months before the present research began. Consequently, in both the City and County Councils, there were no coherent schemes running to promote energy efficiency behaviours among employees.

1.5 Thesis structure

This section provides a summary of the chapters in this thesis.

Chapter One has set out the aims and objectives of this research study, and has provided an introduction to the background and setting in which it takes place.

Chapter Two reviews research related to this study that has been documented in the academic literature. It reviews literature from several disciplinary approaches relating to individual energy demand in office settings, discusses the findings of this literature and introduces the disciplinary approach that is used in this study. It identifies a number of areas where this study can make an original contribution to knowledge.

Chapter Three develops this further by outlining the key methodological issues affecting this study. It reviews the literature surrounding the attitude-behaviour approach which is central to this study, and introduces the two behavioural theories which are tested in the study, the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999). It discusses the strengths and weaknesses of this approach, and identifies how this approach can be used to achieve the research objectives described in Section 1.2.

Chapter Four details the methods used and outlines the design of the main elements of the study: the building surveys, the questionnaire survey, and the semi-structured interviews. The chapter also introduces the main office buildings used in this research study, presenting information gathered during the building surveys which informed the design of the questionnaire surveys and interview schedules. These designs and the methods of analysis are also discussed.

Chapter Five relates to the first objective, identifying the key contextual, organisational, social and psychological/attitudinal influences on individual energy demand in the office setting. It presents the samples and the main findings of the initial analysis of data collected from the questionnaire survey.

Chapter Six develops this analysis further by focusing particularly on the relationships between behaviours performed in the office and home settings (Objective 2) and the influence of different levels of control on behaviour (Objectives 3 and 4).

Chapters Seven and Eight investigate the methodological approach adopted in this study by testing the ability of the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms

Theory (Stern et al., 1999) to explain the data collected by the questionnaire survey. Chapter Seven tests the factor structures hypothesised by the two theories using Principal Components Analysis. Chapter Eight uses Structural Equation Modelling to test the relationships between latent variables hypothesised by the two theories. These chapters apply and evaluate social psychological models of individual behaviour and their ability to explain or predict individual energy use behaviours in the office settings (Objective 4).

Chapter Nine discusses the findings of the research, and **Chapter Ten** provides conclusions and recommendations drawn from the study.

Chapter 2: Literature review of individual energy demand in office settings

2.1 Introduction

This chapter presents a review of published academic literature which relates to this study of individual occupant energy demand in office settings. Section 2.2 presents an overview of the different disciplinary approaches to the topic. Section 2.3 defines individual environmentally-significant behaviour as it is seen in the psychological tradition adopted here. Section 2.4 focuses on different factors previously identified as important influences on energy demand behaviour. Section 2.5 discusses the findings of previous psychological research in this research. A summary and discussion of the findings of the literature review (Section 2.6) identifies gaps in the literature and how they relate to the aims and objectives of this research.

2.2 Approaches to research into the environmental impact of offices

Researchers examining the environmental impact and energy demand of offices approach the topic in a number of different ways. Research framed by the building that the environmental impact occurs within tends to use a technical or building management approach, which examines the fabric, operations and efficiency of buildings and their systems. Organisational approaches can have a variety of focal points, including organisational effectiveness and processes of change within organisations. Individual behaviour is frequently examined using behavioural studies, which also touch on interpersonal effects through an examination of norms. These three sets of approaches will now be discussed.

2.2.1 Technical and building management approaches

Geller (2002) argues that there are two ways to reduce energy demand within buildings: by altering the building's fabric or systems to make them more efficient (efficiency), and by altering how the building is used by its inhabitants (curtailment). The technical and building management approach to environmental impact and energy demand implies an efficiency approach which examines the fabric, operations and efficiency of buildings and their systems. One approach is to collect energy consumption data over time. Masoso and Grobler (2010) use sub-hourly data to identify energy consumption in unoccupied buildings, while Balaras et al. (2002) use consumption data to estimate savings from switching off equipment. Ógallachoir et al. (2007) use

utility bills and variables such as treated floor area and numbers of occupants to create a simple building management model.

One growing area of research in office buildings is post-occupancy evaluation of the performance of new of refurbished buildings in comparison with planned or anticipated operations (Bordass and Leaman, 2005a; 2005b). In post-occupancy evaluation studies, a portfolio of techniques can be used to evaluate buildings and their processes, focusing primarily on reducing capital and running costs and raising occupant satisfaction and productivity. Leaman and Bordass (2007) report on a number of studies which have explored sources of occupant satisfaction and compared the performance and perceptions of 'green' buildings. Some of these techniques, such as Building Use Studies (BUS), have been used in conjunction with methodologies examining individual behaviour and motivational factors, to develop a greater understanding of the interaction between buildings and individual occupants and how this affects energy demand (Gill et al., 2010).

These approaches provide insights into how buildings and their systems can affect energy use and environmental impact. These are particularly useful when considering the design of new buildings, or efficiency actions to improve building fabric or systems, but currently provide less insight into curtailment actions, which alter how the building is used by its inhabitants. Efficiency actions can achieve greater reductions in energy use and tend to require a one-off action, while curtailment behaviours typically involve repeated inconvenient or sacrificial actions resulting in smaller individual energy savings (Geller, 2002). However, small individual savings repeated by large numbers of people, such as the occupants of a large office building, can become sizeable in themselves. Additionally, Steg and Vlek (2009) argue that efficiency savings tend to be overtaken by increases in energy consumption, suggesting a need to change behaviours to reduce overall consumption, while technical and physical innovations require individuals to accept, understand and use those innovations. In households, the individual who decides to install a more efficient system may be a main user of the system, while in office buildings this is less likely to be the case. Efficiency actions within office buildings may not involve the building's inhabitants, and so be more passively experienced than in a household. If curtailment actions are to be effective, however, a building's participants must participate actively.

Technical and building management approaches to this area of research, then, provide a useful picture of how the environmental impact and energy demand of buildings and systems can be reduced. At present, it is less useful for understanding how the behaviour of building occupants can reduce environmental impact and energy demand. This requires more focus on the activities of building occupants, whether by the individual or the whole organisation.

2.2.2 Organisational approaches

Etzion (2007) argues that much of the literature on organisations and the natural environment uses three distinct viewpoints: the level of the individual firm and how the organisation's leadership can improve performance; the level of the industry, between the firm and the organisational environment; and the level of the organisational environment, which affects how different actors perceive and evaluate the natural environment. Lo et al. (2012) identify that there is currently little systematic analysis of the interplay between individual and organisational determinants, with most organisational research addressing environmental performance in the aggregate, emphasising management rather than individual behaviours. Scherbaum et al. (2008) argue that energy use among employees of organisations is generally considered from an organisational level of analysis, focusing on organisational structures, policies, and interventions that facilitate or inhibit organisationally-desired behaviours. This includes research which examines process theories around organisational change (e.g. Van De Ven and Poole, 1995), or the influence of organisational goals (e.g. Rapp and Selmer, 1985; Selmer, 1994). Ramus and Killmer (2007) identify the influence of values and leadership style, companies' norms and ethics, and change management. They conceive of corporate greening as pro-social organisational behaviour and argue that leader behaviours and values can cascade down through an organisation.

Bansal and Gao (2006) identify two primary approaches to organisation and environment research: the natural environment as an important factor in determining organisational outcomes, and the natural environment as an important outcome in itself. They argue that much recent literature in this field focuses on improving environmental performance rather than the performance of the organisation. This can be seen in research such as that of Schleich (2009), which identifies the role of energy management systems and energy audits, or work by Cebon (1992) or Selmer (1994), which identifies the importance of energy managers and the level of influence they have within the organisation.

Other literature examines the organisation through interpersonal or group effects, by examining the mechanisms within organisations that influence how individuals behave, and whether these act as barriers to improving environmental performance. Baumgartner and Zielowski (2007) argue that social mechanisms based on shared ways of thinking, feeling and behaving serve as social adhesives within groups or societies. Schein (1996) sees organisational culture as shared, tacit ways of thinking and reacting which can be a powerful and stable force within organisations. Linnenluecke and Griffiths (2010) argue that organisational culture is often cited as a primary

reason for the failure of organisational change. A detailed literature examines organisational change (e.g. Van De Ven and Poole, 1995), looking primarily at the organisation as a whole rather than the individual.

Baumgartner and Zielowski (2007) and Linnenluecke and Griffiths (2010) both discuss Schein's topology of organisational culture, which describes three levels of cultural evidence, moving from observable culture to espoused values and to underlying assumptions. Baumgartner and Zielowski (2007) argue that challenging an underlying assumption will release fear and defensiveness, so the level of observable culture is easier to address. Linnenluecke and Griffiths (2010) identify a similarity between Schein's topology and three levels at which organisations may adopt corporate sustainability principles: the surface level visible in technical solutions and published reports, the value level seen through changes in employees' beliefs and values, and the underlying level requiring changes in core assumptions. This suggests that change will be imposed on the different levels of the organisation, leading to changes in ideas. Individuals, this suggests, will be changed by the organisation, rather than the organisation changed by individuals.

One implication of this view is that the values of the individual employee are related to the values of the organisation as a whole. Indeed, if leaders' values and behaviours can 'cascade down' through an organisation as Ramus and Killmer (2007) intimate, this suggests that all levels of the organisation, and the individuals within that organisation, have (or, perhaps, ideally will have) some level of shared or common values. Yet the organisation is not the only influence on the individual employee, and the individual employee may hold views or attitudes that contradict the espoused values of the organisation.

Change could also come through employee-led interventions. Nye and Hargreaves (2010) describe one company's behaviour change program which encouraged individuals to discuss environmental problems and develop workplace actions. They compare this Environment Champions program to an Eco Teams program targeting behaviour within the home. Nye and Hargreaves (2010) conclude that, while involvement with Eco Teams was an exercise in resistance to less 'green' establishment behaviour, Environment Champions became an exercise in compliance, by encouraging conformity with changing norms and social practices.

The significance of norms within organisational settings is explored by Andersson et al (2005), who apply adapted elements of a behavioural studies approach (Stern et al.'s (1999) Values-Beliefs-Norms theory) to examine perceived organisational values and beliefs about the corporation. Corporate values indicating a commitment to environmental sustainability are an important factor in the performance of pro-environmental behaviour by individual employees

(Cordano and Frieze, 2000; Ramus and Steger, 2000). Andersson et al.'s (2005) findings suggest that individual employees' perceptions of the organisation's values and beliefs, which could be expected to influence behaviour, did not have the same impact on their behaviour as their own values and beliefs on independent actions. This suggests that the organisation is not the only influence on individual behaviour within organisational settings. Behavioural studies taking account of multiple influences may be able to better explain that behaviour than studies focusing on organisational factors alone.

2.2.3 Individual and group behavioural approaches

An approach frequently used to examine environmental impact from the perspective of individual behaviour is that of behavioural studies, informed by environmental and social psychology. Much of this research focuses on behaviour within households or other settings (Steg and Vlek, 2009), but a smaller body of literature addresses individual behaviour within organisational settings (Lo et al., 2012). Such studies seek to identify factors influencing individual behaviour, including both conscious decision-making and more automatic, unconscious behaviour. Clayton and Brook (2005) argue that studies of environmentally-significant behaviour from a behavioural perspective include a desire not just to understand behaviour, but also to change it. This field, sometimes referred to as conservation psychology, is related to environmental psychology, which examines the relationship between an individual's environment and their behaviour, and to social psychology's interest in the impact of situational context on behaviour.

During the 1970s and 1980s many studies in this field were exploratory in nature (as discussed by Bamberg and Schmidt, 2003). Marans and Lee (1993) describe a shift in the 1980s from examining whether attitudes relate to behaviour to examining whether attitudes and behaviour co-vary (whether they change together). Bamberg and Schmidt (2003) describe that during the 1990s there was a move towards applying well-established social-psychological theories such as the Norm Activation Model (Schwartz, 1977), the Theory of Reasoned Action (Ajzen and Fishbein, 1980), and its successor the Theory of Planned Behaviour (Ajzen, 1991). More recent theoretical work has specifically addressed environmentally-significant behaviour through theories such as Values-Beliefs-Norms (Stern et al., 1999), or by integrating different theoretical approaches, to evaluate influences on behaviour and interventions to change behaviour (Steg and Vlek, 2009).

Individual behaviour is influenced by the context in which it takes place, whether that is a physical or interpersonal context. Within an office, an individual's behaviour may be influenced by the attitudes, behaviours or perceived norms of their peers. In addition, the individual is fulfilling a particular role within the organisation and may perceive different behavioural

expectations from that organisation. Baumgartner and Zielowski (2007) argue that every group or human society uses a variety of mechanisms to coordinate individual actions. Social mechanisms, they argue, serve as social adhesives within human organisations, and are based on common assumptions, shared values and norms, and the same ways of interpreting and rules of communication. These social mechanisms are important within organisational settings, where norms of behaviour may mean that individuals behave differently compared to in other settings.

The individual behavioural approach of conservation psychology is attractive for examining individual behaviour within offices because much of the existing work, largely in household contexts, seeks ways to change that behaviour (Steg and Vlek, 2009). By using a similar approach within offices, research can identify behaviour change interventions in other contexts that have successfully targeted factors identified as important. For this to be successful, however, behavioural studies within organisational contexts need to take account of the additional influences of interpersonal and organisational expectations.

2.3 Defining individual environmentally-significant behaviour

Stern (2000) defines environmentally-significant behaviour by 'the extent to which it changes the availability of materials or energy from the environment or alters the structures and dynamics of ecosystems or the biosphere'. This definition emphasises the impact of the behaviour rather than the intent that underlies it. For research that aims to alter behaviour in order to reduce energy demand, this emphasis is important; this suggests that researchers should not look for the behaviours that are easiest to change, but for behaviours that, if changed, will have a sizeable effect on the amount of energy used.

There are five main groups of behaviours examined by research into individual environmental behaviour: energy demand and efficiency; waste and recycling; travel mode choice; political activism and support for social movements; and purchasing behaviour and 'green' consumerism. The focus of this research is on energy demand, but previous research conducted into the other groups of behaviours can also provide useful insights for this research.

Much of the research into individual energy demand and efficiency behaviours has focused on households (Steg et al., 2005; Abrahamse et al., 2007; Owens and Driffill, 2008), although some examines energy demand behaviour in organisational settings (Siero et al., 1996, Scherbaum et al., 2008). Similarly, research into individual waste and recycling behaviour has focused primarily on households (Guagnano et al., 1995, Carrus et al., 2008, Oom Do Valle et al., 2005)

although some examines an organisational context (Lee et al., 1995; Tudor et al., 2007a). A substantial literature examines commuting behaviour (Bamberg and Schmidt, 2003; Wall et al., 2007; Abrahamse et al., 2009), and compares travel mode choice for work and leisure journeys (Anable and Gatersleben, 2005), but only limited research specifically addresses business travel. Political activism and support for social movements includes active support for or involvement in environmental campaigns or social or political movements (Stern et al., 1999; Vaske and Donnelly, 1999, Nilsson et al., 2004). Ramus and Killmer (2007) examined such behaviours by employees as extra-role activities. Purchasing behaviour and 'green' consumerism includes one-off purchases such as installing energy-efficient domestic heating systems (Black et al., 1985) and other consumer or lifestyle choices (Shove and Warde, 1998; Gilg et al., 2005; Hansla et al., 2008). Within an organisation, such behaviours might be part of a particular employee's role, but may not be carried out by more general employees.

Based on the results of two studies, Dietz et al. (1998) and Stern et al. (1999), Stern (2000) identifies and describes four classes of pro-environmental behaviour:

1. Environmental activism, e.g. active involvement in environmental organisations or demonstrations;
2. Non-activist public behaviour, including support or acceptance of public policies such as environmental regulations or taxes;
3. Private-sphere environmentalism, including the purchase, use and disposal of household products;
4. Other environmentally-significant behaviour including behaviour within organisations.

This final category is of particular importance for examining how individual behaviour can contribute to the 'greening' of organisations, as it identifies that individuals may affect the environment by influencing organisations to which they belong, or by how they carry out their role within an organisation. While the other categories are distinct, however, many behaviours within organisations could fit into more than just this fourth category. 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. 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); energy demand (e.g. Abrahamse et al., 2005); and travel mode choice (e.g. Bamberg and Schmidt, 2003; Anable and Gatersleben, 2005). Much of this research is conducted in household settings, where individual control over performance is likely to be relatively high. While even in households most individuals do not have complete autonomy –

people they live with may influence or constrain their behaviour, or finances, time or the provision of facilities might affect their choices – it is still likely that an individual will have greater control over these behaviours in their own household than in the context of a workplace.

Stern (2000) argues that the first three classes of behaviour can be divided into two further categories, of public-sphere behaviour (environmental activism and nonactivist public behaviour) and private-sphere behaviour. While public-sphere behaviour has the potential to have a significant impact on its own, for example by altering public policy, Stern (2000) argues that private-sphere behaviour only has a significant impact in the aggregate, when large numbers of people carry out or refrain from a particular behaviour. The distinction between private and public behaviour is not as clear within organisations. While some behaviours, such as influencing the policies of the organisation, may be like public-sphere behaviours, others, such as individual energy-saving actions, are similar to private-sphere behaviours in that they stem from individual decisions and only have influence in the aggregate. In an organisational context such as a workplace, the individual may control the performance of the behaviour in the moment of acting, but may be less able to alter their circumstances to make a behaviour possible or easy (for example, they can choose whether or not to turn off a light if there is a switch, but are probably unable to install different lighting controls). This raises the question of whether such behaviours can be characterized as private-sphere within an office setting. Is recycling or energy use behaviour fundamentally different when performed in an office rather than a household? This would suggest that context is fundamental to how individuals perceive environmentally-significant behaviour. Such a finding would be important for understanding how to change individual behaviour within organisations.

2.3.1 The relationship between attitudes and behaviours

Much of the research into individual environmentally-significant behaviour focuses on the relationship between people's attitudes and their behaviour (Gardner and Stern, 2002). Consistency between attitudes and behaviour is frequently assumed, and many interventions have been based on the idea that changing attitudes will lead directly to behaviour change. There is support for this notion: Festinger (1957) asserts that cognitive dissonance, where people's behaviour does not match their attitudes, is an active force that individuals try to reduce or avoid. Marans and Lee (1993) argue that, while inconsistencies exist between attitudes and behaviours, most people behave according to their attitudes.

Recent research has focused on a perceived gap between people's attitudes and behaviours. There is disagreement about the nature of this gap. Many researchers have identified that levels of pro-environmental action in society do not reflect the levels of concern and support for environmental issues expressed in surveys (e.g. Barr, 2004; Nordlund and Garvill, 2002; Tudor et al., 2007b). However, Ajzen and Fishbein (2005) argue that attitudes predict behaviours when there is a similar specificity between the attitude and the behaviour: general environmental attitudes will predict general environmental behaviours, while attitudes towards specific behaviours will predict those specific behaviours. Kaiser et al. (2010) question whether there really is a separation between attitudes and behaviours and argue that many 'gaps' can be explained by problems with measuring attitudes and behaviours. For studies of environmentally-significant behaviour, it is useful to match specific attitudes to specific behaviours to gain a deeper understanding of the dynamics of influences on individual behaviour. Given the differences that organisational contexts are demonstrated to make to the nature of these behaviours, and on factors influencing these behaviours, it seems that specificity in the context of behaviours being studied is also desirable.

Nordlund and Garvill (2002) suggest that one reason for this apparent gap between general attitudes and specific behaviour is a conflict between immediate individual and long-term collective interests. A number of researchers (e.g. Biel and Thøgersen, 2007; Joireman et al., 2001) argue that pro-environmental action is an example of social dilemmas where people face a choice between maximising their own short-term interests or maximising long-term collective interests. Bicchieri (2002) describes two types of social dilemma: the public goods dilemma in which individuals must contribute to the provision of a public good; and the common resource dilemma in which groups share a scarce resource. Perhaps the best known of this latter type is Hardin's (1968) Tragedy of the Commons. Hardin argued individuals would be compelled to increase the size of herds kept on common land to gain individual advantage despite this leading to exhaustion of the common resource. However, Gardner and Stern (2002) argue that historical examples show that collective rules and norms of behaviour develop in such scenarios, while Bicchieri (2002) argues that, despite rational self-interested individuals being predicted to act in individual self-interest, social dilemma experiments show consistent cooperation rates of 40-60%. Biel and Thøgersen (2007) argue that individuals will look for cues to interpret a situation, and that personal norms can act as default social rules in social dilemma situations.

Joireman et al. (2001) describe two dimensions within the decision to engage in pro-environmental behaviour: a social dimension, representing a conflict between individual and collective interests; and a temporal dimension, representing a conflict between immediate and delayed consequences. Individual action required to mitigate climate change can be interpreted as

a social dilemma including these social and temporal aspects. Not only do large numbers of individuals need to act in the collective interest for aggregate behaviour to be significant, but they need to act even though positive consequences of their behaviour are delayed into the future, and negative consequences (e.g. cost or inconvenience) are experienced in the present. In addition, future consequences may be the absence of an effect: avoiding potential future harm, rather than achieving positive improvement.

A similar social dilemma exists in relation to the depletion of fossil fuel reserves. It is in the collective interest to use them sparingly, but this requires collective agreement. Again, individuals face the dilemma of whether to reduce their own use when, without a collective effort, this may cause them inconvenience without significantly affecting overall consumption.

2.4 Factors influencing individual environmentally-significant behaviour

Bamberg (2003) identifies that much of the research carried out into environmentally-significant behaviour in the two decades before the early 1990s assumed that people's behaviour in environmentally-related domains was directly and strongly influenced by their degree of environmental concern. There was little evidence for this, Bamberg (2003) argues, and gradually scepticism of this relationship developed, with environmental concern now often either substituted by behaviour-specific attitudes, or influencing only symbolic 'low-cost' behaviours such as voting (e.g. Diekmann and Preisendorfer, 2003).

Lee et al. (1995) argue that environmentally-significant behaviours are likely to have multiple antecedents, and that different environmentally-significant behaviours are likely to have distinctly different antecedents. For Stern (2000), different types of causal variables are important for different behaviours. Researchers have identified a wide range of factors that may influence environmentally-significant behaviour, including socio-demographics, situational characteristics, prior awareness and experience of the behaviour, environmental values, and the effect of psychological variables on perception (Clayton and Brook, 2005; Barr, 2007). Clayton and Brook (2005) focus on the impact of situational context and argues that past experiences, knowledge and motivations influence behaviour by changing the actor's interpretation of their context. They describe behaviour as a function of current context, past experiences and knowledge, and fundamental motives such as control and belonging.

Bamberg and Moser (2007) carried out a meta-analysis of four psycho-social determinants of pro-environmental behaviour originally identified by Hines et al. (1987). These are attitude, locus of control/self-efficacy, moral responsibility, and behavioural intention. Bamberg and Moser (2007) identify a high level of association between these factors and the performance of environmentally-significant behaviour. For behaviour in an organisational setting, it seems possible that locus of control and self-efficacy may be particularly important for individuals.

Stern (2000) describes four types of causal variables:

- Attitudinal factors including norms, beliefs and values;
- External or contextual factors;
- Personal capabilities;
- Habit or routine.

Stern argues that these causal variables work differently to influence behaviour, and that different causal variables are important for different behaviours. Studies that only focus on attitudinal or on contextual factors, Stern argues, will only get limited results. The literature examined in this review supports this contention. In organisational contexts, it seems that setting, and individual, interpersonal and organisational influences on behaviour interact. Research focusing only on one element may develop useful insights about that element, but it is interaction between elements that shapes individual behaviour in an organisational context.

The range of factors that may influence environmentally-significant behaviour is large. However, examination of the literature on each factor suggests that it is possible to group them broadly under the four headings identified by Stern (2000). In addition, the organisational context suggests that whether an individual has control over behaviour, and their perceptions about that control (Hines et al., 1987), may also be important. This section, then, examines five groups of factors in greater detail: personal capabilities; habit and routine; attitudinal/psychological factors; control factors; and contextual factors. Table 2.1 presents further details of the factors in each group, and these factors are discussed below.

Type of factors	Group	Detail of factors
Personal capabilities	Knowledge	Awareness of consequences of behaviour (Schwartz, 1977) Knowledge about energy consumption issues or alternative behaviours (Gardner and Stern, 2002) Control over equipment/access to facilities (Gardner and Stern, 2002) Physical capabilities, e.g. disabilities, skill levels (Gardner and Stern, 2002)
	Facilities	Access to or provision of facilities (Gardner and Stern, 2002)
	Personal capabilities	Physical capabilities e.g. disabilities, skill levels (Gardner and Stern, 2002)
Habit and routine	Habit and routine	Prior experience of desired behaviour (Lee et al., 1995) Current habitual and routine behaviour (Ouellette and Wood, 1998) Effect of infrastructure & hardware (Shove and Warde, 1998)
Psychological/ attitudinal factors	Worldviews	Egocentric, homocentric, biocentric (Stern et al., 1993) New Ecological Paradigm (Dunlap et al., 2000) Religious beliefs (Clayton and Brook, 2005)
	Value orientations	Self-transcendence, self-enhancement, openness to change, traditional values (Schwartz, 1992) Pro-self and pro-social (Joireman et al., 2001)
	Environmental beliefs	General environmental concern (Bamberg, 2003) Specific beliefs about behaviours (Bamberg, 2003)
	Norms	Social (within a group/society) (Schwartz, 1977; Biel and Thøgersen, 2007) Personal (set for oneself) (Schwartz, 1977) Subjective (social norms as perceived by actor) (Ajzen, 1991)
	Moral considerations	Altruistic behaviours, moral obligation (Schwartz, 1977) Ascription of responsibility to act to oneself (Schwartz, 1977) The environment as a 'valued other' (Stern et al., 1999)
Control factors	Actual control	Physical control over environment or equipment
	Control beliefs	Self-efficacy (Bandura, 1977; Owens and Driffill, 2008) Perceived behavioural control (Ajzen, 1991) Diffuse or shared responsibility (Blamey, 1998)
Contextual factors	Situational factors	Socio-demographics, e.g. age, gender, children (Dietz et al., 1998; Stern et al., 1993) Money, inc. financial incentives/penalties (Abrahamse et al., 2005) Time (Gardner and Stern, 2002) Convenience or comfort (Gardner and Stern, 2002) Legal, policy or institutional factors (Gardner and Stern, 2002)
	Nature of the context	Shared, socially constructed environment (Clayton and Brook, 2005) Nature of the setting, e.g. workplace, household Physical environment and control over behaviour

Table 2.1 *Summary of types of factors influencing individual behaviour*

2.4.1 Personal capabilities

There are two primary areas of personal capability that might affect someone's ability to carry out a particular behaviour. They may be physically incapable, either because they personally are not able, for example due to a disability, or because there is a lack of provision for carrying out that activity, for example due to a lack of recycling facilities. Alternatively, they may lack knowledge, including being unaware of the consequences of a particular behaviour, or being

unaware of any alternatives to that behaviour. Research suggests that providing facilities and information alone are not enough to change behaviour (Gardner and Stern, 2002). Making a behaviour easy enough to perform may mean it would not be necessary to change people's attitudes in order for that behaviour to occur (Guagnano et al., 1995), although without an accompanying attitude change, behaviours may not become long-term (Castro et al., 2009). In the context of an office setting, the provision of facilities to be able to perform behaviours such as recycling is an important factor. This relates to issues of control, and to the individual's perceptions of their own control.

2.4.2 Habit and routine

While there is general agreement that habit may play a role in predicting behaviour, there is less agreement about how habit should be defined. Triandis (1977) suggests that habit should be measured by the frequency of the performance of the behaviour, while Ajzen (1991) argues that habit is a separate construction from past behaviour. Steg and Vlek (2009) review findings on the nature of habit, and argue that habitual behaviour is triggered by a cognitive structure that is learned and retrieved from the memory when an individual perceives a particular situation. Habits, they argue, refer to how behavioural choices are made, not their frequency. Such behaviours, they suggest, are generally only reconsidered when the context of that behaviour changes significantly. Such changes could provide an opportunity to change behaviour itself (Verplanken and Wood, 2006; Bamberg, 2006). In an office setting, this might be when an employee starts a new job, or at the time of an office relocation.

2.4.3 Psychological/attitudinal factors

Five groups of psychological and attitudinal factors have been identified from the literature (Table 2.1): worldviews; value orientations; environmental beliefs; norms; and moral considerations. These are discussed in turn below.

Stern et al. (1993) identify three types of worldview. The egocentric worldview prioritizes self-interest over the interests of others, the homocentric worldview prioritizes human interests over the individual and the environment, and the biocentric worldview places an equal or higher value on the natural environment as on individual humans or humanity. Stern (2000) identifies that most people who behave in a pro-environmental manner hold a combination of biocentric and homocentric worldviews, referred to as a social-altruistic worldview. The New Ecological Paradigm (NEP) is a scale determining the extent of individuals' pro-environmental worldview

(Dunlap et al., 2000). Barr (2007) argues that the NEP is established in opposition to the pre-existing Dominant Social Paradigm (DSP). Castro et al. (2009) argue that the DSP can co-exist with new ideas such as the NEP within society and individuals. High levels of agreement with pro-environmental ideas in surveys may be a surface consensus enabled by the possibility of keeping ideas and behaviours uncoordinated.

This goes some way to explaining the attitude-behaviour 'gap' identified in Section 2.3.1. It also supports the notion that the values and beliefs of the organisation are not the only influences on individual behaviour in organisational settings. If a surface consensus may exist without challenging deeper-held beliefs, then an employee's own values and beliefs can co-exist with those of the organisation, even where they are contradictory. If that is the case, then it suggests that the notion that the organisation's leaders' beliefs and behaviours can 'cascade down' through an organisation refers to this surface consensus (Ramus and Killmer, 2007) (see Section 2.2.2). Changing the organisation's values and beliefs alone, then, may not affect the values and beliefs of the individual employees. What is not clear is the implication of this for changing individual employee behaviours in the office: is changing the surface consensus enough to lead to changes in individual behaviour in the office setting?

Nordlund and Garvill (2002) categorise Schwartz's (1992) value orientations (self-transcendence, self-enhancement, openness to change, and traditional values) in two dimensions: openness to change versus conservation, and self-transcendence versus self-enhancement. They argue that self-transcendence forms a dimension of collective interests and self-enhancement one of individual interests. Joireman et al. (2001) identify a similar division between pro-self and pro-social value types, associating pro-self with competitiveness and pro-social with cooperation.

Environmental beliefs refer to beliefs about the environment, specific behaviours and their impact on the environment. This includes environmental concern: beliefs about and attitudes towards environmental problems. General environmental concern is ineffective at predicting specific environmental behaviours (Bamberg, 2003), although some researchers (Stern et al., 1999) argue that it influences specific attitudes, which are good predictors of specific behaviours. Bamberg (2003) argues that only situation-specific cognitions are direct determinants of specific behaviour. Oom Do Valle et al. (2005) found that predictions of behaviour were more accurate when specific attitudes or beliefs were examined. This specificity is important for the examination of environmentally-significant behaviour in office settings.

Different types of norms have been shown to be important influences on behaviour. Social norms are expectations or cues given by a group to guide the behaviour expected from an individual.

These can become internalized as personal norms, resulting in feelings of guilt or pride (Biel and Thøgersen, 2007). Interventions based on normative messages have had mixed success in changing behaviour, with some studies reporting boomerang or rebound effects (Schultz et al., 2007). In a study of household energy use, Schultz et al. (2007) found that descriptive messages giving average neighbourhood energy use produced either desirable energy savings or undesirable increases in energy use, depending on whether households were already high or low energy users. Adding an injunctive message conveying social approval or disapproval eliminated this boomerang effect. The type of norm communicated in behaviour change interventions, then, is important for their success. Examining household recycling behaviour, White et al. (2009) found evidence for the influence of personal and social descriptive norms (based on an individual's own behaviour or the behaviour of their social group), and of personal injunctive norms (based on what the individual approves of), but did not find evidence for the influence of social injunctive norms (based on what the individual thinks other people approve of). White et al. (2009) argue that in group settings, identification with the group is an important factor in the attitude-behaviour relationship. In an office setting, where social effects and the role of the group may be strong, it is likely that norms will have an important influence on behaviour.

Moral considerations are a particular focus of Schwartz's (1977) Norm Activation Theory and, developing from this, Stern et al.'s (1999) Values-Beliefs-Norms Theory. The moral considerations result in altruistic behaviour, defined by Schwartz (1977) as behaviour intended to benefit another, performed as an expression of internal values not for social or material reinforcements. In the context of environmentally-significant behaviour, the 'other' that behaviour is intended to benefit can be the environment, rather than a person. This ties in to the social-altruistic worldview described by Stern (2000), where deep-held and stable beliefs about the world support the protection of valued others, whether those 'others' are people, aspects of society or the natural environment.

2.4.4 Control factors

Actual physical control over the performance of a behaviour is clearly a prerequisite for any examination of the factors influencing behaviour: if lights are controlled automatically and there are no lights switches in an office, all other factors that might influence whether an individual turns off the lights become irrelevant. Assuming the existence of controls or control systems that allow individuals to perform a particular energy saving behaviour, however, it is the individual's perceptions of their own level of control, their control beliefs, which are of interest.

Control beliefs may be influenced by a number of factors. Ajzen's (1991) Theory of Planned Behaviour (see Section 3.3.1) includes the construct Perceived Behavioural Control. This has two aspects: beliefs about the environmental constraints of performing the behaviour (e.g. whether the actor believes there are light switches), and beliefs about personal control over internal resources such as skills, confidence or ability (e.g. whether the actor believes that the lighting controls are too complicated for them to operate) (Armitage and Conner, 1999). The first aspect focuses on the actor's perceptions of their control over the behaviour, rather than the reality of that control. The second aspect, however, relates to Bandura's (1977) concept of self-efficacy, which refers to beliefs about the effectiveness of the actor's performance of a behaviour. Bandura (1977) argues that the actor's belief in their ability to reach a desired outcome directly influences their behaviour. Linked to this is the concept of locus of control (Rotter, 1966), which describes the performance of a behaviour as depending in part on whether the actor perceives the outcome as contingent on their own behaviour, or independent of it. Hines et al. (1987) and Bamberg and Moser (2007) identify the significance of locus of control and more general notions of efficacy to the performance of individual environmentally-significant behaviour. This is not only about whether the actor is able to carry out the behaviour, but whether their performance of the behaviour will lead to the goal; will turning off the office light actually save much energy?

Owens and Driffill (2008) argue that an individual's sense of responsibility to act may also be linked to this more general notion of efficacy. Where individuals perceive that they do not have the responsibility to take action or the agency to have much effect, their behaviour may be restricted by a sense of futility. In settings where the individual has more direct control over and responsibility for behaviours, such as a household, individuals may perceive that they have a responsibility to perform or not perform behaviours and act accordingly. Within an office setting, however, responsibility to act may be perceived to belong to employees with particular roles, such as environmental or energy managers, or may be perceived as shared or diffuse, weakening the norms that influence the behaviours (Blamey, 1998). Additionally, the individual's actual control may be different in an office setting to a setting such as a household. Automated or centralized control systems for lighting, heating and cooling may reduce or remove the individual's control over energy use. Sharing a workspace with colleagues may discourage individuals from altering temperatures or turning off lights to avoid potential conflict.

The sense of futility at a lack of agency described by Owens and Driffill (2008) may also arise from the aggregate nature of many curtailment behaviours. Where behaviours only have a sizeable effect on energy demand in aggregate, individuals may question the efficacy of their own part (Barr, 2004; Gifford, 2008; Owens and Driffill, 2008). If the impact of one individual's

behaviour is small, whether they actually perform the behaviour may seem unimportant, discouraging them from enacting the behaviour despite their attitudes or intentions supporting it.

2.4.5 Contextual factors

Two groups of contextual factors are identified in Table 2.1: situational factors, and factors relating to the nature of the context. Stern's (2000) classification of 'other external or contextual' factors includes factors that might affect an individual's attitudes towards performing a behaviour, or that might encourage or constrain that behaviour in another way, included here as situational factors. This review differentiates these factors from a second group of factors arising from the nature of the context itself. For this second group of factors, context is an overarching environment in which the behaviour occurs, with both objective and psychological aspects that constrain and shape behaviour.

Socio-demographic situational factors affecting environmental attitudes, beliefs and behaviours include age and educational achievement (Dietz et al., 1998), cultural and socio-structural issues around gender (Stern et al., 1993), and consumer issues around gender (Diamantopoulos et al., 2003). Situational factors centred around cost (financial, time or comfort) may be very different within an organisation to within other contexts such as households. In the case of financial cost, Siero et al. (1996) argue that because expenditure affects a householder more directly than an employee within an organisation, it is not possible to generalise from the behaviour of a householder to the behaviour that same individual would perform in an organisational setting. This emphasises expenditure as a major influence on behaviour, but recognises that financial costs borne directly by householders are only borne indirectly by individuals in organisational settings, through the effect of financial considerations on the organisation's operations. Furthermore, other cost factors (time, convenience, comfort) may also be affected by an organisational setting. While it seems logical that an employee would seek to enact behaviours that made the best use of their time, or that were most convenient or comfortable, other influences such as established patterns of working, or policies established by management, might override the behaviour they would otherwise choose. This might result in behaviour with a more negative impact on the environment, or more pro-environmental behaviour.

Clayton and Brook (2005) argue that the context of behaviour includes the influence of other people, and is partly informational and partly normative. Context is objective, constraining and shaping behaviour, but also psychological, affecting perceptions of expectations of behaviour. For Clayton and Brook (2005), people's interpretation of context is influenced by past experience

and stored knowledge. They argue that the environments people act in are not just a physical reality, but also a social construct whose meaning needs to be learnt. In the case of an organisational setting such as an office, this is clear: when people commence employment, their first few days or weeks are often spent learning how the new workplace operates and adjusting their own behaviour and routines.

The overarching nature of this interpretation of context is perhaps clearest in the physical location or setting in which a behaviour occurs. In the setting of an office, the context includes the organisation that employs the individual, with its expectations, policies and practices, as well as the shared nature of the office environment. The physical environment of the office, and in particular the levels of control that an individual has over their own energy demand behaviour, is also an important aspect of that context. The next section examines previous research which illuminates individual-level energy demand behaviour in this context in greater detail.

2.5 Individual-level energy demand in office settings

2.5.1 Studies of behaviour in workplaces

Many studies of individual environmentally-significant behaviour focus on household settings (Abrahamse et al., 2005; Abrahamse et al., 2007; Carrus et al., 2008; Oom Do Valle et al., 2005), while a smaller number look at community effects and interventions (Hopper and Nielsen, 1991; Staats et al., 2004). Another setting is a university, with studies examining student behaviour (Bamberg and Schmidt, 2003; Boyce and Geller, 2001), a mixture of student and employee behaviour (Wall et al., 2007), university employee behaviour (Scherbaum et al., 2008) or the university as an organisation (Ógallachoir et al., 2007). Some work has examined comparative feedback on energy use behaviour in industrial settings (Siero et al., 1996), and into waste management among UK health workers (Tudor et al., 2007a, 2007b). A small body of work examines individual environmentally-significant behaviour in an office setting: recycling in offices (Marans et al., 1993; Lee et al., 1995), energy use by university office workers (Scherbaum et al., 2008) and in public buildings (Matthies et al., 2011), and the implementation of an environmental champions program in an office building (Nye and Hargreaves, 2010).

Scherbaum et al's (2008) study uses Stern et al.'s (1999) Values-Beliefs-Norms theory as a framework to explore factors influencing energy use behaviours among office-based university employees. They found that personal norms were significant predictors of pro-environmental behaviours by individual office workers; the aims and values of the organisation do not dictate

how the individual behaves. Workplace behavioural interventions, this suggests, should attempt to modify employees' personal norms to encourage them to act in a more pro-environmental manner. However, a study of office-based recycling in Taiwan (Lee et al., 1995; Marans and Lee, 1993) found that organisational support for and commitment to recycling can directly affect the performance of the behaviour without altering personal norms. These findings are supported by Tudor et al.'s (2007b) study of recycling behaviour among UK health workers. The key factor that Tudor et al. (2007b) identify that links the intention to perform pro-environmental behaviour to the actual performance of that behaviour was the employees' underlying belief systems and attitudes. This literature suggests that the organisation has a role in encouraging pro-environmental behaviours from its employees, but that this cannot be divorced from the effects of individual beliefs and attitudes.

2.5.2 Influences on behaviour across categories and contexts

A number of researchers have considered whether behaviour in one setting, such as the household, can predict behaviour in another setting, such as the workplace. Siero et al. (1996) argue that it is not possible to generalise from household energy saving behaviour because expenditure is experienced more directly by the household, while employees only benefit indirectly from energy saving at work. However, this suggests that cost is an overriding factor in the decision process, while the previous discussions presented in this chapter suggest that there are multiple influences on behaviour.

Other researchers have identified prior experience of a behaviour as another factor prompting the performance of behaviours in different settings. Examining recycling behaviour in an office setting, Lee et al. (1995) found that employees who actively recycled at home were more likely to recycle at work than colleagues who did little recycling at home. In a hospital context, Tudor et al. (2007b) identified similarities between items respondents reported recycling in the workplace and those they reported recycling at home. A study of textile recycling (Daneshvary et al., 1998) found that active home recycling influenced active recycling at work. Tudor et al. (2007b) 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 domain and action in another implies a 'behavioural snowball effect', with participation in one behaviour leading to uptake of others. This effect has also been described as 'spillover' (Thøgersen and Ölander, 2003), and has proved a popular concept in public behaviour

change campaigns (Thøgersen and Crompton, 2009). Many 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. Research examining the concept of self-construal suggests that performing pro-environmental behaviours may encourage people to see themselves as pro-environmental, and so encourage them to perform other pro-environmental behaviours to maintain consistency with this self-construal (Arnocky et al., 2007). However, Thøgersen and Crompton (2009) are critical of this view of spillover, arguing that small changes do not encourage people to make further changes, and in some cases can be used to justify the performance of behaviours causing greater harm to the environment. Despite these reservations about spillover, there is evidence that behaviour requiring similar taxonomic categories such as time, space and skill level tend to be strongly correlated (Thøgersen and Ölander, 2003). This suggests that the idea of situational cues linking behaviours might have a broader significance. In particular, situational cues that trigger the performance of behaviours (such as finishing a task, or leaving a room) may prove to be particularly important.

The earlier discussion of Stern's (2000) classification of four categories of environmentally-significant behaviours (Section 2.3) has already identified a potential crossover between private-sphere environmentalism and behaviour within organisations. If further connections between these categories could be identified, and if from that the mechanism could be identified by which the performance of one behaviour could influence another behaviour, or a similar behaviour in another context, this would be valuable for future attempts at changing behaviour, whether in organisational contexts or in public behaviour change campaigns.

2.6 Summary of literature review findings

This chapter has provided a review of the key literature that underpins this research. It began by examining the main approaches to this topic utilised by different disciplines, particularly from technical and building management, organisational, and individual and group behavioural perspectives. The review then narrowed its focus to examine individual-level approaches to the topic, particularly from social psychological and environmental psychological approaches, sometimes described as conservation psychology.

The review identified that, while behaviour in organisational settings is oftened defined as separate to that of individual behaviour in settings such as households, there are common elements to behaviours in both settings. Factors influencing individual environmentally-significant behaviours included psychological/attitudinal influences such as norms, beliefs and

values; external or contextual factors; personal capabilities; and habits or routine. Relationships between attitudes and behaviours were explored, revealing that employees' values and beliefs can co-exist with those of the organisation, even where they appear to contradict each other.

A key factor identified by the review was control over the performance of a behaviour. This included perceptions of control, perceptions of the efficacy of acting, and actual control. Perceptions of control and of the efficacy of acting were found to be linked to individuals' perceptions of their responsibility to act. For an office setting, diffuse or shared responsibility to act might have a negative effect on people's behaviour. Actual control over the performance of a behaviour was also related to the context in which a behaviour took place. Context included situational aspects, such as socio-demographics, issues of cost and social or organisational factors, as well as the physical setting in which a behaviour occurred. For energy demand behaviour in an office setting, the physical environment (and consequent levels of individual control over energy demand), the influence of the organisation (including expectations, policies and practices), and the shared nature of the office environment were all recognised to be important.

Previous studies of individual environmentally-significant behaviour in office settings supported the earlier finding that employees' own values and beliefs can co-exist with those of the organisation, but further revealed that personal norms were particularly influential on individual behaviour in office settings. The literature was inconclusive as to whether changing the surface consensus within an organisation was sufficient to change individual employees' behaviour, or whether individual attitudes or values also needed to be changed.

Examination of the literature revealed uncertainty about whether or how the performance of one behaviour influenced the performance of other behaviours. There was some evidence that behaviours sharing situational cues, or behaviours that the actor had prior experience of, might be performed across locations. However, there was disagreement about the existence of the phenomenon of 'spillover', whereby the performance of one pro-environmental behaviour led to the performance of other pro-environmental behaviours. Such a question illuminates the relationship between behaviours performed in the office and home setting.

2.6.1 Gaps in the literature

This review has identified three main gaps in the current literature which this research can address. The first gap addresses the relationship between individuals and the organisation, and how these relate to other influences on individual employees' attitudes and behaviours. This

raises two questions: how far individual energy use within organisational settings is influenced by individual employees' motivations or by the expectations of the organisation; and whether the organisation can influence individual behaviour without changing employees' attitudes or personal norms. Both of these areas reflect the social and organisational elements present in an office location, and raise questions about the effects of social and group norms and organisational expectations on behaviour. This gap relates to Objective 1 of this research, to identify contextual, organisational, social and psychological/attitudinal influences on energy use in office settings, and to Objective 4 of this research, which evaluates how well existing social psychological models of individual behaviour explain how these factors influence behaviour. The research addresses these questions through the questionnaire survey, which particularly examines individual factors but also brings in social factors, and through subsequent interviews, which explore individual employees' perceptions of social influences on attitudes and behaviour.

The second gap focuses on the connections between similar behaviours performed in different settings, through situational cues predicting or influencing specific behaviours, or through the related concept of 'spillover'. This gap relates to Objective 2 identified for this research, which is to investigate the connections between similar individual energy demand behaviours performed in different settings. The research included a comparison of work and home-based attitudes and behaviours, examined in both the questionnaire and the subsequent interviews.

The third gap identified is the role of actual and perceived control over energy use by individuals. This is an under-researched area that can provide useful insights into energy use behaviour. Actual and perceived control are frequently examined separately, but by bringing the physical and psychological elements of control together, new insights may be developed about the barriers that people perceive towards performing energy-saving behaviours in a social context, and about the effect that a lack of control over energy use in one context might have on the performance of similar behaviours in another context. This relates to Objective 3 of this research, to investigate the roles of actual and perceived control over energy use in the performance of individual energy use behaviours. These issues are examined in the questionnaire and in-depth interviews.

This chapter has reviewed literature that underpins this research, discussing approaches adopted by different disciplines and identifying that those used in environmental psychology are appropriate to this study. The chapter identified several areas where this research can make an original contribution to knowledge, and related these areas to the overall aim and objectives of the study, and the methods to be used to examine them. The next chapter outlines the methodological approach and discusses the theoretical viewpoints which underlie this research.

Chapter 3: Methodology

3.1 Introduction

Chapter One outlined the background to this research study and its aims and objectives. The review of academic literature in Chapter Two provided an overview of different disciplinary approaches to the topic of individual energy demand in office settings, and discussed the existing research in this area that uses an attitude-behaviour approach developed in environmental and social psychology. This chapter will discuss the main methodological approach used in this research, and how the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999) are utilised. The chapter first outlines the origins of the attitude-behaviour approach (Section 3.2), and will then discuss the two behavioural theories utilised in the study (Section 3.3). Section 3.4 focuses on limitations and criticisms of this approach found within the published academic literature. Section 3.5 discusses the approach utilised in this study and how this transcends some of the limitations of the attitude-behaviour tradition.

At the heart of this research is the relationship between psychological/attitudinal influences on individual energy demand behaviours, the context that the behaviour occurs within, and the performance of the behaviours. In an office setting, individual energy demand is shaped and constrained physically by the buildings and building systems that individuals work within, socially by the shared nature of the workspace and the people it is shared with, and organisationally by the expectations and procedures of the organisation they work for. While the attitude-behaviour approach focuses most obviously on the relationship between individualistic psychological/attitudinal variables and the performance of behaviours, the importance of contextual influences is recognised within this approach, as discussed in Section 3.2 below.

3.2 Attitude-behaviour studies and conservation psychology

Clayton and Brook (2005) argue that studies of environmentally-significant behaviour from a psychological perspective frequently include a desire not just to observe and understand behaviour, but also to change it. This field, sometimes known as conservation psychology, is related to environmental psychology, which examines the relationship between an individual's environment and behaviour, and to social psychology, which is interested in the impact of situational context on behaviour. At the heart of this approach is work centred on the relationship between people's attitudes and the behaviours that they carry out. There is disagreement about the nature of this relationship, and whether particular attitudes do influence particular behaviours.

This is an important debate because many behaviour change interventions assume that changing attitudes will change behaviour. Many researchers have identified that levels of pro-environmental action do not reflect the levels of concern and support for environmental issues expressed in surveys (e.g. Barr, 2004; Nordlund and Garvill, 2002; Tudor et al., 2007b), suggesting that attitudes do not directly predict behaviour. However, Ajzen and Fishbein (2005) argue that attitudes do predict behaviour when there is a similar specificity between the attitude and the behaviour: attitudes towards specific behaviours predict those specific behaviours.

Section 2.2.3 described the development of a behavioural approach within environmental psychology which led to the application of social-psychological or attitude-behaviour theories to environmentally-significant behaviour. These theories were developed to explain the relationships between different external or contextual factors, psychological/attitudinal factors and the performance of a particular behaviour. Many of these theories expanded on Guagnano et al.'s (1995) ABC Theory, which described a relationship between attitudes (A) and external conditions (C) and the effect these have on behaviour (B) (Figure 3.1).

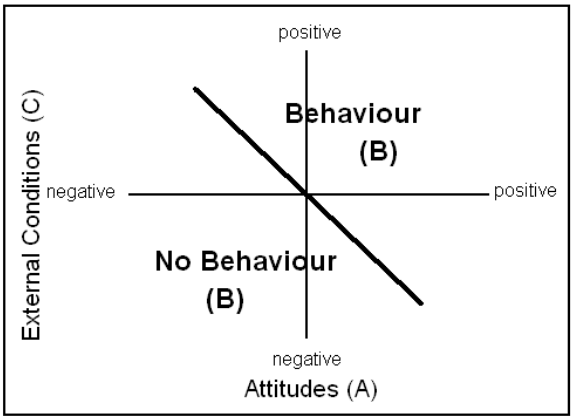


Figure 3.1 *ABC Theory (Guagnano et al., 1995)*

The ABC Theory posits that external conditions can alter attitudinal processes, and that cognitive and social-psychological processes may affect responses to external conditions. The attitude-behaviour relationship is strongest when contextual factors are weak, but when contextual factors are very strongly negative or positive there is little link between attitudes and behaviours. Guagnano et al. (1995) developed this theory from a study of kerbside recycling. When access to recycling facilities was extremely difficult, few people recycled regardless of their attitudes towards recycling, while when access to recycling facilities was very easy, most people recycled regardless of their attitudes. When it was possible but not easy to recycle, the correlation between attitudes and behaviour was strongest.

This describes the relationship at the heart of attitude-behaviour studies, which see behaviour as a product of a combination of external factors (contextual factors) and internal factors (psychological/attitudinal factors). The performance or non-performance of behaviours can be entirely dictated by the physical, social or organisational context (individuals cannot turn off unneeded lights in rooms where manual controls are absent). In other situations, it may not be clear whether it is contextual or psychological/attitudinal factors that influence performance or non-performance (an individual may leave unneeded lights on in a shared office because of their perceptions of colleagues' preferences, or out of habit or custom, or because they do not regard energy conservation as a priority).

Where the individual has higher levels of control over their behaviour (where contextual factors have less influence), the attitude-behaviour tradition suggests that psychological/attitudinal factors such as values, norms, beliefs, habits, and perceptions of the ability to act, have a greater influence on whether that behaviour is performed. However, there are situations where the performance or non-performance of a behaviour appears to be entirely within the individual's control (whether someone in a single-person office with manual lighting control turns off unneeded lights), but individual psychological/attitudinal factors still may not be decisive (they might deliberately leave their lights on to signal to colleagues that they are present, reflecting social norms or practices rather than individual values).

A fuller discussion of the range of possible influences on behaviour can be found in the literature review (Section 2.4). These are grouped as personal capabilities, habit and routine, psychological/attitudinal factors, control factors, and contextual factors.

3.3 Attitude-behaviour theories

The theories developed to explore the relationships between these factors and their influence on the performance of particular behaviours fall into two main groups. The Theory of Reasoned Action (Ajzen and Fishbein, 1980) and the subsequent Theory of Planned Behaviour (Ajzen, 1991) are both rational actor theories, rooted in economic psychology, which posit that people plan to take the course of action most likely to maximise their desired outcomes based on the options, or their perceptions of the options, available to them. Norm-Activation Theory (Schwartz, 1977), rooted in social psychology, was developed to explain altruistic behaviour performed by one individual towards another individual, with a focus on individual values and normative influences, and was adapted and extended to explain pro-environmental behaviour as Values-Beliefs-Norms Theory (Stern et al., 1999; Stern, 2000).

Both groups of theories could help to explain individual energy use in office buildings. Values-Beliefs-Norms Theory has been used once in this context (Scherbaum et al., 2008) and is specifically designed to address environmentally-significant behaviour such as energy use, while the Theory of Planned Behaviour has been more widely used, including in studies of environmentally-significant behaviour in household settings (Steg et al., 2005). Table 3.3 sets out the factors that each theory proposes influence individual behaviour, then summarises the main focus and limitations of the theory.

Theory	**Factors**	**Focus**	**Limitations**
Theory of Reasoned Action (Ajzen and Fishbein, 1980)	Attitude towards the behaviour Subjective norm Intention	Rational actor model, stresses intentions as predictors of behaviour	Assumes rational basis to behaviour. Assumes complete volitional control over performance of behaviour.
Theory of Planned Behaviour (Ajzen, 1991)	Attitude towards the behaviour Subjective norm Perceived behavioural control Intention	Stresses intentions and perceived behavioural control over actual behaviour or control	Assumes rational basis to behaviour. Does not include moral or value-led influences.
Norm Activation Theory (Schwartz, 1977)	Awareness of consequences Ascription of responsibility Personal norms	Role of altruism and norms in the decision to help a valued other	Assumes a unilateral helping relationship with responsibility to act and ability to alleviate need.
Values-Beliefs-Norms Theory (Stern et al., 1999)	Value orientations Environmental worldview (NEP) Awareness of consequences Ascription of responsibility Pro-environmental personal norm	Values and worldviews don't vary much from situation to situation but sense of obligation does	Not been widely used.

Table 3.3 *Main features of attitude-behaviour theories*

3.3.1 The Theory of Reasoned Action and the Theory of Planned Behaviour

The Theory of Planned Behaviour has become one of the most influential and popular conceptual frameworks for the study of human action (Ajzen, 2001). It is based on a 'rational actor' view of human action which assumes that people plan to take the course of action most likely to maximise their desired outcomes. This was first developed into the Theory of Reasoned Action (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980), as presented in Figure 3.2.

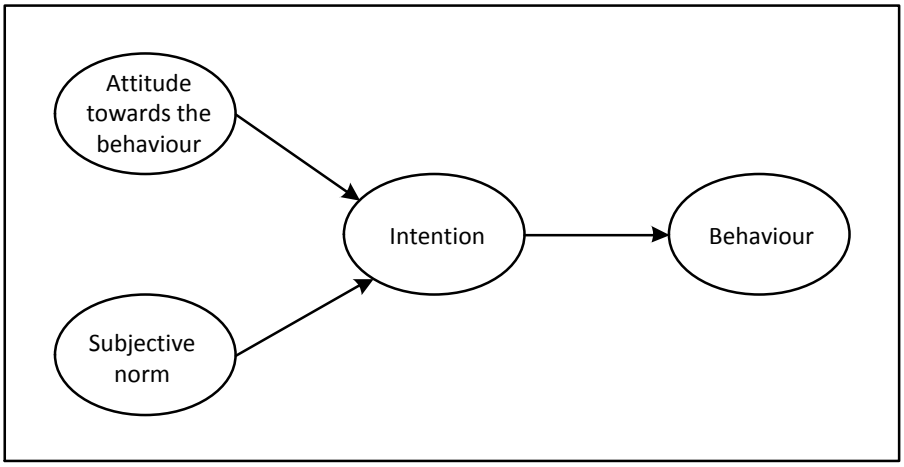


Figure 3.2 *The Theory of Reasoned Action (from Ajzen and Fishbein, 1980)*

The Theory of Reasoned Action proposes that the performance of a behaviour is predicted by the intention to perform the behaviour, which in turn is predicted by the actor's attitudes towards the behaviour and by the subjective norm. In this model, attitudes are formed from a combination of beliefs about the behaviour and evaluations of the behaviour (Fishbein and Ajzen, 1975; Ajzen and Fishbein,1980), and are just one of the influencing variables, rather than a central driving force behind the performance of a behaviour. The subjective norm is also a key concept, appearing in both the Theory of Reasoned Action and the subsequent Theory of Planned Behaviour. In the Theory of Reasoned Action, it is formed from a combination of normative beliefs (based on beliefs about the opinions of referent others) and the actor's motivation to comply with those norms.

A major limitation to the Theory of Reasoned Action, which would eventually lead to the development of the Theory of Planned Behaviour, is its weakness in dealing with behaviours over which the actor has incomplete volitional control (Ajzen, 1991). Sheppard et al. (1988) identify that the Theory of Reasoned Action is not designed for situations where the performance of an action 'requires knowledge, skills, resources, or others' cooperation, or necessitates overcoming environmental obstacles'. In earlier work (Fishbein and Ajzen, 1975; Ajzen and Fishbein, 1980) Fishbein and Ajzen suggest that much of human behaviour is under volitional control, so measures of intention would predict behaviour. Later work, however, acknowledges that control over the performance of a behaviour might be a problem in some situations (Ajzen, 1985; Ajzen, 2002).

Like the Theory of Reasoned Action, the Theory of Planned Behaviour (Figure 3.3) stresses the importance of intention as a precursor to behaviour, and proposes that actions are based on

whether the actor thinks that the behaviour has a positive or negative outcome (Attitude Towards the Behaviour), and on whether they think that other people would want them to carry out the behaviour (Subjective Norm). The construct of Perceived Behavioural Control, which asks whether the actor believes that they are able to carry out the behaviour, is included in the model to address the problem of whether the actor has volitional control over the behaviour (Ajzen, 1991; Ajzen, 2002). Assessment of the effect of the Perceived Behavioural Control construct on a range of target behaviours identifies that including Perceived Behavioural Control enhances the ability to predict both intention and behaviour, with these effects being strongest when the behaviour 'presents some problem with respect to control' (Madden et al., 1992).

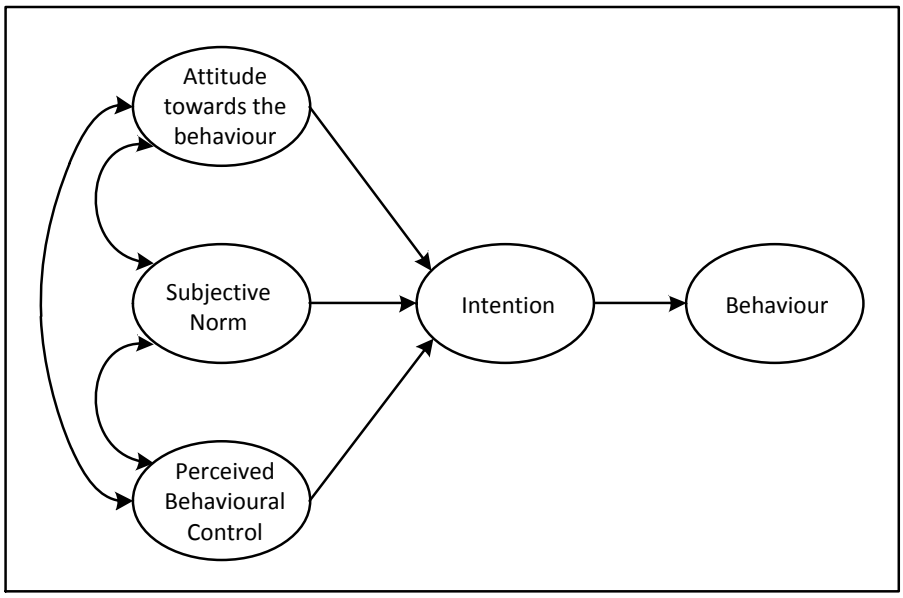


Figure 3.3 *The Theory of Planned Behaviour (Ajzen 1991)*

Ajzen (2002) identifies that concepts related to Perceived Behavioural Control appear in other behavioural models, notably as 'barriers' in the Health Belief Model (Rosenstock, 1988), as 'facilitating conditions' in the Theory of Interpersonal Behaviour (Triandis, 1977), and perhaps most importantly as self-efficacy in the work of Bandura (1977, 1989, 1997). Perceived self-efficacy is 'people's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives' (Ajzen, 2002).

One criticism of the Perceived Behavioural Control construct as conceptualised by Ajzen, discussed by Armitage and Conner (1999), is that it includes both personal control over internal resources such as skills, confidence or ability (relating directly to Bandura's concept of self-efficacy) but also relates to the perception of control over environmental constraints on the behaviour. Sparks et al. (1997) argue that such a distinction is not problematic, as a measure of the 'perceived difficulty' of performing a behaviour captures both concepts. Armitage and

Conner (1999) disagree, arguing that this renders the concept of Perceived Behavioural Control 'vague' and 'subjective', and so can reduce the sensitivity of the Theory of Planned Behaviour. However, the subjectivity of the concept may be necessary, given that it seeks to measure the perceptions of the actor rather than a concrete reality.

Where the Theory of Planned Behaviour differs from other models of behaviour is in its identification of the perception of behavioural control as being of greater psychological interest than their actual control over the performance of the behaviour. For understanding what might motivate one person to act while another does not under similar physical circumstances, this focus on the actor's perception does appear to be more useful.

One area where rational actor models such as the Theory of Planned Behaviour and the Theory of Reasoned Action receive criticism is for their underlying assumption that people make reasoned choices based on the information available to them (see Ajzen, 2011 for a discussion). Factors such as incomplete information of the influence of habit may lead individuals to act in a manner that does not appear rational. However, Fishbein and Ajzen (2010, p.24) clarify that their framework does not assume rationality, encompasses both deliberative and spontaneous decision-making, and assumes that behavioural intentions follow in a 'reasonable, consistent and often automatic fashion' from beliefs about performing the behaviour. Criticisms of the approach are discussed further in Section 3.4.

A further limitation of rational actor models is that they do not include the influence of moral factors such as values, or altruistic or cooperative responses rather than self-interested behaviours. These deep-seated psychological constructs are found in the next group of attitude-behaviour theories to be examined here.

3.3.2 Norm Activation Theory and Values-Beliefs-Norms Theory

The Norm Activation Theory (NAT) (Schwartz, 1977; Schwartz and Howard, 1981) was developed to explain altruistic behaviour performed by one individual towards another individual, and informed the later development of Values-Beliefs-Norms Theory (VBN) (Stern et al., 1999). Schwartz (1977) describes altruism as moral, normative behaviour reflecting individually-held attitudes towards helping others in need. Norm Activation Theory (Figure 3.4) describes a process moving from an initial perception of need through the activation of personal norms and the generation of feelings of moral obligation to an overt response.

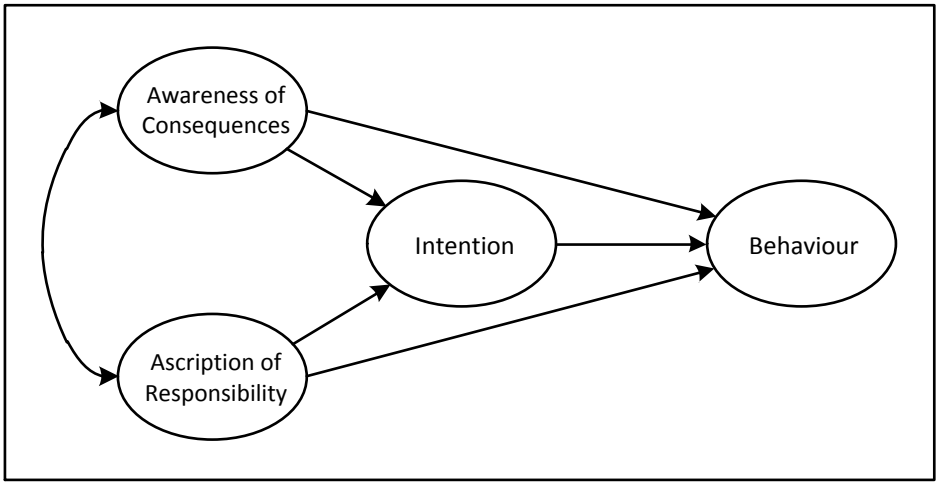


Figure 3.4 *Norm Activation Theory (Schwartz, 1977)*

Schwartz developed Norm Activation Theory with human helpees in mind; that is, with an individual helper offering assistance to another individual human (the helpee). However, researchers have since suggested that the same principles apply to non-human helpees such as the environment (e.g. Stern et al., 1993; Hopper and Neilsen, 1991; Blamey, 1998). Bamberg and Schmidt (2003) argue that research using Norm Activation Theory assumes that people have a general value orientation towards the welfare of others; that is, they are motivated to prevent harm to others. Norm Activation Theory holds that the activation of norms for helping behaviour is most likely when an actor is aware of the positive consequences their behaviour would have for an object in need, and ascribes responsibility to herself or himself for helping (Blamey, 1998).

Hopper and Neilsen (1991) identify that a critical feature of such altruistic behaviour is that while most people would verbally endorse a norm governing a particular moral behaviour, not everyone acts accordingly. Blamey (1998) argues that the unilateral helping behaviour identified by Schwartz (1977) includes a narrowly-defined responsibility to act, with the helper able to directly alleviate the need of the helpee. In the case of public goods such as environmental action, Blamey (1998) argues that direct action is often not possible or practical, responsibility may be shared or diffuse, and the consequences of action may be less certain or less visible. This may be particularly relevant for an issue such as climate change, where action is urged to avoid a potential future harm to unspecified others.

Values-Beliefs-Norms Theory (VBN) (Stern et al., 1999; Stern, 2000) was developed from Schwartz's (1977) Norm Activation Theory specifically to examine environmentally-significant behaviour. Values-Beliefs-Norms Theory (Figure 3.5) presents a series of psychological constructs in a chain, moving from relatively stable values and worldviews to behaviour-specific feelings of responsibility and obligation. As in Norm Activation Theory, key constructs within

Values-Beliefs-Norms Theory are Awareness of Consequences (AC), Ascription of Responsibility (AR) and Personal Norm (PN). For pro-environmental behaviour to take place, the model suggests, the actor must perceive a threat to something that is valued (AC), which could reflect a biospheric worldview (i.e. the threat is to the natural world), a homocentric worldview (i.e. the threat is to human society), or it could be a combination of the two. The actor also needs to feel that it is their responsibility to do something about that threat (AR), and feel a moral obligation to perform a particular behaviour to protect what it valued (PN). A central assumption is that, while values and worldviews do not vary much from situation to situation, an individual's sense of obligation to perform a particular action will vary.

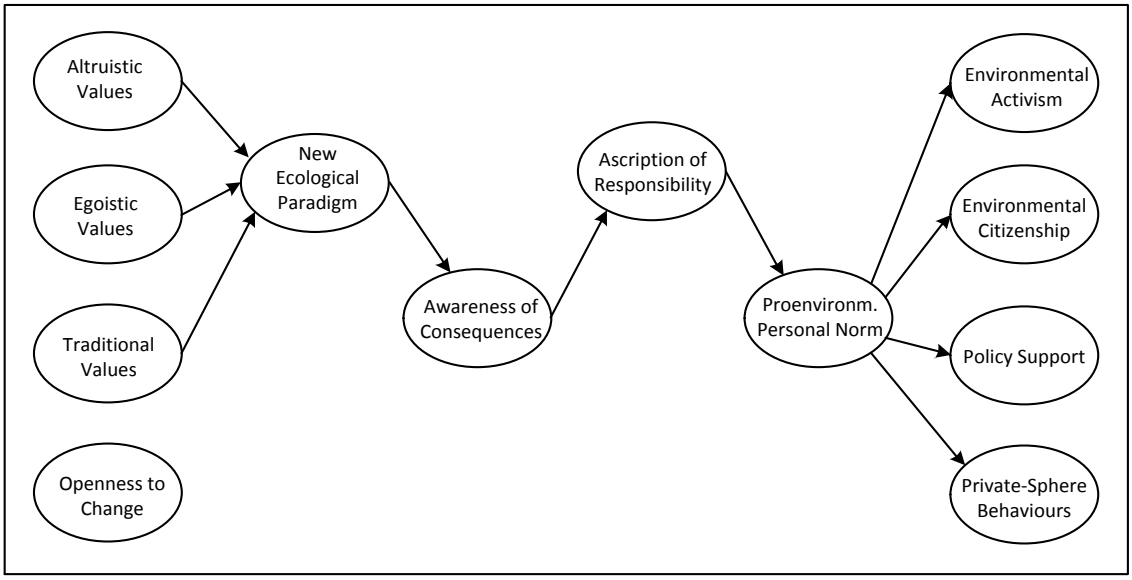


Figure 3.5 *Values-Beliefs-Norms Theory (Stern et al., 1999)*

The theory suggests that the actor needs to feel a responsibility to do something about that threat, and also needs to feel a moral obligation to act. This further suggests that if individuals perceive it is the responsibility of someone else (including governments or companies) to address an issue, they are unlikely to take action themselves. Additionally, Vales-Beliefs-Norms Theory suggests that it is not enough to simply inform people about such threats (targeting the AC construct); for action to occur, people must both take personal responsibility for the problem (targeting AR) and feel obliged to take action to address it (targeting PN).

A major difference between Norm Activation Theory and Values-Beliefs-Norms Theory is that the central relationship between Awareness of Consequences (AC), Ascription of Responsibility (AR) and Personal Norms (PN) and their influence on behaviour is seen as a mediating relationship in Norm Activation Theory, but as a causal chain in Values-Beliefs-Norms Theory. In Norm Activation Theory, Awareness of Consequences and Ascription of Responsibility, while

both correlated, can both influence behaviour independently of each other, both directly and by first influencing Personal Norms. In Values-Beliefs-Norms Theory, however, these form a causal chain, with the actor first becoming aware of the consequences of performing (or not performing) a behaviour, then ascribing responsibility to act to themselves, and then absorbing this into a pro-environmental personal norm, before acting. Steg et al. (2005) found support for the causal version of this relationship found in Values-Beliefs-Norms, and argue that this is more logical, as actors need to be aware of the consequences of an action before they are able to adopt responsibility for performing (or not performing) that action.

Values-Beliefs-Norms Theory has been applied to research less often than other longer-standing theories such as the Theory of Planned Behaviour (Steg et al., 2005). Two of the main applications of the theory have been in research on energy consumption; Steg et al.'s (2005) research looking at the acceptability of energy policies, and Scherbaum et al.'s (2008) research into individual energy consumption behaviour among university employees. Both of these studies found support for the constructs and relationships described by Values-Beliefs-Norms Theory.

This research includes a comparison of the ability of the Theory of Planned Behaviour and of Values-Beliefs-Norms Theory to account for the influences of different factors on the reported performance of energy use behaviours. This will extend the theoretical knowledge in this field by applying these theories in a relatively new context, and by comparing the explanatory power of a less-tested theory (Values-Beliefs-Norms Theory) with a widely-tested theory (Theory of Planned Behaviour). Such a comparison will also provide insights into the comparative importance of different factors believed to influence behaviour across different contexts.

3.4 Epistemology and challenges to the attitude-behaviour tradition

Before embarking on a comparison of the explanatory power of the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999), it is important to consider the assumptions underlying such a study, and in particular, what information the study is expected to provide and the claims that are made for that information. Such questions are addressed by the analysis of the epistemology of a research study.

Epistemology is the theory of knowledge, relating to the claims or assumptions made about the ways in which it is possible to gain knowledge of reality, what can be known, and the criteria such knowledge must satisfy in order to be called knowledge rather than beliefs (Blaikie, 1993). An objectivist epistemology sees meaning and meaningful reality existing independently of any

consciousness (Crotty, 2005); the truth is out there, waiting to be identified. A constructionist epistemology rejects this view of human knowledge, however, arguing that truth, or meaning, comes into existence through people's engagement with the realities of the world: meaning is constructed by people, and can be constructed differently by different people (Crotty, 2005).

A consistently objectivist epistemological approach would distinguish scientifically-established objective meanings from subjective meanings. Crotty (2005) argues that, while this approach would still accept that subjective meanings are important in people's everyday lives, it would nevertheless make people's everyday understandings of the world epistemologically inferior to more scientific understandings by focusing on a search for objective truth outside those understandings. For research examining human behaviour, which may be influenced by people's everyday understandings rather than by objective scientific certainties, approaching this research from an objectivist epistemological position would require careful consideration of how the influence of more subjective understandings could be accounted for within the research.

A consistently constructionist epistemology would put all understandings, whether scientific or non-scientific, on the same footing. This would suggest that all knowledge or meanings were constructions; scientific knowledge itself would merely be a particular form of constructed knowledge designed to serve a particular purpose (Crotty, 2005). The implication of this, Crotty (2005) argues, is that no knowledge is objective, absolute or truly generalisable; quantitative methods may still be used to carry out research, but the claims that could be made about the results produced would seem to be less certain, more provisional, than an objectivist epistemology might suggest.

One of the central issues in the philosophy of science is the extent to which social life can be studied in the same way as the natural world; whether the theories and methodologies of the physical sciences can also be applied to the social sciences (Blaikie, 1993). This is particularly relevant for the attitude-behaviour tradition, which assumes the existence of mental states (or 'attitudes') that are 'long-lived and… relate to behaviour in a systematic manner' (Breakwell, 1993). This suggests that the attitude-behaviour tradition takes an objectivist epistemological position: attitudes are stable and systematic, and can therefore be uncovered by empirical research, as long as the research design has taken sufficient account of the different influencing variables. The extent to which this view of knowledge is assumed within the attitude-behaviour tradition is underlined by the observation that few research papers within this tradition ever state their epistemological positions.

However, there are challenges to and criticisms of the central assumption of the attitude-behaviour tradition that there is a (measurable) relationship between attitudes and behaviours. For most attitude-behaviour theories or models this extends beyond a narrow definition of 'attitudes' to include a range of possible influencing variables, but the central relationship between these and the performance of behaviour remains. There are two main challenges to the dominance of this relationship emerging in the current literature.

Kaiser et al. (2010) question whether there is a separation between attitudes and behaviours, as the models with their causal or predictive relationships suggest. Kaiser et al. (2010) argue that treating the attitude-behaviour relationship as a causal one is a conceptual misunderstanding, and that, as Greve (2001) argues, they are inseparable aspects of a unity – two sides of the same coin. Behaviours, in this view, are simply the embodiment of attitudes; the performance of a behaviour reveals the attitude intrinsic to that performance. Furthermore, Kaiser et al. (2010) argue that many of the 'gaps' identified between measured attitudes and behaviours in the literature (see Section 2.2.1 for a discussion of this 'attitude-behaviour gap') can be explained by the nature of the measurement instruments used. It is easier to state support for a particular behaviour than to carry out that behaviour, they argue; responses to items asking about support for a particular behaviour may actually be measuring the ease (psychological as well as actual) of answering the question, rather than the ease of supporting the behaviour.

Kaiser et al. (2010) are at pains to reassure that their challenge to an underpinning assumption of attitude-behaviour research does not mean that they advocate abandoning psychologically-based explorations of influences on individual behaviour. They argue that empirically meaningful questions remain in identifying influences on the formation of attitudes. Even within this critical view, then, the constructs explored in an attitude-behaviour study are believed to be able to return meaningful insights into the process leading to the performance of a particular behaviour.

A further challenge to the centrality of attitude-behaviour relationships comes from the field of sociology. Researchers such as Shove (e.g. Shove and Pantzar, 2005; Shove, 2010) and Hargreaves (e.g. Hargreaves, 2011) argue that attitude-behaviour studies place too much focus on the individual, and that behaviour needs to be seen as a practice, embedded in a social context. This is more than a difference of emphasis. Shove (2010) argues that in a practice-based approach, people figure as 'carriers of practice', but in an attitude-behaviour approach they figure as 'autonomous agents of choice and change'. Hargreaves (2011), meanwhile, places practice-based theory in opposition to the 'undersocialised methodological individualism' of the attitude-behaviour approach. From a practice-based theory approach, Hargreaves (2011) argues, individuals are removed from centre-stage and become 'carriers' of social practice. The target of

research, interventions and policy, then, is not individual behaviour, but the mechanisms which shape, maintain or challenge practices which are then enacted by individuals.

For Shove (2010), a particular weakness of the attitude-behaviour approach lies in its use to define UK government policy objectives. The focus of the attitude-behaviour approach on individual actors, Shove (2010, 2011) argues, shifts the focus for changing patterns of consumption and environmental impact from the practices of society as a whole (government, business, organisations) to the behaviours of individual actors (individual responsibility). Shove (2010) argues that such an individualistic focus can suit the political climate, and can become self-perpetuating through policy and research funding priorities.

However, not all of these criticisms of the attitude-behaviour approach are accurate. Shove (2010) characterises the relationships within the attitude-behaviour tradition as 'Attitude-Behaviour-Choice', rather than the 'Attitude-Behaviour-Context' formulation that would be more accurate. Shove's (2010) formulation may be accurate for some of the policy developments and priorities Shove cites, but it does not characterise the theoretical basis of the attitude-behaviour tradition outlined in this chapter. An objection to the misapplication of a theoretical stance to a policy environment is not adequate grounds for dismissing the theoretical position itself. Moreover, replacing 'context' with 'choice' fundamentally changes the placement of responsibility for changing behaviour: 'context' implies that it is the physical, social and cultural aspects that shape behaviour that need to be changed, whereas 'choice' implies that behaviour change is a matter of encouraging individuals to make different decisions. The focus on context which is apparent in much attitude-behaviour research, and which is an important feature of this thesis, seems to present precisely the kind of embedded social context that practice-based theory argues for.

Shove (2010) identifies other criticisms of the attitude-behaviour approach which do address more directly the theoretical basis for the approach. It is true that many different researchers have developed lists and categorisations of determinants that could form barriers to or drivers for pro-environmental behaviours; examples of such approaches can be seen in the summaries of influencing factors discussed in Section 2.3. Shove (2010) criticises the lack of rigour with which determinants can be selected for inclusion in studies, and the consequent freedom of policymakers to select or ignore barriers that suit their own approach. However, one advantage of models such as the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999) is that the selection of variables is determined by the theories underpinning the models. Through the original development of theoretical models from empirical data, and subsequent applications and refinements by other researchers using other data, the variables and their relationships within the attitude-behaviour models are rigorously tested. The

problem that Shove (2010) identifies, then, is not a lack of rigour in the models, but a lack of rigour in applying some elements of the models, and in their application to policymaking.

Identifying such weaknesses in criticisms of the attitude-behaviour approach does not address the main difference between attitude-behaviour and practice-based approaches: individual behaviours versus socially-embedded practices. It is true that focusing narrowly on relationships described by particular attitude-behaviour models is not helpful for understanding broader influences on behaviour. The individualistic focus of the attitude-behaviour tradition can be a limitation in some contexts. In an office context, where social and organisational factors may be important, behaviour may be influenced by social norms within groups of colleagues, by the expectations of senior management, or by the goals and values of the organisation. However, these influences are likely to act in combination with the individual's own attitudes, values and beliefs. The Theory of Planned Behaviour (Ajzen, 1991) includes the subjective norm, measuring the actor's perceptions of other people's expectations of their behaviour, while Values-Beliefs-Norms Theory (Stern et al., 1999) only includes the Personal Norm, not any direct measure of social normative effects.

To fully explore factors influencing individual energy demand in office settings, then, the measurement of constructs within attitude-behaviour theories can only form one aspect of the study. A methodology which embraces more than one approach to understanding the behaviours it examines is more likely to offer a comprehensive explanation of those behaviours. The attitude-behaviour tradition is able to explain relationships between variables influencing behaviours at the level of the individual. The research presented here uses an attitude-behaviour approach, but extends it in two ways. Firstly, by using two attitude-behaviour theories, the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999), the research can include both a more rational-actor interpretation of behaviour, and a moral-normative interpretation. Secondly, the research does not rely solely on the influences on behaviour suggested by the theories, but also explores the wider effects of context, in particular social influences (at the level of shared office spaces) and organisational influences (through the perceptions of individual employees and through the policies of the organisation). How this is achieved is described in further detail in Chapter 4.

3.5 Chapter summary

This chapter discussed methodological aspects of this research study, focusing on the centrality of the relationship between psychological/attitudinal influences on behaviour, the context that the behaviour occurs within, and the performance of the behaviour.

The background to the attitude-behaviour approach was presented, and its focus on the relationships between external/contextual factors, psychological/attitudinal factors and the performance of behaviours was described. These relationships were typified by the development of Guagnano et al.'s (1995) ABC Theory, which identified that the attitude-behaviour relationship was strongest when contextual factors were weak, and weakest when behaviour was constrained by contextual factors. The chapter provided a summary and discussion of some of the key contextual and psychological/attitudinal factors identified as influential within the literature.

The two attitude-behaviour theories to be applied in this study were introduced. The Theory of Planned Behaviour (Ajzen, 1991) is a rational actor model based on the earlier Theory of Reasoned Action (Fishbein and Ajzen, 1980). The Theory of Planned Behaviour (Ajzen, 1991) posits that behaviour is directly influenced by the formation of intention, which is in turn influenced by attitudes towards the behaviour, by subjective norms, and by perceptions of control over the behaviour. This final factor, Perceived Behavioural Control, is particularly important as it emphasises interest in the actor's perceptions of their own control rather than the reality of that control. The second theory is Values-Beliefs-Norms Theory (Stern et al., 1999), which was developed from Schwartz's (1977) Norm Activation Theory and emphasises the actor's values, sense of moral obligation, and their willingness to protect valued others (including the environment). Values-Beliefs-Norms Theory presents a causal chain of influencing factors, moving from general values to behaviour-specific attitudes.

The research uses the two theories to explore different influences on individual energy demand in office buildings through a questionnaire survey measuring the elements making up each theory. A comparison of the explanatory power of each theory will add to the understanding in this field by applying the theories in a relatively new context, and by comparing a lesser-tested theory (Values-Beliefs-Norms Theory) with a widely-tested theory (Theory of Planned Behaviour). Such a comparison will also provide insight into the comparative importance of different factors believed to influence behaviour across different contexts. In the following chapter, the methods for data collection and analysis used to carry out the research are discussed.

Chapter 4: Methods

4.1 Introduction

This chapter introduces the methods utilised in this research to collect and analyse data. Section 4.2 outlines the design of the research. Section 4.3 presents the findings of building surveys/tours that took place in the main office buildings and which then informed the design of the rest of the data collection. Section 4.4 describes the development of the questionnaire survey, the measures included in it, and the methods of analysis to be used with the results. Section 4.5 introduces the semi-structured interviews which followed the questionnaire survey. Section 4.6 discusses how the different methods used in this research are brought together, and their presentation in this thesis. Section 4.7 presents a summary of the contents of this chapter.

4.2 Research design

This research focuses on the influences on energy demand behaviour by individuals in the particular context of the office. Local authority offices were selected because, as discussed in Section 1.2.2, the previous UK government had obliged local authorities to reduce energy demand within their own estates, including within their own office buildings. As a result, many local authorities developed policies and strategies to achieve this, and were likely to be willing to take part in research that could help them with this. The decision to include two Councils in the study rather than just one was taken to ensure that a large enough sample could be collected to allow for statistical analysis to take place. Many of the statistical techniques used in this study required several hundred participants in order to have statistical power. Additionally, the ability to compare the two organisations, and the results that each organisation returned, was important for the validation and generalisability of the research findings. Consistency of findings across both organisations would help to justify claims of generalisability, while differences would highlight possible areas for further analysis.

The two participating organisations, Nottingham City Council and Nottinghamshire County Council, were not only selected due to ease of access, but because they shared characteristics that made them a good choice for a comparative study. They are both large Councils providing a similar range of services and employing large numbers of people; in 2011, Nottingham City Council had 12,069 employees (Nottingham City Council, 2012c) and Nottinghamshire County Council had 23,404 employees (Nottinghamshire County Council, 2012a). Many of these employees were not employed in office-based roles, but in roles providing direct services such as

care work, education, maintenance or cleaning. Unfortunately, neither Council was able to provide figures for the proportion of their employees who could be described as office-based, however both had large office buildings to house many of their office-based employees.

While employees from Nottinghamshire County Council were based across the county area, their main office headquarters were on two sites in the urban area of Greater Nottingham: the County Hall complex and Trent Bridge House. The majority of the County Council employees who responded to the questionnaire survey were based in these buildings (226 out of 285 respondents). Both of these sites were located less than two miles from the city centre and only one mile from Nottingham City Council's main office building, Loxley House. This means that the sample of office-based employees for both Councils was drawn from roughly the same population: office-based local authority employees living in or within commuting distance of the city of Nottingham. The sample of participants was limited to those who saw themselves as office-based employees, and so excluded employees in non-office based roles such as teachers and cleaners, but included employees who were based in an office but spent part of the working day out of the office, for example on site visits or at external meetings.

There were three main components to the study design:

1. Initial investigations including collecting corporate documents and conducting surveys of the main office buildings;
2. An online questionnaire survey; and
3. In-depth interviews.

Initial investigations at the two Councils included discussions with employees who had responsibility for energy and building management; collecting and examining documents such as organisational structures, carbon management plans and other relevant policies and strategies; and undertaking surveys of the main office buildings. Discussions about the research study were held with officers from the Sustainability teams at each Council, who have overall responsibility for the design and implementation of the Councils' energy and climate change strategies. These discussions centred on the aims of the research, the main questions that the research would seek to address, and what would be of particular interest to the Councils.

Both Councils were interested in reducing the energy demand from office buildings, through building management and changing the behaviour of building occupants. The County Council was particularly interested in changing specific behaviours, such as reducing the use of portable electric heaters and desk fans. The City Council was particularly interested in the effect that the

recent centralisation of many office-based employees into one modern, centrally-controlled building had had on employee attitudes and behaviour towards energy use. The surveys of the main office buildings took place following these discussions, to develop an initial understanding of the buildings, their energy and control systems, and to identify other issues that were likely to be important to the study. Further details of the building survey are discussed in Section 4.3.

The main part of the study comprised an online questionnaire survey administered to office-based employees at both participating local authorities (one version at the County Council and two versions at the City Council). This questionnaire survey provided primarily quantitative data, to be analysed using a variety of established statistical techniques, but also included a small number of open-ended questions that could contribute to both quantitative and qualitative analyses. Findings from the questionnaire survey, and from initial discussions and building tours, informed the design of questions for semi-structured interviews carried out with a smaller sample of Council employees. The design and development of the questionnaire survey is discussed in further detail in Section 4.4.

The interviews provided qualitative data that was analysed using thematic analysis. This allowed a more in-depth examination of some of the issues identified in the questionnaire survey, building survey and discussions with employees responsible for building and energy management. The design of questions and methods of qualitative data analysis are further discussed in section 4.5.

The initial proposal to both Councils was that actual energy measurements would be taken in one of the Councils by selecting a small office where monitoring devices could be left for one or two weeks to record patterns of energy use by different appliances. However, at the time of the actual study the change in national government had led to reductions in local authority budgets, and employees in both Councils were facing possible redundancy. In this climate, it was felt that devices monitoring patterns of energy demand, and by extension patterns of employee behaviour, would not be acceptable. As a result, the performance of energy-related behaviours was measured through self-reports collected in response to the questions in the questionnaire survey.

4.2.1 Self-reported behaviour

The use of self-reported behaviours in studies that include questionnaire surveys is very common, but is also open to criticism. One such criticism is that self-reported data might not accurately reflect the behaviour which was actually performed by participants. Previous research has identified that self-reported data can inflate the levels of performance reported, through effects

such as social desirability bias, whereby respondents answer in a way that presents their behaviour in a more desirable light. However, these effects are most frequently found with topics deemed to be particularly sensitive (Kreute et al., 2008), which is unlikely to be the case for energy demand behaviours in an office setting. Additionally, self-completing a questionnaire (rather than completing one in discussion with a researcher) has been found to reduce social desirability bias, while respondents completing online surveys are even less likely to be affected than those completing automated telephone surveys (Kreute et al., 2008). Even where there are inflations in self-reported behaviours, there is evidence that these reports do still have validity for the measurement of actual behaviour (Chao and Lam, 2011).

The limitation on measuring the actual behaviour of occupants also prevented the use of other means of collecting data, such as observations of employee behaviour, or the completion of diaries of activities. However, the in-depth interviews conducted following the questionnaire survey allowed a further opportunity to explore the behaviours, with richer data about the individual's thought processes, motivations and other influences on their behaviour.

4.3 Initial survey of buildings

Tours of the main office buildings involved in this study took place prior to the development of the questionnaire survey. The results of the survey are included here because they provide insights that informed the development of the design of the rest of the study, and in particular the design of the questionnaire survey.

At both Councils, the tour was led by the employee who had responsibility for the overall management and monitoring of energy demand and energy systems within the buildings, and included meeting with the employee who had responsibility for the day-to-day management and maintenance of the buildings and their services. The County Council was particularly interested in ways of changing individual behaviours such as the use of portable heaters and desk fans, while the City Council was particularly interested in the effect of the recent centralisation of most employees into one modern, centrally-controlled building on employee attitudes and behaviour.

4.3.1 Nottingham City Council buildings

The City Council tour was of one building, Loxley House (Figure 4.1), a large five-storey office building with a concrete frame and glazed panel cladding, situated in the city centre next to Nottingham railway station.

Figure 4.1 *External view of Loxley House*

Since acquiring Loxley House in 2009, the City Council had moved large numbers of its office-based employees into the building (1,785 employees at the time of this study) and closed a number of other office buildings throughout the city, leaving Loxley House as the main office accommodation for the Council's employees. This amalgamation was expected to significantly reduce the overall running costs and energy demand from the Council's office accommodation, and enabled the City Council to dispose of many of its least efficient buildings.

The building was constructed in 2002 for financial services company Capital One (which still occupied an older, linked building next door) and was acquired by Nottingham City Council in 2009. A large atrium housed a coffee bar and seating area, and each floor included large open-plan office areas open to the atrium (Figure 4.2), glazed meeting/training rooms, and hub areas containing printers, photocopiers, small kitchens and vending machines. A Building Management System (BMS) operated in the building, with temperature controlled centrally, and lighting controlled through a mixture of centralised and motion-triggered control. The exception to this was meeting rooms, which had independent controls for temperature and lighting in each room.

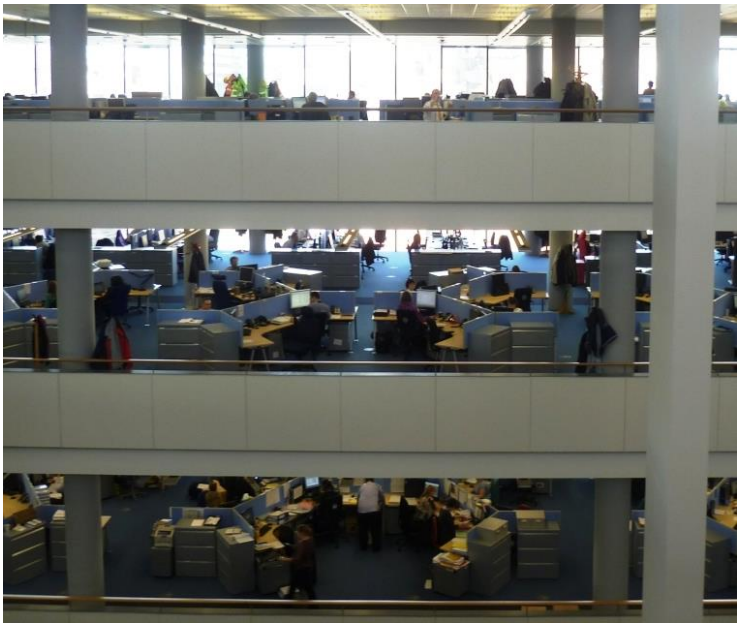


Figure 4.2 *Internal view of Loxley House*

The City Council's concentration of many office-based functions into one building reduced the complexity of their building management council-wide, although many office-based employees were still accommodated in a variety of smaller buildings, often with another primary function, such as leisure centres and libraries. The issues arising for energy management in these multi-function buildings, and in other older office buildings, were similar to issues faced by the County Council, with older buildings requiring greater levels of maintenance and upgrading, and with big variations in the types and effectiveness of the control systems within the buildings. However, the City Council's ability to rationalise its building stock in the light of the acquisition of Loxley House had allowed them to dispose of many of their least efficient buildings.

4.3.2 Nottinghamshire County Council buildings

Like the City Council, many office-based employees of the County Council were based in other buildings away from the main buildings in West Bridgford, in particular in multi-function buildings and in other parts of the county. These employees were included in this research, but formed a smaller part of the sample, with the majority of respondents to the questionnaire survey (226 out of 285 respondents) based in the main buildings discussed here. The survey of County Council buildings focused on the Council's four largest office buildings, all in the West Bridgford area of Nottingham, about one mile from the City Council's Loxley House. The County Hall site (Figure 4.3) included the main County Hall building plus two annex buildings, the Riverside Building and the CLASP Building. The fourth building, Trent Bridge House, discussed below, was about five minutes' walk away.

Figure 4.3 *External view of the CLASP building (foreground) and County Hall (background)*

County Hall was a brick-built building completed in 1948 which included the Council chambers and other civic function rooms, as well as a combination of single-occupancy offices and larger open-plan offices (Figure 4.4). The Riverside Building, a concrete building dating from the late 1960s, housed the IT data centre and office accommodation, including an open-plan hot-desking area. The CLASP Building was built earlier in the 1960s in prefabricated concrete to a design by the Consortium of Local Authorities Special Programme (CLASP, see http://www.clasp.gov.uk), which brought local authorities' procurement power together to seek better designs and value for the construction of public sector buildings. This building predominantly housed open-plan offices but included some single-occupancy offices. The building contained large quantities of asbestos; as a result, it was scheduled for demolition within four or five years and improvements to the building's fabric or systems were therefore not seen as a priority.

Figure 4.4 *Examples of open-plan and single-occupancy office accommodation in County Hall*

Trent Bridge House (Figure 4.5) was a 1970s concrete-built ten-storey office block in an L-shaped design, with reception, café and other facilities on the ground floor and open-plan office accommodation plus meeting rooms on the other floors.

Figure 4.5 *External view of Trent Bridge House*

Cosmetically, the interior condition of Trent Bridge House was more dated than much of the accommodation in the County Hall complex, and particularly in the main County Hall building. There were also signs of problems with the fabric of the building, in particular draughts around windows and signs of wear on the concrete edifice. These problems were also reflected in the building's systems; issues caused by uneven temperatures and poor temperature control throughout the building are discussed below. Figure 4.6 shows an example of one of the open-plan offices in this building.

Figure 4.6 *Internal view of Trent Bridge House open-plan office accommodation*

These four buildings (County Hall, the CLASP Building, the Riverside Building, and Trent Bridge House) formed the main hub of the County Council's office accommodation, although office-based employees were also spread across a large number of smaller buildings throughout the County. Many of these smaller buildings were not exclusively office buildings, but had other functions such as libraries or day centres. Two larger office complexes in other parts of the County, Lawn View House in Mansfield and Sherwood Energy Village in Ollerton, were considered for inclusion in this study; however, their locations a long way from the city of Nottingham and the fact that few responses to the questionnaire survey were received from these buildings (13 responses from Sherwood Energy Village and 11 from Lawn View House) resulted in them not being a focus for the study.

The complexities of examining and comparing office-based energy demand behaviours across a range of building types were apparent during the tour of buildings in the County Hall complex, where many offices within the same buildings had very different control systems for lighting, heating and cooling. This meant that the building a respondent was based in would not identify the level of individual control that the respondent had over lighting, heating and cooling in their office; specific questions would be needed in the questionnaire survey to elicit this information.

4.3.3 Heating and cooling

The tours of both Councils' buildings identified that temperature was a significant concern across all of the office buildings. For the County Council, this had a large impact on the building

occupants, particularly in Trent Bridge House, which saw fluctuations in temperature between the top and bottom of the building and between the two wings of the L-shaped design. In some parts of Trent Bridge House, employees supplemented the centrally-provided heating with electric fan heaters, which had a significant energy demand. In parts of the building that were too hot, some employees stacked possessions or filing on top of perimeter heating vents in an attempt to reduce the heat and draughts emitted. Similar issues could be found in County Hall and in the two annex buildings, with the building survey finding examples such as windows left open above very hot radiators that could not be turned off in County Hall, and in the Riverside building a working air conditioning unit directly above a working heater with no obvious way to turn either off. Maintenance and control of such systems was further complicated by private contractors being responsible for some of the systems, particularly in the Riverside Building.

The use of portable electric heaters was a contentious issue in all of the County buildings visited, with their use banned in County Hall, and with disagreement in other buildings about whether they were really justified. The controversy surrounding the use of these heaters highlighted that temperature, and associated factors of individual comfort, could complicate the issue of energy demand for heating and cooling. In particular, perceptions of comfort could undermine efforts to conserve energy by appealing to individuals to reduce their own use of portable heaters.

Despite being a much more modern building with modern heating and cooling systems, temperature was still a concern within the City Council's Loxley House. As heat rises and each open-plan office space was open to the atrium, the internal temperatures were often higher on the upper floors than the lower floors. Some occupants also complained about draughts rising from floor vents. With lighting, heating and cooling in most areas controlled centrally by the Building Management System, requests for changes in office temperature had to be made to building management staff. However, the Building Management System controlled temperatures within a set of tolerances throughout the building, and was seen as effective by building management staff. There was the potential for conflict between individual building occupants and building management staff, if perceptions of comfort differed between the two groups or if frustration at the lack of local control over temperature affected perceptions of comfort. Whether this was the case could be revealed by questionnaire responses and interviews. Building occupant thermal comfort is not, however, a main focus for this research, which examines energy use that can be easily controlled by individual building occupants. Thermal comfort will be explored only insofar as it affects individuals' use of energy in the building, or their attitudes towards the use of energy.

In all of the buildings, heating and cooling were provided centrally, but with varying levels of local control. In the City Council's Loxley House, local controls were available in

meeting/training rooms only, and were accompanied by pictorial guides showing how controls should be set. However, these guides might not have been considered particularly clear for unfamiliar users (Figure 4.7).

Figure 4.7 *Guides for temperature controls in Loxley House meeting rooms*

In the County Council buildings, there are numerous different systems, controlled in different ways, with some controls being very easy to understand and others being much less intuitive or having no instructions (e.g. Figure 4.8).

Figure 4.8 *Examples of easy to understand and less intuitive temperature controls in the County Council buildings*

This suggests that the presence of local controls for heating or cooling may not be enough for occupants to have, or perceive that they have, control over the temperature themselves; this study may also need to identify whether people feel that they know how the controls work. As a result, the study might recommend that Councils provide clear instructions or replace controls with

more intuitive designs as part of a programme to encourage building occupants to control office temperatures more effectively.

4.3.4 Lighting

Lighting controls in the buildings followed a similar pattern. In the County Council buildings, there were a variety of control systems, from automated systems with little local control to light switch pull-cords hanging from individual lights above clusters of between one and four desks (Figure 4.9).

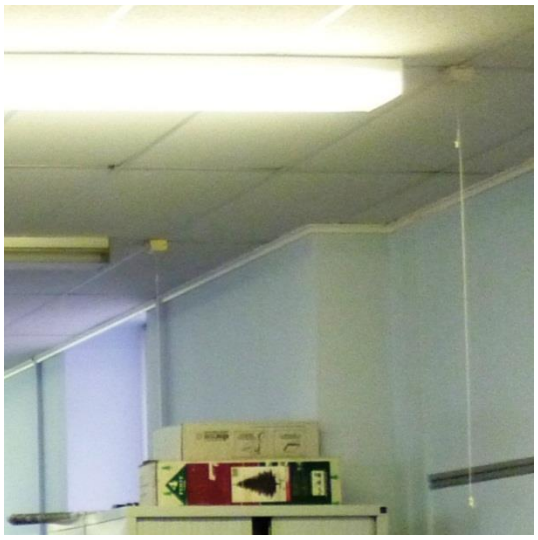


Figure 4.9 *Light switch pull-cords hanging from individual lights*

As with heating and cooling systems, the variety of control systems meant that questions would need to be included in the questionnaire survey to identify the exact level of control that each respondent had over lighting in their area. In the City Council's Loxley House, with the exception of meeting/training rooms, lighting was controlled centrally by the Building Management System. Some areas might have been considered over-lit, in particular in corridor areas and close to windows. Perceptions of the lighting levels, then, would be a useful area of enquiry for the questionnaire survey and subsequent interviews.

The perception of the lighting more generally was also an issue for Loxley House. The building had been conceived for the previous owners as a prestige building in a landmark location, but perceived extravagance or waste could have opened the Council up to criticism, particularly with budget cuts affecting some services. Low-energy lighting around the perimeter of the building, part of the prestige elements of the building's design, had led to a perception that unnecessary lights were left on overnight, wasting Council funds. This was compounded by motion-controlled

lights on each floor being triggered by security staff making their rounds at night. Both of these issues were being addressed, to reduce wasted energy and to improve the perception of the building, in line with the Council's public commitment to energy conservation and the tightening of Council budgets nationwide, as outlined in Section 1.4.2.

4.3.5 Computers and computer monitors

For all the office buildings surveyed, individual occupants were able to turn their own computers and monitors off when they were not in use. In all cases, however, computers were connected to networks, and this could slow the process of booting up the computers; for both Councils, this was accepted as a reason for most employees to not turn off their computers when they were away from their desks but expected to return before the end of the day. In both Councils, individuals were expected to turn off their computers at the end of the day, even though in many buildings it was possible for computers to be powered down centrally once the building was empty. Monitors could be turned off independently of computer base units; this could be done at the end of the day, but also during the day when employees were away from their desks. Energy saving settings were available on many computers.

4.3.6 Implications for the design of the study

The building tours were useful for identifying information that would need to be elicited from respondents in the questionnaire survey, particularly around the levels of control that individuals had over heating, cooling and lighting. Table 4.1. summarises the levels of individual control identified for the main systems or equipment in each of the buildings surveyed. The range of buildings and the differences in controls even within the same building meant that identifying relationships between behaviours and the levels of control that each individual had over their energy demand would not be straightforward. Any scales created to measure the overall behaviour reported by each respondent would need to take account of the level of control that respondents reported for each behaviour.

	City Council	County Council	
	Loxley House	**County Hall site**	**Trent Bridge House**
Heating	Centrally-controlled, except in meeting rooms	Mix of room-level or central control	Centrally-controlled, supplemented by individual fan heaters
Cooling	Centrally-controlled, except in meeting rooms	Mix of room-level or central control	Centrally-controlled, supplemented by individual desk fans
Lighting	Centrally or automatically controlled, except in meeting rooms	Ceiling pull-switches above banks of 1-4 desks	Ceiling pull-switches above banks of 1-4 desks
Computers & monitors	Individual control	Individual control	Individual control

Table 4.1 *Types of control systems in each building surveyed*

In buildings that performed particularly poorly in terms of occupant comfort and temperature, the building tours raised the question of whether it was reasonable or sensible to expect occupants to change their behaviour around heating or cooling in order to conserve energy. Such requests, apart from being unreasonable where they resulted in worsening conditions for the occupants, could prove so unpopular that they would be difficult to implement or maintain, and could also provoke a backlash against other energy conservation measures. However, perceptions of what would be reasonable and what would qualify as a worsening of conditions could also be subjective. Recommendations for actions arising from this study, then, would need to take account of occupants' likely reactions as well as the potential energy savings that could be made. Those likely reactions could best be judged through careful probing during in-depth interviews.

Despite this caveat, the building tours did suggest a number of opportunities for behaviour and building management changes to save energy. The subsequent questionnaires and interviews would enable the study to identify which of those opportunities were likely to be successful, and to identify further opportunities for energy saving.

One consequence of the building surveys for the design of the study was the decision that the energy demand behaviours examined in the study would not include centralised heating or cooling, even where individuals reported that these could be controlled from within the office. There were three main reasons for this decision. First is the confounding effect of occupant thermal comfort: in many of the buildings surveyed, occupants had little control over internal temperatures and poor thermal comfort, and had adopted a variety of methods to counteract this, including blocking heaters or using additional heaters. In these buildings, the need for comfort

overrides many other motivating factors for the use of energy. Understanding the motivations behind heating energy use in these circumstances would be more likely to reveal insights into thermal comfort than into motivations for individual-level energy use in the office setting.

Secondly, the research focuses on behaviours controlled and performed by individuals. Centralised heating and cooling were excluded because even where they were controlled within a single office rather than building-wide, they generally involved one set of controls affecting the entire office environment, making it difficult to characterise as an individual behaviour. While office lighting could be similarly described, office lighting is included because lighting controls are more flexible than heating controls, allowing different areas to be lit or unlit in a way that is generally not possible with heating or cooling. Additionally, office lighting controls are generally more accessible, visible and instantly controllable by the individual than heating or cooling, and the need or lack of need for lighting can be easily and instantly assessed by the individual.

The third reason to exclude centralised heating and cooling was to help focus the research. With two organisations, several different buildings, the application of two attitude-behaviour theories, and the use of both quantitative methods (statistical analysis of the questionnaire survey) and qualitative methods (in-depth interviews analysed using thematic analysis), there were already a sizeable number of different elements to the research. By focusing on individually-controlled use of energy, primarily for lighting and computer use, the focus of the research was tightened, allowing for more in-depth analysis of a smaller number of behaviours.

4.4 Questionnaire Survey

A major part of this research was based on a questionnaire survey administered to office-based employees at the two participating Councils. This questionnaire provided primarily quantitative data that could be analysed using established statistical techniques to identify relationships between the different factors identified as possible influences on behaviour. A questionnaire was the most appropriate method to collect this form of data as it allowed for sufficient numbers of responses to be collected for statistical analysis to be carried out. For many of the statistical techniques used in this research, larger sample sizes increased the reliability of the results, while some of the methods required sizeable numbers of responses in each possible response category for the analysis to run successfully (Field, 2009); the requirements for each method are discussed in the appropriate section of this report.

4.4.1 Questionnaire development and pre-testing

The questions to be included in the questionnaire were discussed with members of both the County Council's and the City Council's Sustainability teams. These discussions identified the key areas of interest that would be covered by the questionnaire, with a focus on energy use for lighting and computers (excluding, for example, energy use for heating and cooling, or for business or commuter travel) within the Councils' office accommodation (including buildings with mixed uses, such as libraries that included office accommodation), and on the self-reported behaviours and attitudes of individual office-based employees.

The questionnaire was developed using a pre-testing process described by both Oppenheim (2001) and Robson (1997), which involved pre-testing the questionnaire with several sets of individuals who did not form part of the main sample. Initial pre-testing was undertaken by two sets of individuals: three academic reviewers from the researcher's own department, and three employees of other local authorities which were not taking part in the research study. These reviewers were asked to complete the questionnaire themselves, to identify and comment on questions that were ambiguous, repetitive or intrusive, or that had missing response categories, and to record how long the questionnaire took to complete. The questionnaire was revised following this feedback, clarifying the wording of some questions and identifying ways to shorten the questionnaire. A second version of the questionnaire was tested by six employees of the County Council, primarily members of the Sustainability team, following the same procedures. A third revised version was then discussed and agreed with the County Council's Sustainability team. The County Council's Communications team, who would be responsible for circulating the questionnaire, then provided further feedback, in particular on ways to shorten the questionnaire further. A final version of the questionnaire was then agreed for distribution to County Council employees.

Discussion of how the questionnaire would be circulated and returned identified that an online questionnaire would be the most effective method, using the Bristol Online Survey software package, as all of the potential participants were on the Council's email system and had easy access to the internet. A link to the questionnaire could then be circulated via email, making it easier to reach employees based in a large number of different buildings spread across a wide geographical area. Another advantage was that the Bristol Online Survey software package could collate the data in a form ready for importing directly into SPSS data analysis software, which eliminated the need to spend time on data entry and the associated risk of errors. Figure 4.10 presents a screenshot of one screen of the online questionnaire.

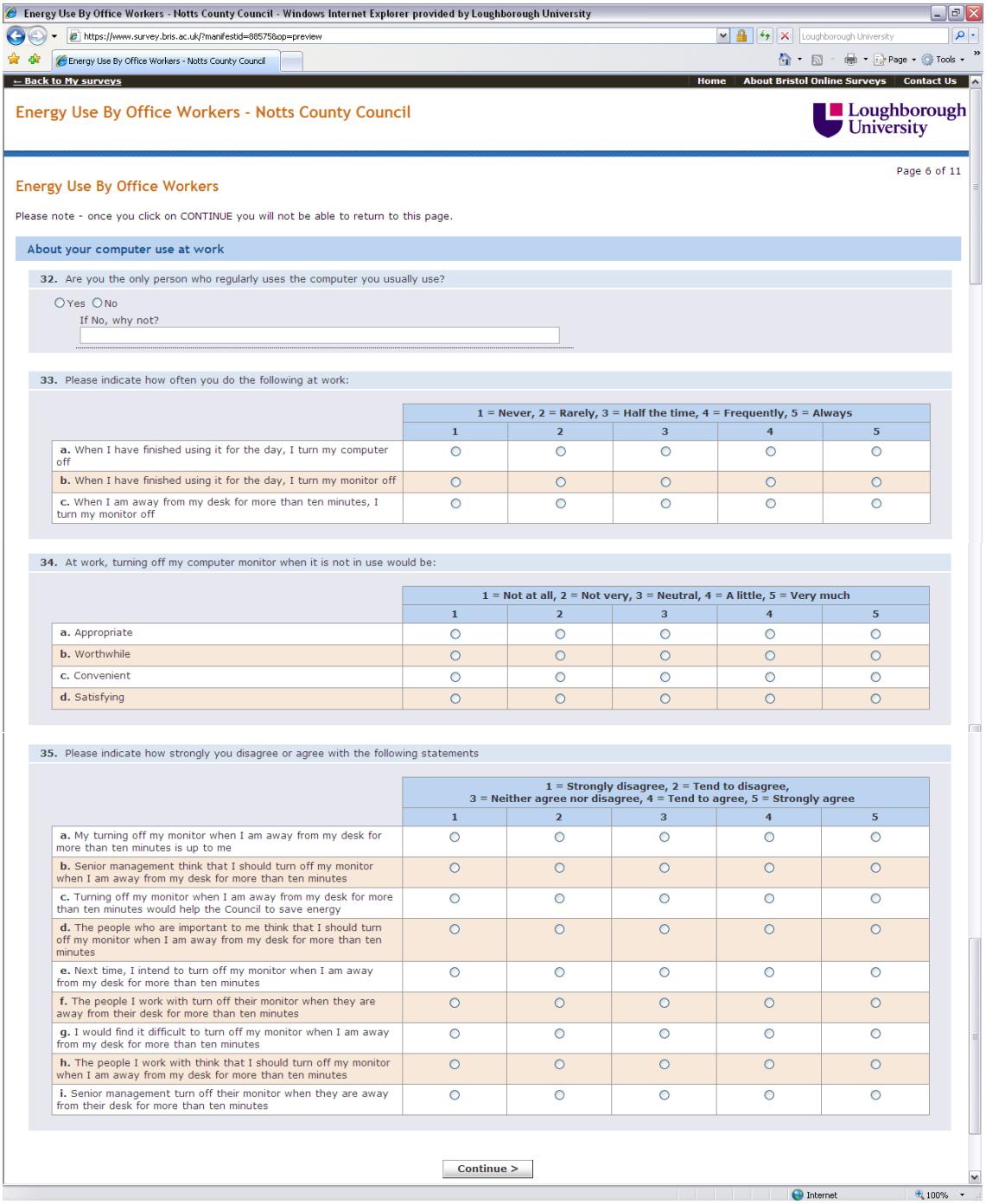


Figure 4.10 *A screenshot of one screen of the online questionnaire*

Two different versions of the questionnaire were produced for the City Council, to reflect the different levels of individual control over energy demand within the different buildings. In particular, employees based in Loxley House had less individual control than many of the employees based in other City Council buildings. Consequently, one version of the questionnaire was created for employees based in Loxley House (the 'City Loxley' version) and one for employees based in all other City Council buildings (the 'City Other' version).

The County Council questionnaire (the 'County' version) was used as a model for these two versions. Questions not relevant to the City Council were deleted, in particular about the use of portable heaters, and for Loxley House some questions about behaviour were replaced with open-ended questions about employees' views of their lack of control over those behaviours. The open-ended questions were tested for clarity with fellow academic researchers and refined accordingly. The testing of other questions previously carried out for the County Council version of the questionnaire was felt to be sufficient. The questionnaire was then discussed and agreed with members of the Sustainability team at the City Council. The complete City Other version of the questionnaire is included in Appendix 1.

4.4.2 Measures for the Theory of Planned Behaviour

The questionnaire survey measured variables relating to the enactment of the behaviours. In addition to reports of actual performance of behaviours, the questionnaire included items (that is, questions or attitude statements) designed to measure psychological/attitudinal, demographic and contextual variables. The psychological/attitudinal items included items measuring constructs from the Theory of Planned Behaviour (Ajzen, 1991) and from Values-Beliefs-Norms Theory (Stern et al., 1999). The theories include a number of latent variables, which are variables that cannot be observed or measured concretely, but which can be identified by measuring several different aspects of the whole variable (for example, subjective norms can be measured by examining the respondent's perceptions of how different groups of people would view a certain action). Constructs, then, are the groups of items which are used to measure a latent variable.

The performance of eleven behaviours was measured using respondents' self-reports on a five-point scale ranging from 'Never' to 'Always'. Items measuring constructs in the Theory of Planned Behaviour were worded specifically for each measured behaviour, while those for Values-Beliefs-Norms Theory were not behaviour-specific. Items measuring specific constructs from the Theory of Planned Behaviour (Ajzen, 1991) were used with six of the eleven behaviours. Including questions about the performance of more behaviours than were then examined with the Theory of Planned Behaviour allowed the performance of these six behaviours to be placed in a wider context, with initial analysis examining the reported frequency of performance of all eleven behaviours. Table 4.2 indicates which of the behaviours were measured in each version of the questionnaire, and the smaller sub-set used with behaviour-specific items from the Theory of Planned Behaviour (Ajzen, 1991).

Behaviour group	Behaviour	City Loxley		City Other		County	
		Behav.	TPB	Behav.	TPB	Behav.	TPB
A: Office lighting	A1: Turn office lights off when not needed	x	x	✔	✔	✔	✔
	A2: Turn meeting room lights off when leave room empty	✔	✔	✔	x	✔	x
	A3: Turn toilet lights off when leave unoccupied	✔	x	✔	x	✔	x
B: Office computers	B1: Turn off computer when finished for day	✔	x	✔	x	✔	x
	B2: Turn off computer monitor when finished for the day	✔	x	✔	x	✔	x
	B3: Turn off computer monitor when away from desk for more than ten minutes	✔	✔	✔	✔	✔	✔
C: Office heating and cooling	C1: Turn off portable heaters when away from the desk	x	x	x	x	✔	✔
	C2: Turn off desk fan when away from the desk	x	x	x	x	✔	✔
D: Home lighting	D1: Turn off lights in a room when not needed	✔	✔	✔	✔	✔	✔
	D2: Turn off lights in a room when leave room empty	✔	x	✔	x	✔	x
E: Home computers	E1: Turn off home computer when finished using it	✔	x	✔	x	✔	x
	E2: Turn off home computer monitor when away from the desk for more than ten mins.	✔	✔	✔	✔	✔	✔
F: Other home	F1: Turn main TV off fully instead of leaving on standby	✔	x	✔	x	✔	x

Behav. = Performance of the behaviour.
TPB = Items from Theory of Planned Behaviour used with this behaviour

Table 4.2 *Measurement of the performance of behaviours, and behaviours used with the Theory of Planned Behaviour (TPB), in each version of the questionnaire*

Table 4.3 shows the items measuring constructs from the Theory of Planned Behaviour (Ajzen, 1991), developed based on the literature review (Chapter 2) and the discussion of the attitude-behaviour models (Chapter 3), and informed by the building surveys discussed in this chapter. All items were measured on a 5-point scale with response options *Strongly disagree, Tend to disagree, Neither disagree nor agree, Tend to agree,* and *Strongly agree*. Most were worded so that agreement indicated a more pro-environmental or pro-energy conservation stance; items that were reverse-worded so that agreement indicated a less pro-environmental or less pro-energy conservation stance are indicated with an (R).

The behaviours used with the Theory of Planned Behaviour constructs were chosen to allow comparisons of similar behaviours across the three versions of the questionnaire, and across the

office and home settings. Additional items were included for the use of portable heaters and desk fans in the County version as this was of particular interest to the County Council.

TPB construct	**Item measuring construct**
ATT: Attitude	ATT1: *(Performing behaviour)* would be *(appropriate / worthwhile / convenient / satisfying)* ATT2: *(Performing behaviour)* would help *(the Council/my household)* to save energy
SN: Subjective Norm	SN1: People who are important to me *(perform the office behaviour)* SN2: People I work with *(perform the office behaviour)* SN3: Senior management *(perform the office behaviour)* SN4: People who are important to me think that I should *(perform the office behaviour)* SN5: People I work with think that I should *(perform the office behaviour)* SN6: Senior management think that I should *(perform the office behaviour)*
	SN7: People who are important to me *(perform the home behaviour)* SN8: People I live with *(perform the home behaviour)* SN9: People who are important to me think that I should *(perform the home behaviour)* SN10: People I live with think that I should *(perform the home behaviour)*
PBC: Perceived Behavioural Control	PBC1: I would find it difficult to *(perform the behaviour)* (R) PBC2: *(Performing the behaviour)* is up to me
INT: Intention	INT1: Next time, I intend to *(perform the behaviour)*

(R) Reverse-worded item

Table 4.3 *Items measuring constructs from the Theory of Planned Behaviour (Ajzen, 1991)*

4.4.3 Measures for Values-Beliefs-Norms Theory

The items used to measure constructs from Values-Beliefs-Norms Theory (Stern et al., 1999) were not behaviour-specific, and so only needed to be asked once in each version of the questionnaire. The items (Table 4.4) were selected with reference to Stern et al. (1999), plus two scales developed by other researchers. The scale used to measure V: Values was adapted by Stern et al. (1995) from work conducted by Schwartz (Schwartz and Bilsky, 1987; Schwartz, 1992, 1994) which identified common value types, constant across cultures. The scale used to measure W: Worldview was adapted by Stern et al. (1999) from Dunlap et al.'s (1992) New Ecological Paradigm, measuring attitudes towards the environment. Additional items measuring AC:

Awareness of Consequences, AR: Ascription of Responsibility and PN: Pro-environmental Personal Norm were developedfrom Stern et al. (1999) and the findings of the building surveys.

Scale	Factor	Item measuring construct
V: Values	V1: Openness to change	V1a: Curious, interested in everything, exploring V1b: A varied life, filled with challenge, novelty and change
	V2: Self-enhancement	V2a: Influential, having an impact on people and events V2b: Wealth, material possessions, money
	V3: Conservation (traditional)	V3a: Honouring parents and elders, showing respect V3b: Self-discipline, self-restraint, resistance to temptation V3c: Family security, safety for loved ones
	V4: Self-transcendence (biospheric)	V4a: Protecting the environment, preserving nature V4b: Respecting the earth, harmony with other species
	V5: Self-transcendence (altruistic)	V5a: Social justice, correcting injustice, care for the weak V5b: A world at peace, free of war and conflict
W: Worldview	W1: Reality of limits to growth	W1a: We are approaching the limit of the number of people the earth can support W1b: The earth is like a spaceship with limited room and resources
	W2: Anti-anthropocentrism	W2a: Humans have the right to modify natural environment to suit their needs (R) W2b: Plants and animals have as much right as humans to exist
	W3: Fragility of nature's balance	W3a: When humans interfere with nature it often produces disastrous consequences W3b: The balance of nature is strong enough to cope with the impacts of modern industrial nations (R)
	W4: Rejection of exemptionism	W4a: Human ingenuity will ensure that we do NOT make the earth unliveable (R) W4b: Despite our special abilities humans are still subject to laws of nature
	W5: Possibility of an ecological crisis	W5a: Humans are severely abusing the environment W5b: The so-called 'ecological crisis' facing humankind has been greatly exaggerated (R) W5c: If things continue on their present course, we will soon experience a major ecological catastrophe
AC: Awareness of Consequences	AC1: Work	AC1a: The Council's energy consumption affects the environment
	AC2: Home	AC2a: My household's energy consumption affects the environment
	AC3: General	AC3a: The exhaustion of fossil fuels is a problem AC3b: Environmental quality will improve if we use less energy
AR: Ascription of Responsibility	AR1: Work	AR1a: When I'm at work, it's not my responsibility to conserve energy (R)
	AR2: Home	AR2a: Conserving energy at home is my responsibility
	AR3: General	AR3a: I feel jointly responsible for the exhaustion of energy sources AR3b: My contribution to the energy problem is negligible (R) AR3c: It's not just the government and industry that are responsible for high energy consumption levels, but I am too
PN: Pro-environmental Personal Norm	PN1: Work	PN1a: I should do what I can to help the Council save energy
	PN2: Home	PN2a: I should do what I can to save energy at home
	PN3: General	PN3a: I feel morally obliged to save energy regardless of what others do PN3b: Conserving energy and natural resources is important to me PN3c: I would be a better person if I saved energy

(R) Reverse-worded items

Table 4.4 *Psychological/attitudinal questionnaire statements from Values-Beliefs-Norms Theory*

For all of the constructs apart from V: Values, respondents were asked to state how strongly they disagree or agreed with the statement given. Responses were measured on a 5-point scale with response options *Strongly disagree, Tend to disagree, Neither disagree nor agree, Tend to agree,* and *Strongly agree*. For V: Values, respondents were asked to 'rate each item according to how important the statement is as a guiding principle for you', with responses measured on a 5-point scale with options *Not at all important, Tends not to be important, Neutral, Tends to be important,* and *Extremely important*. Reverse-coded items are indicated with (R).

4.4.4 Measures for contextual and demographic variables

In addition to measuring the performance of behaviours, and the constructs from the attitude-behaviour theories, the questionnaire included a number of items measuring contextual and demographic variables. These related to the office building the respondent was based in and the level of control they had over the performance of behaviours, plus personal, employment and household characteristics. The items included in the questionnaire are presented in Table 4.5. Further socio-demographic items relating to educational attainment, income, ethnicity and disability were not collected because the Sustainability teams in the two Councils identified these as sensitive topics that could discourage respondents from completing the questionnaire.

Items collected by the questions in A: Building and control related to the physical environment that the respondent worked in. The building tours/surveys (Section 4.2) identified that even within the same building there were different control systems for lighting and heating, so it was necessary to ask respondents about these on an individual level. The implications of this are discussed further in Section 5.2. The questions in B: Personal and employment characteristics, and C: Household characteristics, identified characteristics about the individual respondent. Responses were collected with a mixture of open boxes (where respondents could type in their own answer) and categories (where respondents selected one tick-box). The response categories are presented in Table 4.5.

Variable group	Item measuring variable	Response categories
A. Building and control	A1. Building based in	Open
	A2. Able to switch off lights in office	Yes/No/Don't know
	A3. Able to switch off lights in meeting rooms	Yes/No/Don't know
	A4. Able to switch off lights in toilets	Yes/No/Don't know
	A5. Able to control heating from within office	Yes/No/Don't know
	A6. Including self, number of people sharing office	Open
B. Personal and employment characteristics	B1. Gender	Female/Male
	B2. Age	Open
	B3. Full or part time	Full time/Part time
	B4. Managerial role	Yes/No
	B5. Member of Corporate Leadership Team	Yes/No
	B6. How long in this local authority service	Open
	B7. How long in all local authority service	Open
	B8. Proportion of time spent in office	Less than half the time/ About half the time/ More than half the time/ Most of the time/ All of the time
C. Household characteristics	C1. People who share home	Lone adult/ Lone adult with child(ren)/ Multiple adults/Multiple adults with child(ren)
	C2. Housing tenure	Owner-occupier/ Rented self-contained/ Rented shared/ Other

Table 4.5 *Items measuring contextual and demographic variables*

4.4.5 Selection of sample

Participants in the study were office-based employees of Nottingham City Council and Nottinghamshire County Council. They were based in the buildings visited during the building tours (the City Council's Loxley House, and the County Council's Trent Bridge House and County Hall complex) and also in other smaller buildings across the Councils' areas. At the time of the study in 2011, Nottingham City Council had a total of 12,069 employees, and Nottinghamshire County Council had a total of 23,404 employees, although a large proportion of these were not office-based employees and were therefore not approached to take part in this study. Neither Council was able to provide a figure for the total numbers of their employees who were office-based, however an analysis of local government employment discussed in Section 1.4.1 identified that more than half of local government employees could be described as manual

workers. The number of office-based workers at each Council, then, was likely to be less than 6,000 for the City Council and less than 11,500 for the County Council. At the time of the study, there were 1,785 employees based in the City Council's main office building, Loxley House, and 450 based in one of the County Council's main office buildings, Trent Bridge House.

The County Council's version of the questionnaire was originally to be circulated by an all-staff email giving a link to the online questionnaire, but permission for this was refused at a late stage. Instead, the link to the online questionnaire was promoted on the Council's intranet and in an internal email newsletter sent to all employee accounts, alongside a short item describing the research project. An email inviting people directly to participate in the study was sent in one building only, Trent Bridge House. As a result, the invitations to take part in the research study were not as direct to most employees, and a lower response rate that originally hoped was anticipated. The questionnaire was promoted on the Council's intranet for a second time four weeks later, and the questionnaire closed to further responses two weeks after that.

A total of 285 employees returned useable questionnaires using the County version. In Trent Bridge House, where 450 employees received the direct invitation to take part, 144 employees returned useable questionnaires, a response rate of 32% for that building. The remaining 141 useable questionnaires were from the other County Council buildings, with 82 of those from the County Hall complex and the final 59 spread across 28 other buildings. The overall response rate could not be calculated, as it was not possible to know how many potential respondents had seen the intranet and newsletter invitations to take part, but this would have been considerably lower than the response rate from the direct email invitation in Trent Bridge House.

There were two versions of the City Council questionnaire, one aimed at employees based in Loxley House and the other aimed at employees based in all other City Council offices. Both were circulated by an email sent to all staff inviting them to take part in the survey and giving a short introduction to the research study. Permission for a reminder email due to be sent three weeks later was cancelled at the last minute, for internal Council reasons, so again, a lower response rate than originally hoped was anticipated. 1,785 employees were based in Loxley House at the time the invitation to take part was sent, and 337 useable questionnaires were returned, giving a response rate of 19%. A further 197 useable questionnaires from occupants of other City Council buildings were received. No figures were available to be able to calculate what response rate this represented, but it would have been considerably lower than 19%.

The useable questionnaires returned were the responses remaining after data cleansing had taken place. The purpose of the data cleansing was to remove questionnaires that contained too many

missing responses, or were otherwise thought to be unreliable. These included questionnaires with large numbers of missing responses scattered throughout, or where the respondent had abandoned the questionnaire at an early stage. They also included questionnaires where the respondent had ticked the same response category for every question, even where a question had been reverse-worded, as this suggested that the respondent was not reading the questions. However, questionnaires were kept where there were only small numbers of missing responses, where responses had not been given to questions that were not relevant to the respondent (e.g. they had no control over lighting in their office), or where the missing responses were to the optional questions about energy use at home.

Prior to data cleansing, the City Loxley version had 421 responses, reducing to 337 after cleansing; the City Other version reduced from 246 responses to 197, and the County version reduced from 330 responses to 285. These were sizeable reductions, and may have stemmed from the length of the questionnaire; employees were completing it at work, and while the invitations to take part did suggest it would take around half an hour to complete, completion during the working day could well have been interrupted. It is also likely that some respondents simply got bored and gave up. One danger resulting from this is that the sample would become increasingly self-selecting, with those who were more committed to environmental issues or to energy conservation being more likely to return a useable questionnaire.

Overall, a total of 819 useable questionnaires were returned. Of these, 337 respondents completed the City Loxley version, 197 completed the City Other version, and 285 completed the County version. The responses were then analysed using a number of statistical techniques; these analyses are described in Chapters 5 to 8.

4.4.6 Analysis of open-ended questions

In addition to the statistical analysis of responses to closed questions, a number of questions in the three versions of the questionnaire were open-ended questions allowing respondents to form their own responses rather than choosing from pre-selected responses. The statistical analysis carried out on most of the questionnaire items can only measure responses given within the boundaries set by the questionnaire design; open-ended questions, however, give respondents the opportunity to identify other variables or influences on their behaviour that might not have previously been identified by the researchers. Table 4.6 presents the open-ended questions included in the three versions of the questionnaire in this study.

Version	Question
Included in all three versions	1. What do you think are the biggest influences over your energy use at work? 2. What do you think could be done to save energy in your building? 3. What do you think could be done to save energy across the whole of the Council?
City Loxley only	4. What do you think about the level of control you have over the temperature in your office? 5. What do you think about how draughty or stuffy your office is? 6. What do you think about the amount of light around the area where you usually sit? 7. What do you think about the quality of light around the area where you usually sit? 8. What do you think about your level of control over the lights around the area where you sit?
City Other & County only	9. What action are you able to take if you are too hot or cold in your office? 10. Would you like to have more control over the temperature in your office? If so, how?

Table 4.6 *Open-ended questions included in all three versions of the questionnaire*

In addition to providing an opportunity to catch additional influences on behaviour that were not considered during the design of the questionnaires, the open-ended questions also allow respondents' ideas about what could reduce energy demand in their own building and across the organisation to be recorded. These suggestions can be used in this study in three ways. Firstly, the frequency with which particular items are mentioned can provide further insight into the perceptions of Council employees about the influences on energy demand behaviour, adding to the insights from the data analysis described in the previous sections. Secondly, they can identify particular issues within buildings that could be addressed to reduce energy demand, and so help to inform the recommendations for action that will arise from this study. Thirdly, they help to identify issues and themes that can be explored in further detail in subsequent interviews.

4.5 Semi-structured interviews

The semi-structured interviews were conducted six months after the questionnaire survey had been administered. While the questionnaire survey questions had largely been driven by theoretical insights into the possible influences on behaviour, and respondents' answers to the questionnaire survey items were mostly constrained to the response options provided, the semi-structured interviews gave an opportunity for the respondents to produce their own responses to questions. Semi-structures interviews are frequently used alongside questionnaire surveys in multi-method research, often to address one issue in multiple ways, as a form of triangulation (Robson, 1997). In this research study, the purpose of the semi-structured interviews was not triangulation in the strict sense of checking the results of the previously-used method, but was more complementary, allowing exploration of issues that were not fully covered in the questionnaire, in particular the effect that the organisational and social setting of an office

environment had on attitudes and behaviour. Thus, the interpretation of quantitative results could be enhanced by the analysis of qualitative data.

The interview participants were selected from respondents who indicated willingness to be interviewed in the final question in the questionnaire survey. Only a small number of interviews were conducted, as the interviews were conceived as secondary to the main data collection from the questionnaire survey. While this did mean that the results of the interviews would be less appropriate for generalising across the whole population, as the interviews were secondary to the results gained from the larger questionnaire survey this was not seen as a major problem. Selections of interviewees were made to reflect a range of ages, genders, the building they were based in and the department they worked within. Employees who worked in the departments directly responsible for energy and climate change policy implementation in each Council were excluded. Additionally, respondents whose answers to attitude questions revealed them to be either extremely pro-environmental or extremely hostile to environmental issues were excluded, as within such a small sample they were likely to skew the findings. Nine interviewees were selected; four from the City Council and five from the County Council.

Interviews were conducted in the respondents' own office buildings. Respondents were asked to find somewhere quiet and private where they would feel comfortable being interviewed, including locations outside their office building if that was preferred, and all opted to use either meeting rooms or empty offices in their own building. All of the interviews were conducted by the author, to minimise the risk of introducing researcher effects which could bias the data (Breakwell, 2006). Each of the interviews lasted around 45 to 50 minutes.

The interview schedule was developed and refined following pilot interviews conducted with five office-based employees of a different local authority that was not part of the study. Pilot interviews followed a five-stage process, as described by Breakwell (2006, p.240):

1. Test whether the explanation for the interviews is clear (ask testers to explain the interview back in their own words)
2. Test the comprehension of questions, checking for ambiguity, relevance and vocabulary (ask testers to explain questions in their own words)
3. Amend the questions in the light of stages 1 and 2
4. Test for comprehension with a new pilot sub-sample
5. Test whether the schedule is producing the kinds of results that are wanted

The interview schedule is presented in Appendix 2. The topics addressed by the questions can be summarised as follows:

- The importance of energy saving to the organisation, management and employees
- Expectations on employees' behaviours
- Interactions between colleagues around the use of shared equipment and controls
- Barriers and encouragements to energy saving at work
- The effect of budget cuts on employee behaviours and attitudes around energy use
- The similarities and differences between energy use in the office and at home
- Connections between energy use across locations

The interviews were transcribed using a simplified Jefferson system (Psathas, 1995). Analysis of the transcriptions used a thematic method (Ryan and Bernard, 2003; Braun and Clarke, 2006). Thematic analysis is a commonly used approach in qualitative research in which themes are identified both from the data itself (the inductive approach) and from the investigator's prior theoretical understanding of the phenomenon (the a priori approach) (Ryan and Bernard, 2003). The process of analysis involves discovering themes and sub-themes, deciding which are important, building hierarchies of themes, and linking these themes to theoretical understandings of the phenomenon being researched (Ryan and Bernard, 2003). Braun and Clarke (2006) are critical of the language of 'emerging' themes sometimes used in studies that utilise thematic analysis, arguing that this denies the active role that the researcher has in identifying, selecting and reporting the themes. This active role emphasises the importance of the process of theme identification and categorisation being undertaken in a rigorous manner.

The process used for thematic analysis in the present study is based on procedures outlined by Braun and Clarke (2006), and follows six key phases:

1. Familiarisation with the data
2. Generating initial codes
3. Searching for themes
4. Reviewing themes
5. Defining and naming themes
6. Final analysis and writing up

The process of searching for, reviewing and defining themes is an iterative process, and in the current study was conducted first on one interview transcript, then on each of the remaining in

turn, with the codes and themes refined at each stage. The codes were sorted into groups of related items to enable the identification of key themes.

4.6 The focus of subsequent chapters

This chapter presented details of the two main methods used to collect data for analysis in subsequent chapters of this thesis. The questionnaire survey produced predominantly quantitative data to be analysed using statistical methods, while interviews produced qualitative data for thematic analysis. The main focus of the thesis is the quantitative data produced by the questionnaire survey, with qualitative data used to explore themes from a different perspective. The levels of analysis for each method are different, with statistical analysis seeking effects that are significant across the population, while thematic analysis adds richness by exploring the social and organisational context that the behaviour occurs within.

As discussed in Section 1.3, the overall aim of this research is to examine factors that influence the individual energy demand behaviours of office-based workers. The objectives identified to achieve that aim were:

1. To identify the key contextual, organisational, social and psychological/attitudinal influences on individual energy use in office settings.
2. To investigate the connections between similar individual energy use behaviours performed in different settings.
3. To examine the roles of actual and perceived control over energy use in the performance of individual energy use behaviours.
4. To apply social psychological models of individual behaviour and evaluate their ability to explain individual energy use behaviours in office and home settings.
5. To make appropriate recommendations for future policy and research.

Section 2.6.1 identified gaps in the current literature that could be addressed by this research:

1. The relationships between individuals and the organisation, and how these relate to other influences on individual employees'energy use behaviour. This leads to the question of how far individual energy use in organisational settings is influenced by individual employees' motivations or by the expectations placed on them by the organisation.

2. Connections between similar behaviours performed in different settings, through situational cues, or the related concept of the 'spillover' of performance from one behaviour to another.
3. The role of actual and perceived control over energy use by individuals. This brings the physical and psychological elements of control together. There is also the effect that a lack of control over energy use in one setting has on the performance of energy use behaviours in another setting.

The following chapters in this thesis present analysis conducted to address the aim, objectives, and gaps in the literature. Table 4.7 presents a summary of the focus of the subsequent data analysis chapters, identifying the objectives and gaps in the literature addressed by each, and the type of data used in the analysis. The final chapters in the thesis, Chapter 9 and Chapter 10, present discussion and conclusions developed from these analysis chapters.

Chapter	**Objective(s)**	**Gap(s) in literature**	**Data source**	**Focus of chapter**
5: Impact of demographics and situational factors on energy demand behaviours	1	1	Questionnaire survey	Performance of behaviours and relationships between these and key contextual and socio-demographic variables
6: Individual energy demand behaviours in offices and at home: An investigation of spillover	1, 2, 3	1, 2, 3	Questionnaire survey, Interviews	Influence of attitudes and organisational factors on behaviour. Comparison of 2 buildings with different control over behaviour. Behaviours in office and home setting.
7: Factor structure in the Theory of Planned Behaviour and Values-Beliefs-Norms Theory	1, 2, 4	2	Questionnaire survey	Principal Components Analysis of performed behaviours across 3 building groups and 2 settings
8: Structural Equation Modelling analysis of the Theory of Planned Behaviour and Values-Beliefs-Norms Theory	1, 2, 3, 4	1, 2, 3	Questionnaire survey	Structural Equation Modeling analysis of relationships between performance of behaviours and influencing variables proposed by theories

Table 4.7 *Summary of the focus of data analysis chapters*

For further ease of navigation through the rest of the thesis and to provide a visual representation of where different buildings were included in the analysis, Table 4.8 summarises some of the key details about each of the buildings. This includes the types of controls over lighting that were available to the building occupants, the number of building occupants where this was known (although as previously discussed, the Councils were unable to provide complete information on this), the number of responses to the questionnaire survey from each building (and, where it could be calculated, the percentage response rate per building), and the numbers of the chapters where results from those buildings are included in subsequent analysis.

Building	Building purpose	Building surveyed	Lighting controls				No. of occupants	Quest. returned	% response	Chapters
			Office	Over desk	Meeting	Toilets				
Nottingham City Council										
Loxley House	Office	Yes	C or A	NA	I	C or A	1785	337	19	5, 6, 7, 8
Lawrence House	Office	No	C or A	NA	I	I	NK	20	NK	5, 7
Gate House	Office	No	A or I	NA	I	I	NK	14	NK	5, 7
Mary Potter Centre	Office	No	I	NA	I	I	NK	14	NK	5, 7
Denewood Centre	Office	No	I	NA	I	I	NK	13	NK	5, 7
Libraries	Service/ Office	No	I	NA	I	I	NK	24	NK	5, 7
Eastcroft Depot	Service/ Office	No	I	NA	I	I	NK	14	NK	5, 7
Advice/Contact/Housing	Service/ Office	No	I	NA	I	I	NK	18	NK	5, 7
Leisure/ Museums	Service	No	C or I	NA	I	I	NK	19	NK	5, 7
Children's centres	Service	No	I	NA	I	I	NK	20	NK	5, 7
Other buildings	Mixture	No	C, A, I	NA	I	I	NK	41	NK	5, 7
Nottinghamshire County Council										
Trent Bridge House	Office	Yes	I	I	I	I	450	144	32	5, 6, 7, 8
County Hall Complex	Office	Yes	I	I	I	I	NK	82	NK	5, 7, 8
Sherwood Village	Office	No	I	I or NA	I	I	NK	13	NK	5, 7, 8
Lawn View House	Office	No	I	I or NA	I	I	NK	11	NK	5, 7, 8
Other offices	Mixture	No	A or I	I or NA	I	I	NK	19	NK	5, 7, 8
Day centres	Service	No	I	NA	I	I	NK	12	NK	5, 7, 8
Other buildings	Mixture	No	A or I	I or NA	I	I	NK	15	NK	5, 7, 8

C = Central, A = Automatic, I = Individual, NA = Not applicable (none), NK = Not known

Table 4.8 *Summary of details of buildings used in research*

4.7 Chapter summary

This chapter presented details of the design of the research study and the methods to be used. It introduced the population from which the sample was drawn and the three main elements in the study, which were initial investigations and building surveys, an online questionnaire survey, and in-depth interviews. The combination of methods allowed the study to focus on the energy demand of individual office workers whether they were influenced by physical (building/control systems), social, organisational or psychological/attitudinal factors.

Building details, their control systems and key issues to be considered in the design of the study were identified during surveys of the five main office buildings selected for the study. In all of the buildings, temperature fluctuations were a problem, and particularly so in the County Council buildings. While thermal comfort was not a focus of this study, it raised the question of whether it was reasonable to expect building occupants to change their behaviour around heating or cooling in order to save energy when they were not comfortable, or when doing so would reduce their comfort. Such requests could prove unpopular or provoke a backlash against energy saving initiatives. The likely reaction of building occupants to any expected behaviour change was an important consideration.

It was decided that centrally-controlled heating or cooling would not be included in the study. As the building surveys had identified that thermal comfort was perceived as a problem in all of the buildings, and particularly in the County Council buildings, comfort rather than energy conservation was likely to drive people's use of heating and cooling. Additionally, because heating and cooling were not controlled by individuals and did not only affect individuals, it was difficult to examine on an individual basis.

This chapter built on the theoretical and methodological understandings developed in previous chapters by identifying and discussing the methods which would be used to conduct the research. This included consideration of how the different elements could be brought together. The following four chapters present the results of the research study, before Chapters 9 and 10 draw together all of the findings with a discussion leading to the final conclusions.

Chapter 5: Demographics, situational factors and energy demand behaviours

5.1 Introduction

This chapter begins with an introduction to the characteristics of the sample of responses to each version of the questionnaire survey, including situational factors and individual demographics. Energy use behaviours reported by the respondents in the office and home settings are presented and discussed. The chapter examines the relationships between the characteristics of the sample and energy use behaviours reported in the office and home settings. This analysis partly addresses the first objective of this research, by identifying contextual influences on individual energy use in office and home settings.

Section 5.2 details the buildings that respondents are based in and the levels of control that they report over energy demand in those buildings. Section 5.3 presents a summary of the demographics of the samples returned by each building group. Data describing the reported performance of energy demand behaviours in the office setting is presented in Section 5.4., and in the home setting in Section 5.5. The chapter concludes with analysis of correlations between the characteristics of the samples of responses and the reported performance of behaviours in both settings (Section 5.6). A summary of the findings of the chapter is also presented (Section 5.7).

5.2 Situational factors: Buildings and control

The data presented in this chapter was collected by the questionnaire survey. A total of 819 useable questionnaires were returned, with 337 responses from the City Loxley building, 197 responses from the City Other building group, and 285 responses from the County building group. A summary of the responses from each building group, the buildings within that group, and the main building function is presented in Table 5.1. Respondents were based in 103 different buildings, although the majority were based in five buildings: the City Council's Loxley House (40.6%), the County Council's Trent Bridge House (17.3%), and the three buildings making up the County Council's County Hall Complex (9.9%), totalling 67.8%. Further discussion about these five main buildings can be found in Section 4.3, which describes the findings of building surveys conducted prior to the development of the questionnaire.

Building group	Building name/description	Main building function	No. of buildings	Respondents per building group		% of all responses
				n	%	
City Loxley	Loxley House	Office	1	337	100	40.6
		Total	**1**	**337**	**100**	**40.6**
City Other	Lawrence House	Office	1	20	10.6	2.4
	Gate House	Office	1	14	7.1	1.7
	Mary Potter Centre	Service/office	1	14	7.1	1.7
	Denewood Centre	Service/office	1	13	6.6	1.6
	Libraries	Service/office	3	24	12.2	2.9
	Eastcroft Depot	Service/office	4	14	7.1	1.7
	Advice/contact/housing	Service/office	7	18	9.1	2.2
	Leisure, museums	Service	12	19	9.6	1.4
	Children's centres	Service	14	20	10.6	2.4
	Other buildings	Mixture	26	41	20.8	5.1
		Total	**70**	**197**	**100**	**23.8**
County	Trent Bridge House	Office	1	144	48.6	17.3
	County Hall Complex	Office	3	82	27.7	9.9
	Sherwood Village	Office	4	13	4.4	1.6
	Lawn View House	Office	1	11	3.7	1.3
	Other offices	Office	5	19	6.4	2.3
	Day centres	Service	6	12	4.1	1.4
	Other buildings	Mixture	11	15	5.1	1.8
		Total	**32**	**296**	**100**	**35.6**

Table 5.1 *Breakdown and categorisation of buildings in which questionnaire respondents are based*

Respondents from the City Other building group came from the widest spread of buildings, with 197 respondents based in 70 different buildings. The larger number of buildings in this sample reflects that many City Council office functions had been concentrated in Loxley House, so those responding to the City Other questionnaire were likely to be based in smaller, specialised buildings delivering front-line services. This identifies a difference between the services provided by the two Councils: many front-line services delivered by the City Council which require their own specialised buildings, such as children's centres or leisure centres, are not delivered by the County Council, but by separate District Councils which are not part of this study.

5.2.1 Numbers in shared offices

Respondents within the City Other and County building groups were asked how many people (including themselves) shared their office. This was not asked of the City Loxley building group, as it was already known that they were accommodated in very large open-plan offices. To aid analysis of the effect of the number of people sharing an office on the performance of behaviours, the results were recoded into five categories: single person offices, offices of 2 to 6 people, offices of 7 to 15 people, offices of 16 to 30 people, and offices of 31 and more people. Table 5.2 presents the results of these categorisations for each of the building groups.

These categories were chosen to reflect hypothesised social effects: people in single offices have the most individual control, offices with 2 to 6 people are likely to allow for some negotiation with other occupiers about the use of equipment that may affect other people (e.g. lights, desk fans), offices with 7 to 15 people are still small but negotiations might be more difficult, offices with 16 to 30 people are medium-sized offices where negotiation would be much more difficult, and offices with 31 or more people are likely to be open-plan and consequently may have more automated features such as light sensors rather than controls that can be operated by individuals.

Response		**City Loxley**	**City Other**	**County**
n (total responding to this question)		337	196	279
% of respondents	Single person office	0	10.7	2.9
	2 to 6 people	0	32.1	12.9
	7 to 15 people	0	26.0	24.0
	16 to 30 people	0	16.8	28.7
	31+ people	100	14.3	31.5
	Total	**100**	**100**	**100**

Table 5.2 *Responses in each building group (%) categorised by number of people sharing respondent's office*

The distribution of responses in each category indicates that respondents from the City Other building group are more likely to be based in smaller offices (with 68.8% of respondents based in offices of 15 or fewer occupants), while respondents from the County building group were more spread among the categories, with many in medium-sized offices (52.7% of respondents in offices of between 7 and 30 occupants). Respondents within the City Loxley building group were known to be based exclusively in large open-plan offices.

5.2.2 Individual control over lighting

For the office-based behaviours examined in this research, individual control was assumed for all respondents for office computers and monitors, and in the County building group, desk fans and portable heaters. In the City Other and County building groups, respondents were asked to state whether they were able to control lighting in their own offices, meeting rooms and toilets, and whether they could control the lights directly above their own desk separately from those above other people's desks. It was known that respondents from the City Loxley building group did not have individual control over any office lighting apart from within meeting rooms.

Asking respondents to state whether they are able to control lighting necessarily measures their perceptions of their control over the equipment, rather than the objective reality of that control (a respondent may believe that they do not have control when actually they do). In this case, the perception of control is equally important as the reality, as someone who believes they are unable to control equipment will not perform the behaviour of controlling that equipment even if they are actually able to. Assessing the accuracy of respondents' perceptions of control by visiting each building was not practical, not simply because of the number of buildings involved, but also because the initial surveys of the main office buildings (see Section 4.3) identified that building systems and controls varied markedly even within buildings. As it was already known that all of the City Loxley respondents were able to control meeting room lights, they were asked whether they were able to control these lights to measure the accuracy of their perceptions of control.

Questions asked of respondents, and the response categories offered, were:

1. Do the meeting rooms in your building have switches to turn the lights off? (Yes; No; Don't know)
2. Do the toilets in your building have switches to turn the lights off? (Yes; No; Don't know)
3. In the room that is your office, are you able to turn off the lights? (Yes; No; Don't know)
4. If yes to the previous question, are you able to control the lights above your own desk separately from the lights above other people's desks? (Yes; No; Don't know; I have an office to myself)

The results of the questions about control over lighting are presented in Table 5.3.

Lighting question	Response		City Loxley	City Other	County
1. Meeting room lights	n (total responding)		289	195	285
	% of respondents	Yes	85.8	87.2	91.2
		No	2.4	8.7	3.5
		Don't know	11.9	4.1	5.3
		Total	**100**	**100**	**100**
2. Toilet lights	n (total responding)		NA	198	284
	% of respondents	Yes	NA	75.8	81.0
		No	NA	19.2	10.6
		Don't know	NA	5.1	8.5
		Total	**NA**	**100**	**100**
3. Office lights	n (total responding)		NA	197	285
	% of respondents	Yes	NA	84.3	90.5
		No	NA	10.2	7.0
		Don't know	NA	5.6	2.5
		Total	**NA**	**100**	**100**
4. Lights above own desk	n (total responding)		NA	171	258
	% of respondents	Yes	NA	28.6[a]	62.4
		No	NA	69.6	37.2
		Don't know	NA	1.8	0.4
		Total	**NA**	**100**	**100**

NA = Not Applicable (question not asked of those respondents)
[a] 28.6% includes 11 respondents (6.4% of 171) in single-person offices

Table 5.3 *Respondents' reports of control over lighting*

The figures reveal that across all of the building groups, respondents reported similarly high levels of control over lighting, except for lighting directly above their own desk. 62.4% of respondents from the County building group reported control over lights above their own desk, compared to 28.6% from the City Other building group (or 22.2% when respondents in single offices were excluded). This reflects the high proportion of respondents from the County building group based either in Trent Bridge House (48.6% of County respondents) or the County Hall complex (27.7%) (see Table 5.1), which include areas where lights above desks are controlled by pull-switches hanging from the ceilings (see Figure 4.9).

The only question about control of lighting asked of the City Loxley respondents, whether they could control meeting room lights, scored consistently highly across all three sets of responses. This suggests that perceptions of control reported in these answers are close to the reality: a relatively small 2.4% of respondents from the City Loxley group incorrectly reported that they were not able to control lights in meeting rooms, while 11.9% reported that they did not know.

For both the City Other and County building groups, the question about controlling lights above their own desk attracted the highest numbers of missing responses (27 in each of the building groups). This might reflect some confusion for respondents faced with this question; respondents unfamiliar with the hanging light switches used in some buildings might have had trouble understanding the question, while other respondents who did have hanging light switches may have been in an area where the layout of the desks meant that turning off the light would affect a colleague at a neighbouring desk, reducing their perception of individual control over the light. This aspect of lighting is important: even where individuals have control over lighting, their decision to use or not use the lighting may be based on more than their own individual needs or motivations.

5.2.3 Individual control over heating

Respondents from the City Other and County building groups were also asked whether they could control the level of heating in their office from within the office. While 60.6% of respondents from the City Other building group reported that heating could be controlled from within their office, only 17.9% from the County building group reported such control. This reflects the higher proportion of City Other respondents who are based in offices containing smaller numbers of people (see Table 5.2) spread across a range of smaller buildings which may not be dedicated office buildings (see Table 5.1) and which may not have automated or centralised heating systems.

With no control over heating by employees from within the offices in the City Loxley building, and only 17.9% of respondents from the County building group reporting office-level control over heating, it was decided that heating and cooling would be excluded from the study. Even in offices where individuals reported that they could control the heating, this would be difficult to categorise as an individual behaviour, as this generally involves one set of controls affecting the entire environment. While office lighting could be described in a similar way, office lighting is included in this study because lighting controls are more flexible than heating controls, allowing for different areas to be lit or unlit. Additionally, where they exist office lighting controls are

generally more accessible, visible and instantly controllable by the individual than heating controls, and the need or lack of need for lighting can be easily assessed by the individual.

5.3 Individual and household demographics

The questionnaire survey collected information about a number of personal, employment and household characteristics. Section 5.3.1 presents a summary of personal and employment characteristics; household characteristics are discussed in section 5.3.2.

5.3.1 Personal and employment characteristics

Table 5.4 presents a summary of personal and employment characteristics for respondents from each building group. Socio-demographic items collected related to gender and age. Further socio-demographic items relating to educational attainment, income, ethnicity and disability were not collected because these were regarded as sensitive questions that could discourage respondents from completing the questionnaire. Items relating to employment were whether they were full or part-time, whether they had a managerial role (and if so, whether they were part of the Corporate Leadership Team), the length of time in employment with this local authority, the length of time in any local authority employment, and the proportion of working time spent in the office.

Characteristic	Response		City Loxley	City Other	County
Gender	n (total responding)		337	197	285
	% of respondents	Female	57.9	71.0	48.8
		Male	42.1	29.0	51.2
		Total	**100**	**100**	**100**
Full or part time	n (total responding)		336	196	284
	% of respondents	Full time	88.1	78.1	89.4
		Part time	11.9	21.9	10.6
		Total	**100**	**100**	**100**
Manager	n (total responding)		337	197	285
	% of respondents	Yes	30.1	33.8	22.8
		No	69.9	66.2	77.2
		Total	**100**	**100**	**100**
Age	n (total responding)		337	198	282
	% of respondents	24 & under	3.9	2.6	1.4
		25-34	22.6	21.1	23
		35-44	26.1	26.3	25.2
		45-54	31.2	30.0	34.4
		55-64	12.2	20.0	15.2
		65 & over	4.2	0	0.7
		Total	**100**	**100**	**100**
Length of this local authority service	n (total respondents)		337	198	285
	% of respondents	Less than 5 years	29.7	31.8	22.5
		5 to 9 years	20.2	21.7	29.5
		10 to 19 years	23.7	28.3	25.3
		20 years +	26.4	18.2	22.8
		Total	**100**	**100**	**100**
Length of all local authority service	n (total respondents)		337	197	285
	% of respondents	Less than 5 years	20.8	24.9	17.2
		5 to 9 years	22.0	20.8	25.6
		10 to 19 years	22.6	25.4	26.7
		20 years +	34.7	28.9	30.5
		Total	**100**	**100**	**100**
Proportion of time spent in office	n (total respondents)		334	196	281
	% of respondents	Less than half the time	1.2	7.1	3.6
		About half the time	4.2	8.7	5.7
		More than half the time	6.3	21.4	11.4
		Most of the time	47.0	37.2	54.8
		All of the time	41.9	26.6	24.6
		Total	**100**	**100**	**100**

Table 5.4 *Personal and employment characteristics of the responses for each building group*

The first personal characteristic that was measured was the respondent's gender. In both the City Loxley and City Other building groups, the majority of respondents were female (57.9% and

71.0%), while the split between genders was closer for the County respondents (48.8% female). A report by the Local Government Group (2010) identifies that across England and Wales, employees in all areas of local government employment are 75.1% female. However, this figure includes all employment roles, not just office-based employees. The New Policy Institute (Kenway et al., 2012) identifies that five non-office based roles dominate local government employment, accounting for around 40% of the local government workforce. These roles, educational assistants, care assistants and home carers, school mid-day assistants, cleaners and domestics, and kitchen and catering assistants, are overwhelmingly carried out by women, many part-time (Kenway et al., 2012). Taking this into account, women may be over-represented among the City Other respondents, but slightly under-represented among the respondents from City Loxley and County.

The dominance of female respondents in the City Other building group is reflected in the higher proportion of part-time employees within that sample (21.9% compared to 11.9% for City Loxley and 10.6% for County). The New Policy Institute (Kenway et al., 2012) identifies that the sector is dominated by part-time female employment (see above), and this trend continues into the management and administration of directly-provided services such as day centres, libraries and leisure provision. The high numbers of female and part-time respondents from the City Other building group may reflect the different functions of the buildings (see Table 5.1). As many office-based functions throughout the City Council have been concentrated in Loxley House, the City Other building group contains a higher proportion of employees working in directly-provided services. This explanation is supported by the higher proportion of managers in the City Other sample (33.8%) than in the City Loxley (30.1%) and County (22.8%) samples. For many directly-provided services, managers are more likely to be office-based than more junior employees, and so would form a larger proportion of office-based employees in those buildings.

Breaking down further the figures for managers from the County building group identifies that respondents from Trent Bridge House are 26.4% managers, while those from the County Hall complex are 25.6% managers. In the remaining County buildings, however, managers make up only 10.3% of the respondents. The remaining buildings are smaller offices and buildings delivering directly-provided services to the public, so could be comparable to the City Other sample. The large difference in the proportions of managers responding to the questionnaire survey from these types of buildings for each Council could reflect a greater tendency for managers in the City Other building group to be based in the same location as the service they manage, but for managers in the County building group to be based in the main administrative buildings of the County Hall Complex or Trent Bridge House.

For all three building groups, the overwhelming majority of responses from managers came from lower levels of management (such as team or service managers) rather than senior managers within the Corporate Leadership Teams. In the City Loxley building, two members of the Corporate Leadership Team returned completed questionnaires, while one responded from each of the City Other and County building groups.

The distribution of respondents among the age ranges presented in Table 5.4. reveals little difference between the three building groups. The greatest difference is in the 55-64 age range, with City Loxley recording a smaller proportion (12.2%) than either City Other (20%) or County (15.2%). This may again reflect a difference between buildings housing directly-provided services and the functions accommodated in Loxley House.

Two sets of responses for length of time in local authority service were collected. The first was the length of time the respondent had worked for the Council they were currently employed by. The second was the length of time they had worked for any local authority altogether. As expected, higher proportions of respondents reported longer periods of time in all local authority service than in their current employment, indicating that many had worked for more than one local authority during their career. These questions were asked to identify effects arising from the length of time respondents had worked for local authorities rather than in the private sector.

The final question relating to employment characteristics was the proportion of working time spent in the office during a typical working week. It was anticipated that the majority of office-based workers would spend at least half the time in the office, and that the proportion of working time spent in the office might influence energy use behaviours, particularly through habitual or routine factors. Responses were collected for five categories: less than half the time, about half the time, more than half the time, most of the time, and all of the time. The results are presented in Table 5.4. As expected, most respondents spend most of their working time in the office. A difference between the three building groups was found, with City Loxley respondents spending the largest proportion of their time in the office, and City Other spending the smallest. This was anticipated, as the roles concentrated in Loxley House are more administrative, while those in the City Other buildings often relate to services delivered outside the office environment.

5.3.2 Household demographics

The final set of questions about demographics focused on the respondent's household. Questions about the household and behaviours within the home were optional in all three questionnaires, as

there was concern from both Councils that questions about the home might be seen as intrusive in a survey focusing on workplace energy use. The number of missing responses was higher in these sections of the questionnaires.

Two sets of data were collected about household demographics. The first identified how many adults (aged 18 and over) and children lived in the respondent's home, with responses subsequently categorised as 'lone adult', 'lone adult with child(ren)', 'multiple adults', and 'multiple adults with child(ren)'. The second identified the respondent's housing tenure, with response categories of 'owner-occupier', 'rented self-contained property', 'rented shared property', and 'other'. The results of these questions can be seen in Table 5.5.

Question	**Response**		**City Loxley**	**City Other**	**County**
Including yourself, who lives in your home?	n (total responding)		318	185	260
	% of respondents	Lone adult	19.5	20.0	20.4
		Lone adult with child(ren)	4.1	5.4	2.3
		Multiple adults	55.7	50.3	53.1
		Multiple adults with child(ren)	20.8	24.3	24.2
		Total	**100**	**100**	**100**
What best describes your living situation?	n (total responding)		313	184	262
	% of respondents	Owner-occupier	84.3	82.6	87.0
		Rented self-contained property	11.3	10.9	8.8
		Rented shared property	3.5	5.4	2.3
		Other (living with parents)	0.6	1.1	1.9
		Total	**100**	**100**	**100**

Table 5.5 *Frequencies of responses to household questions (% of responses per building group)*

Seemingly low proportions of children in the respondents' homes may be explained by the distribution of ages of respondents, as discussed above. In all three questionnaires, around half of respondents were over the age of 45 (City Loxley 47.6%, City Other 50%, County 50.3%), and many of those over 55, by which points many children of respondents would be aged over 18 and so would be counted as adults. The question was asked in order to identify possible influences on energy use in the home, hypothesising that households with children might behave differently around using energy than households made up entirely of adults. Such an effect would be most noticeable with younger children, and so the classifications made here should suffice.

The question about home ownership was asked as previous research has identified that type of home ownership has an effect on a household's energy use (for a discussion of this, see Barr et al., 2005). The categories account for different levels of control over energy use within the home: an owner-occupier is more able to make changes to the fabric or operation of the building than a tenant, while a tenant in a self-contained property may have more control over use of systems and appliances than a tenant renting a room in a shared house or flat. The 'other' category was left open for individual responses, and all of those responding in this category stated that they were living at home with their parents. In all three building groups, the majority of respondents were owner-occupiers (84.3%, 82.6% and 87.0%). The proportions of responses to each category from each version of the questionnaire for both household questions are similar enough that neither should be a confounding factor when examining household attitudes and behaviours.

5.4 Office-based behaviours

Energy use behaviours in the office setting examined in this research relate to lighting and computers. Questions relating to heating and cooling were excluded from the study (see Section 5.2.3). Respondents in the County building group were also asked about their use of individual desk fans and portable heaters, but these questions were also excluded from this research as comparisons could not be drawn with the other building groups.

This section examines the responses to questions about the performance of lighting and computer use behaviours in the office setting. Section 5.4.1 examines lighting, and Section 5.4.2 examines computer use. Performance of behaviours is self-reported, and the implications of this are discussed in Section 4.2.1. For each behaviour, respondents were asked to indicate how frequently they carried out that behaviour by selecting one of five categories: 'Never', 'Rarely', 'Half the time', 'Frequently', and 'Always'.

5.4.1 Lighting

Respondents in the City Other and County building groups were asked about three different lighting behaviours: A1 Turning off lights in the office when they were not needed, A2 Turning off meeting room lights when leaving the room empty, and A3 Turning off toilet lights when leaving them unoccupied. As it was known that it was not possible for respondents to the City Loxley version to turn off lights in toilets or in the office, they were only asked about their

behaviour around A2 Turning off meeting room lights. Table 5.6 presents the frequencies of responses in each of the five categories.

Behaviour	Response		City Loxley	City Other	County
A1: Turn office lights off when they are not needed	n (total responding)		NA	170	259
	% of respondents	Never	NA	15.9	5.8
		Rarely	NA	11.8	6.6
		Half the time	NA	12.4	13.5
		Frequently	NA	31.2	35.1
		Always	NA	28.8	39.0
		Total	**NA**	**100**	**100**
A2: Turn meeting room lights off when leave room empty	n (total responding)		289	155	233
	% of respondents	Never	1.4	4.5	1.7
		Rarely	2.8	6.5	3.9
		Half the time	2.1	4.5	3.9
		Frequently	19.4	22.6	29.2
		Always	74.4	61.9	61.4
		Total	**100**	**100**	**100**
A3: Turn toilet lights off when leave unoccupied	n (total responding)		NA	141	216
	% of respondents	Never	NA	19.9	51.9
		Rarely	NA	13.5	19.4
		Half the time	NA	4.3	7.4
		Frequently	NA	19.1	9.7
		Always	NA	43.3	11.6
		Total	**NA**	**100**	**100**

Table 5.6 *Frequencies of lighting behaviours in the office setting (% of responses per building group)*

Across all three building groups, respondents reported very high levels of performance for A2 Turning off meeting room lights, with 93.8% (City Loxley), 88.5% (City Other) and 90.6% (County) reporting that they ‘Frequently’ or ‘Always’ carried out this behaviour. The two behaviours asked only of the City Other and County respondents were not reported to be performed as frequently. 60% (City Other) and 74.1% (County) of respondents reported turning off unneeded office lights ‘Frequently’ or ‘Always’.

Across the three lighting behaviours, respondents from the City Other building group reported greater variations in behaviour. For A2 meeting room lights, 11.0% of City Other respondents reported that they 'Rarely' or 'Never' performed this behaviour, compared to 4.2% for City Loxley and 5.6% for County respondents. The responses to A3 toilet lights and A1 office lights were more evenly spread across the categories for City Other than for County respondents. The greater variation for the City Other building group may reflect the larger number of buildings in this group (70, compared to 32 for County), and a consequently greater variety of building layout, design and control systems. The variations could also arise from differences in social norms or in attitudes towards energy conservation, arising from the smaller size of the offices, or from a sense of distance between small offices and the norms or policies of the organisation as a whole. Relationships between situational and demographic variables and the performance of behaviour are explored further in Section 5.6.

The biggest differences between the City Other and County responses can be seen in reports of A3 turning off toilet lights when leaving them unoccupied. While 62.4% of City Other respondents performed this behaviour 'Frequently' or 'Always', only 21.3% of County respondents reported the same frequencies. Again, this may reflect a difference in the design or layout of the buildings: smaller buildings are likely to have correspondingly smaller toilet facilities, perhaps with single cubicles rather than large shared facilities. The normative or habitual responses to light switching in such settings may be different: single cubicles may encourage a response similar to that at home, where people may switch their bathroom lights off when exiting the room, while large shared facilities may lead to occupants not considering whether lights should be turned off, or feeling that such behaviour is not their responsibility, or deliberately leaving lights on out of consideration for other users. The detail of size of toilet facilities was beyond the scope of this study, although the effects of the other situational and demographic influences introduced in this chapter are discussed in Section 5.6.

5.4.2 Computers

As with lighting, three questions were asked about computer-related behaviours in the office. It was assumed that respondents from all three building groups had individual control over computers and monitors. Respondents were asked whether they turned off the computer when they had finished for the day, the computer monitor at the end of the day, and the computer monitor when away from the desk for more than ten minutes. Frequencies of responses are presented in Table 5.7.

Behaviour	Response		City Loxley	City Other	County
B1: Turn off computer when finished for the day	n (total responses)		334	197	285
	% of respondents	Never	0.3	3.6	1.1
		Rarely	0.3	0.5	0.7
		Half the time	0.3	1.0	1.4
		Frequently	1.8	3.0	2.2
		Always	97.3	91.9	94.7
		Total	**100**	**100**	**100**
B2: Turn off computer monitor when finished for the day	n (total responses)		334	196	285
	% of respondents	Never	10.5	5.6	1.8
		Rarely	5.4	3.6	1.1
		Half the time	4.5	4.1	1.8
		Frequently	7.5	6.1	4.9
		Always	72.2	80.6	90.5
		Total	**100**	**100**	**100**
B3: Turn off computer monitor when away from desk for more than 10 minutes	n (total responses)		334	196	285
	% of respondents	Never	54.2	54.1	52.6
		Rarely	23.7	20.9	20.7
		Half the time	8.1	15.3	9.8
		Frequently	7.5	5.6	7.7
		Always	6.6	4.1	9.1
		Total	**100**	**100**	**100**

Table 5.7 *Frequencies of computer behaviours in the office setting (% of responses per building group)*

All three building groups returned similar patterns of responses, with very high frequencies of turning off both B1 computers and B2 monitors at the end of the day, and very low frequencies of B3 turning off computer monitors when away from the desk for more than ten minutes. The responses to the end of the day behaviours were particularly high. 99.1% (City Loxley), 94.9% (City Other) and 96.9% (County) of respondents indicated that they 'Frequently' or 'Always' enacted behaviour B1, turning their computer off at the end of the day. With such consistently high scores, it was unlikely that further analysis of this behaviour would produce useful insights, and the behaviour was therefore excluded from further analysis.

Responses to B2 turning off computer monitors at the end of the day were not quite as uniformly high, with 79.7% (City Loxley), 86.7% (City Other) and 96.9% (County) respondents reporting that they 'Frequently' or 'Always' carried out this behaviour. The results showed greater variation across the categories than for B1 turning computers off at the end of the day, so the behaviour was not excluded from further analysis at this stage.

For all three building groups, responses to B3 turning off the computer monitor when away from the desk were distributed more evenly across the categories than for the other behaviours, but with the majority reporting low levels of performance. 14.1% (City Loxley), 9.7% (City Other) and 16.8% (County) of respondents reported that they 'Frequently' or 'Always' carried out this behaviour. Notably, the pattern of high and low levels of responses held across all three building groups, suggesting that the factors producing differences in lighting behaviours in the different building groups did not have the same influence on computer-related behaviours.

5.5 Home-based behaviours

The behaviours measured in the home-based section of the questionnaire were chosen to relate to the behaviours measured in the office setting. The home lighting behaviours of D2 turning off lights when leaving a room empty and D1 when they were not needed linked to A2 turning off meeting room lights when leaving the room empty and to A1 turning off office lights when they were not needed. The home-based computer behaviours of E1 turning a computer off when finished using it was designed to relate to the office-based behaviour of B1 turning the computer off at the end of the day. Turning off a computer monitor when away from the computer for more than ten minutes was the same question in both settings (B3 and E2). An additional home-based behaviour of F1 turning a television off completely instead of leaving it on standby was included because it might share similarities with other behaviour involving switching off specific equipment, in particular computer monitors.

Table 5.8 presents responses to the questions about home-based behaviours. As with the office behaviours, responses were collected on a five-point scale. However, due to the framing of the questions in the questionnaire, the categories were from 'Strongly disagree' to 'Strongly agree', rather than the scale from 'Never' to 'Always' that was used for the office-based behaviours. Given that these were both five-point scales, this was not anticipated to be a problem for the analysis. An additional category of 'Not applicable' was also included to account for respondents who did not own a home computer or a television. Responses of 'Not applicable' are excluded from the results in Table 5.8 to allow for easier comparison across the behaviours.

Behaviour	Response		City Loxley	City Other	County
D1: Turn off lights in a room when not needed	n (total responses)		317	186	261
	% of respondents	Strongly disagree	2.5	0	2.3
		Tend to disagree	3.2	1.1	0.8
		Neither disagree nor agree	3.5	4.8	2.7
		Tend to agree	28.1	22.0	27.6
		Strongly agree	62.5	72.0	66.7
		Total	**100**	**100**	**100**
D2: Turn off lights in a room when leave room empty	n (total responses)		316	187	264
	% of respondents	Strongly disagree	2.5	2.7	3.0
		Tend to disagree	4.4	4.3	4.9
		Neither disagree nor agree	5.4	7.0	3.8
		Tend to agree	35.4	25.7	30.7
		Strongly agree	51.9	59.9	57.6
		Total	**100**	**100**	**100**
E1: Turn home computer off when finished using it	n (total responses)		305	176	254
	% of respondents	Strongly disagree	4.6	4.5	6.7
		Tend to disagree	5.2	3.4	6.7
		Neither disagree nor agree	6.2	5.7	7.1
		Tend to agree	22.3	14.8	24.0
		Strongly agree	61.6	71.6	55.5
		Total	**100**	**100**	**100**
E2: Turn off home computer monitor when away from desk for more than ten mins.	n (total responses)		280	157	225
	% of respondents	Strongly disagree	31.4	21.0	32.0
		Tend to disagree	21.8	19.7	16.4
		Neither disagree nor agree	13.9	17.2	15.5
		Tend to agree	13.9	17.2	14.2
		Strongly agree	18.9	24.8	21.8
		Total	**100**	**100**	**100**
F1: Turn main TV off fully instead of leaving it on standby	n (total responses)		302	175	251
	% of respondents	Strongly disagree	16.2	11.4	15.9
		Tend to disagree	9.9	6.9	4.0
		Neither disagree nor agree	4.6	7.4	5.2
		Tend to agree	17.9	14.9	19.1
		Strongly agree	51.3	59.4	55.8
		Total	**100**	**100**	**100**

Table 5.8 *Frequencies of home-based behaviours (% of responses per building group)*

Across all five behaviours, the patterns of responses in the three building groups were similar. Slight differences can be seen in the results for the City Other building group, with slightly higher levels of performance of the behaviours reported for all of the behaviours. While the results of the office-based behaviours for the City Other building group were also the most different of the three building groups, in the office setting this did not manifest as higher levels of reported performance of behaviours. This suggests that different factors are influencing the

performance of behaviours in the home and office settings. Relationships between behaviours and influencing factors across the two settings are explored in greater detail in Chapter Six.

High frequencies of performance of the two home lighting behaviours were reported by respondents from all three building groups. D1 Turning lights off when they were not needed recorded the highest frequencies overall, with 90.6% (City Loxley), 94.0% (City Other) and 94.3% (County) of respondents indicating that they 'Tend to agree' or 'Strongly agree' that they perform this behaviour each time. Responses to D2 Turning a light off when leaving a room empty were slightly lower.

Across all of the building groups, patterns of responses to the computer, monitor and TV standby questions were similar. High numbers of respondents agreed with behaviour E1, turning off their computer when they had finished using it, with 83.9% (City Loxley), 86.4% (City Other) and 79.5% (County) reporting that they 'Tend to agree' or 'Strongly agree' with this statement. These figures were not quite as high as the almost universal reports of behaviour for B1, Turning off an office computer at the end of the day (97.3%, 91.4% and 94.7%). This may indicate a difference in these behaviours in different settings: finishing with a computer in the office is likely to be followed by going home, while finishing with a computer at home is likely to involve remaining in the same environment as the computer and possibly returning to it later in the day.

As with the office setting, the responses to E2, Turning off the computer monitor when away for more than ten minutes, were spread more evenly across the response categories. However, the reported levels of performance of this behaviour were higher at home than they were in the office setting. While 32.8% (City Loxley), 42.0% (City Other) and 36.0% (County) reported that they 'Tend to agree' or 'Strongly agree' with the statement that they always perform this behaviour in the home setting, only 14.1% (City Loxley), 9.7% (City Other) and 16.8% (County) reported that they 'Frequently' or 'Always' performed this behaviour in the office setting. Even allowing for differences in the framing of the response categories, this shows a sizeable difference in the reported performance of two very similar behaviours across the two settings. Further analysis of the relationships between behaviours performed in each setting is presented in Chapter Six.

Responses to the final home behaviour, F1 Turning a television off fully rather than leaving it on standby, again followed a similar pattern across all three building groups. The majority of respondents reported that they 'Tend to agree' or 'Strongly agree' that they perform this behaviour (69.2% in City Loxley, 64.3% in City Other and 74.9% in County). Superficially similar patterns of agreement were seen for other behaviours involving turning off electronic equipment (office-based B1 and B2, turning the computer and the monitor off at the end of the

day, and home-based E1, turning the computer off when finished using it). More sophisticated analyses of the relationships between behaviours are presented in Chapter Six.

5.6 Situational and demographic influences on office and home behaviours

Sections 5.2 and 5.3 introduced situational and demographic variables that may influence energy use behaviours. This section examines correlations between those situational and demographic variables and the reported performance of the energy demand behaviours. The demographic and situational variables were made up of both ordinal and categorical variables, and a different statistical test was required for each type of variable.

As many of the responses given to the behavioural questions were concentrated in a small number of response categories, the ordinal data recorded was not normally distributed, and a non-parametric test was required to identify correlations. Spearman's correlation coefficient (rho, r_s), was selected for this purpose. This ranks the data before applying Pearson's product-moment correlation equation to the ranks to produce a correlation coefficient (r), indicating the strength of any relationship found between two variables. As Spearman's rho is used with non-parametric data, the calculation of the correlation coefficient is conducted on the ranked order of the results rather than on the results themselves, as this is a mathematically better way of handling correlations with non-normally distributed data (Field, 2009). This indicates the proportion of shared variance in the ranked order of the data, rather than in the data itself. Calculating the square of the correlation coefficient (r) produces the coefficient of determination, R^2, which indicates the percentage of shared variance in the ranked order of the results (Field, 2009).

To test the correlations of categorical independent variables with the performance of the behaviours, Pearson's chi-square (χ^2) test was used. This examines categorical data in the form of contingency tables and compares the frequencies observed in the categories to frequencies expected to occur by chance (Field, 2009). The strength of a correlation can be identified by examining the Cramer's V statistic, which returns values between 0 and 1, with values closer to 1 indicating a stronger correlation.

The results of the Spearman's rho tests on ordinal variables are discussed in Section 5.6.1, and the results of the Pearson's chi-square tests on categorical variables are discussed in Section 5.6.2.

5.6.1 Correlations between reported behaviours and ordinal variables

Table 5.9 presents the results of the Spearman's rho (r_s) test for correlations between reported behaviours and the ordinal demographic and situational variables (independent variables). Results are presented only where significant correlations were found in at least one of the three building groups. The results reveal that significant correlations were not found for two behaviours, E2 Turn off home computer monitor when away more than ten minutes, and F1 Turn main TV off fully instead of leaving on standby. However, all of the ordinal demographic and situational variables correlate with at least one behaviour in at least one building group.

Behaviour	Demographic and situational variables (ordinal)	Correlation coefficient (r_s)		
		City Loxley	City Other	County
A1: Turn office lights off when not needed	Number who share office	NA	-.438***	-.112
	Age	NA	.114	-.140*
	Length all local authority service	NA	.137	-.123*
	Time spent in office	NA	.162*	.043
A2: Turn meeting room lights off when leave room empty	Age	.096	.194*	.051
A3: Turn toilet lights off when leave unoccupied	Number who share office	NA	-.032	-.256***
	Length this local authority service	NA	.149	-.156*
	Length all local authority service	NA	.225**	-.118
B2: Turn off computer monitor when finished for the day	Time spent in office	.112*	-.064	.138*
B3: Turn off computer monitor when away more than 10 mins.	Number who share office	NA	-.174*	.080
	Time spent in office	-.069	-.119	-.118*
D1: At home, turn off lights in a room when not needed	Length this local authority service	.004	.002	-.191**
D2: At home, turn off lights in a room when leave room empty	Age	-.037	-.022	-.174**
	Length this local authority service	-.004	-.038	-.247***
	Length all local authority service	.023	-.066	-.204**
E1: Turn home computer off when finished using it	Age	.081	.217**	-.017
E2: Turn off home computer monitor when away more than 10 mins.	No significant correlations found	-	-	-
F1: Turn main TV off fully instead of leaving on standby	No significant correlations found	-	-	-

* Significant at .05 level, ** Significant at .01 level, *** Significant at .001 level

NA = Not Applicable (question not asked of those respondents)

Table 5.9 *Significant correlations identified by Spearman's rho tests between reported behaviour and ordinal demographic and situational variables*

Table 5.9 presents the correlation coefficients (r_s) calculated by Spearman's rho. Behaviour A1, Turn office lights off when not needed, returned the strongest correlation among the office lighting behaviours, correlating significantly with the number of people who share the

respondent's office in the City Other building group. The correlation coefficient (r_s) reveals a highly significant ($p < .001$) negative association ($r_s = -.438$); the fewer people share the office, the more frequently the behaviour is reported. The coefficient of determination ($R^2 = .192$) indicates that 19.2% of shared variance in the ranked order of results can be explained by the correlation. As the number of people in the office increases, more people's preferences must be considered, more people need to be negotiated with, or responsibility for turning off lights is shared by more people, and the frequency of reported performance of the behaviour decreases. While this relationship was significant for the City Other building group, it could not be tested for City Loxley and was not statistically significant for the County building group.

In the County building group, significant correlations were found between A1 Turn office lights off when not needed and the respondents' age ($r_s = -.140$, $p < .05$, $R^2 = .020$) and total length of time spent in local authority service ($r_s = -.123$, $p < .05$, $R^2 = .015$). These negative relationships indicate that the older the respondent, or the longer they have spent in local authority service, the less frequently they report performing the behaviour. However, for A2 Turn meeting room lights off, correlations for the City Other building group with age and length of service were positive ($r_s = .194$, $p < .05$, $R^2 = .038$); the older the respondent, or the longer spent in local authority service, the more frequently they report turning off meeting room lights.

For A3, Turn off toilet lights, significant correlations were again found with the numbers sharing the respondents' office, and with the length of time in local authority service. In the County building group, there was a negative correlation for numbers sharing the office, ($r_s = -.256$, $p < .001$, $R^2 = .066$), with more people sharing correlating with lower reported frequencies of the behaviour. The reasons for this may include those for A1 office lighting, discussed above, or the different layouts and size of toilet facilities, discussed in Section 5.4.1, may also be a factor. Larger shared offices may have larger shared toilet facilities, where occupants may feel that it is inappropriate to turn off the lights, or may feel less individual responsibility to do so.

A significant negative correlation in the County building group was found between A3 turning off toilet lights and the length of time in this local authority service ($r_s = -.156$, $p < .05$, $R^2 = .024$). The older the County respondent or the longer spent in local authority service, the less frequently they report turning off toilet lights. However, for the City Other building group, a positive correlation is found between toilet lights and the length of time in local authority service, ($r_s = .225$, $p < .05$, $R^2 = .051$), with more time in service linked to more frequent performance.

B2, Turn the computer monitor off when finished for the day, is the only behaviour to correlate significantly with the same variable in more than one building group. Both the City Loxley and

County building groups returned positive significant correlations between this behaviour and the amount of time the respondent typically spends in the office (City Loxley r_s = .112, p < .05, R^2 = .013; County r_s = .138, p < .05, R^2 = .019). While this was a small effect (explaining 1.3% and 1.9% of the variance), it was consistent across two building groups, and suggests that respondents who spend more time in the office may develop different habits or end-of-day routines to those who are frequently out of the office.

The effect of time in the office is again seen for the County building group for the behaviour of B3 Turning the computer monitor off when away from the desk for more than ten minutes. This relationship, however, was negative, (r_s = -.118, p < .05, R^2 = .014), indicating that respondents spending more time in the office reported less frequent performance. Respondents frequently leaving the office during the working day may develop different routines to those spending most of their day at their desk, perhaps by switching items off as part of a leaving-the-office routine, or by signalling their absence to colleagues or preventing others from reading their computer screen while absent. Those respondents who spent more time at their desks, in turn, might not need to send the same messages or regard short absences from their desks in the same light.

The largest correlation for office-based computer behaviours is in the City Other building group, between the number of people sharing the office and B3 Turning the monitor off when away for more than ten minutes, (r_s = -.174, p < .05, R^2 = .030). This small effect explains 3.0% of the variance, indicating that the more people share the office, the less frequently the behaviour is reported. A similar relationship seen for office lighting and numbers sharing the office suggested that difficulties negotiating with larger numbers of colleagues, or a sense of shared or diffuse responsibility might exist. Such factors do not seem relevant to computer behaviours, but may reflect the development of particular routines or habits in different types of office.

The relationship between similar behaviours in different settings is raised by the results for home lighting behaviours. Negative relationships seen in the office setting for the County building group between A1 Turning office lights off and the influencing variables of age and length of local authority service are echoed in negative relationships in the County building group between home lighting behaviours, age and lengths of service. The strongest of these relationships is between the home behaviour of D2 Turn off lights when leave a room empty and the length of this service for a local authority, (r_s = -.247, p < .001, R^2 = .061); the longer the length of service, the less likely the respondent is to report performing the behaviour, explaining 6.1% of variance. Other negative relationships between home lighting behaviours, age and length of service explain between 3.0% and 4.2% of variance. The consistency with the relationships seen for office lighting behaviours for the County building group suggests that this effect relates to a

characteristic of the older respondents, rather than the office environment, as the effect is seen in both the office and home setting. However, for the City Other building group, with a positive relationship in the office setting between age-related characteristics and lighting behaviours, no significant correlations were seen in the home setting, suggesting that the effect in that building group reflected an interaction between older respondents and the office environment.

The final correlation identified in the home setting is between age and the behaviour E1, Turning the home computer off when finished using it. For the City Other building group, this reveals a significant positive relationship, (r_s = .217, p < .01, R^2 = .047), explaining 4.7% of variance and indicating that older people reported performing this behaviour more frequently. The positive relationship is in line with those seen for lighting behaviours in the office setting for the City Other group. While there is a difference in the effect that age has in the City Other and County building groups, with a higher age correlating with more frequent performance in the County building group and with less frequent performance in the City Other building group, the effects are consistent within each building group.

5.6.2 Correlations between reported behaviours and categorical variables

Pearson's chi-square (χ^2) test was used to examine correlations between behaviours and categorical variables. One assumption of the test is that expected frequencies of responses are greater than five in each response category; without this, the SPSS software may not be able to complete the calculations, as there are not enough cases for correlations to be identified. With some response categories for performance of behaviours containing low numbers of responses (see Sections 5.4 and 5.5), it was necessary to re-code responses from five categories into two to meet this assumption. Responses of 1 to 3 ('Never' – 'Half the time', or 'Strongly disagree' – 'Neither disagree nor agree') were recoded as 'low' performance, and responses of 4 or 5 ('Frequently'/'Always' or 'Tend to agree'/'Strongly agree') were recoded as 'high' performance. While this made the analysis cruder, in this early stage this was felt to be acceptable.

Tables 5.10 and 5.11 present the results of Pearson's chi-square (χ^2) tests, with results only reported for variables where significant correlations were found. Table 5.10 presents the χ^2 statistic, whether this is statistically significant, and the Cramer's V statistic indicating the effect size of the correlation.

Behaviour	Categorical variable	City Loxley		City Other		County	
		χ^2	V	χ^2	V	χ^2	V
A1: Turn office lights off when not needed	Manager Housing tenure	NA NA	NA NA	4.364* 7.750**	.160 .223	.184 .053	.027 .015
A2: Turn meeting room lights off when leave room empty	*(No significant correlations found)*	-	-	-	-	-	-
A3: Turn toilet lights off when leave unoccupied	Gender Full or part time Housing tenure	NA NA NA	NA NA NA	2.101 .063 4.877*	.123 .021 .194	5.749* 4.817* 6.415*	.163 .150 .181
B2: Turn off computer monitor when finished for the day	*(No significant correlations found)*	-	-	-	-	-	-
B3: Turn off monitor when away from desk for more than 10 mins.	Gender Manager Home tenure	6.780** 4.636* 9.103**	.142 .118 .171	1.178 .189 .024	.078 .031 .012	12.261*** .037 2.044	.207 .011 .089
D1: At home, turn off lights in a room when not needed	*(No significant correlations found)*	-	-	-	-	-	-
D2: At home, turn off lights in a room when leave room empty	*(No significant correlations found)*	-	-	-	-	-	-
E1: Turn home computer off when finished using	Housing tenure	.173	.024	14.060***	.287	1.922	.089
E2: Turn off home computer monitor when away more than 10 mins.	Gender	.440	.040	.002	.004	5.294*	.153
F1: Turn main TV off fully instead of leaving on standby	Manager	6.613**	.148	3.195	.135	1.200	.069

* Significant at p < .05, ** Significant at p < .01, *** Significant at p < .001

Table 5.10 *Results of Pearson's chi-square (χ^2) tests for correlations between categorical variables and behaviours*

No significant correlations were found for behaviour A2, meeting room lights, or for the two lighting behaviours in the home setting. The finding for the home setting is surprising, as housing tenure correlates significantly with two office-based lighting behaviours, A1 office lights and A3 toilet lights. That this effect does not translate into the home setting suggests that different variables affect the performance of lighting behaviours in each setting.

Table 5.11 presents cross-tabulations of the results from Table 5.10, indicating the percentage of respondents in each category reporting low or high frequency of performance of the behaviour. Correlations identified as statistically significant in Table 5.10 are in bold type in Table 5.11.

Behaviour	Independent variable		% of category performing behaviour					
			City Loxley		City Other		County	
	Variable	Categories	Low	High	Low	High	Low	High
A1: Office lights	Manager	Yes	NA		**29.5**	**70.5**	23.8	76.2
		No			**45.9**	**54.1**	26.5	73.5
	Housing tenure	Owner-occup.	NA		**34.4**	**65.6**	27.1	72.9
		Renter			**64.0**	**36.0**	25.0	75.0
A3: Toilet lights	Gender	Female	NA		33.3	66.7	**72.0**	**28.0**
		Male			46.3	53.7	**85.3**	**14.7**
	Full or Part time	Full time	NA		38.5	61.5	**80.7**	**19.3**
		Part time			36.1	63.9	**60.9**	**39.1**
	Housing tenure	Owner-occup.	NA		**32.1**	**67.9**	**81.1**	**18.9**
		Renter			**56.5**	**43.5**	**57.1**	**42.9**
B3: Monitor when away 10 minutes	Gender	Female	**82.9**	**17.1**	77.5	22.5	**82.7**	**17.3**
		Male	**70.9**	**29.9**	70.2	29.8	**64.4**	**35.6**
	Manager	Yes	**85.1**	**14.9**	73.1	26.9	72.3	27.7
		No	**74.5**	**25.5**	76.0	24.0	73.5	26.5
	Housing tenure	Owner-occup.	**81.4**	**18.6**	75.3	24.7	74.6	25.4
		Renter	**61.7**	**38.3**	76.7	23.3	62.1	37.9
E1: Home comp. when finished	Housing tenure	Owner-occup.	15.7	84.3	**9.7**	**90.3**	19.2	80.8
		Renter	18.2	81.8	**37.0**	**63.0**	30.8	69.2
E2: Home monitor away 10 mins.	Gender	Female	54.9	45.1	40.9	59.1	**56.9**	**43.1**
		Male	50.9	49.1	41.3	58.7	**41.5**	**58.5**
F1: TV not standby	Manager	Yes	**41.6**	**58.4**	17.7	82.3	30.5	69.5
		No	**26.5**	**73.5**	30.1	69.9	23.4	76.6

Results identified as statistically significant in Table 5.10 presented here in **bold** type.

Table 5.11 *Cross-tabulations of results of Pearson's chi-square (χ^2) tests for correlations between categorical variables and behaviours*

The Cramer's V statistic (Table 5.10) returns a figure between 0 and 1 indicating the strength of a correlation, with figures closer to 1 indicating a larger effect. The percentages of respondents in each category (Table 5.11) indicate the direction of the relationship identified by the correlation.

Significant correlations for lighting behaviours in the office setting have small effect sizes, as represented by the Cramer's V statistic in Table 5.10. For the City Other building group, Table 5.11 reveals that managers reported higher levels of frequency of performance of behaviour A1,

Turn off the office lights when not needed, than non-managers (V = .160). This is not surprising, given that many managers have responsibility for the running of the office environment. Additionally, in the City Other group, more owner-occupiers reported high frequencies of behaviour A1, Turn off the office lights, than renters (65.6% to 36.0%).

No significant correlations were found for A2, meeting room lights, but significant correlations were found between A3 Turn off toilet lights, and gender, full or part-time employment, and housing tenure. In the County building groups, female and full-time respondents reported more frequent performance of A3 toilet lights (female, V = .163; full-time, V = .150). These results may reflect different patterns of use or routines established by men and women or by full or part-time employees. However, the effects seen are very small.

For the behaviour of A3, Turning off toilet lights, a larger proportion of owner-occupiers in the County building group reported high frequencies of performance than renters (67.9% to 43.5%). For the City Other group, however, a larger proportion of renters reported high frequencies of performance than owner-occupiers (42.9% to 18.9%). The effect sizes for both correlations are small, V = .194 (City Other) and V = .181 (County).

Gender produces differences in the performance of computer behaviours in the office setting. In both the City Loxley and County samples, male respondents reported significantly higher frequencies of performance of behaviour B3, Turn off computer monitor when away for more than ten minutes, with 29.9% of males reporting high frequencies compared to 17.1% of females in the City Loxley building group, and 35.6% of males compared to 17.3% of females in the County sample. Although not statistically significant, the same pattern is seen in the City Other results, with 29.8% of males reporting high frequencies compared to 22.5% of females. The results, while only small effects (City Loxley V = .142, County V = .153), are consistent.

An unexpected result is found for behaviour B3, Turn off computer monitors when away more than ten minutes, for managers in the City Loxley building. Unlike behaviour A1 office lighting, managers reported performance of behaviour B3 less frequently than non-managers, with 14.9% of managers reporting high levels of performance compared to 25.5% of non-managers. Why this should be the case is not clear. The managerial role may encourage managers to feel responsibility for the collective actions of their team, leading them to take responsibility for lighting, whereas this effect is not felt for individual computer monitors. This again is only a small effect (V = .118), and is not seen consistently across the building groups.

Similarly, one building group, City Loxley, identifies a small effect (V = .171) for home tenure for B3 Turn off computer monitor when away more than ten minutes, with renters significantly more likely to perform this behaviour in this building group (38.3% compared to 18.6%). With both managerial roles and housing tenure, age might be a factor: younger people may be less likely to be managers and more likely to be renters. However, age was not itself a significant influencing variable for this behaviour.

The largest effect size was seen in the City Other building group for behaviour E1, Turning the home computer off when finished using it, with 90.3% of owner-occupiers reporting high frequencies of this behaviour compared to 63.0% of renters, V = .287. This is not unexpected: those who own their own homes may perform more turning-off behaviour generally as a result of feeling greater responsibility for their homes, while those who rent tend to be younger and so may use technology differently in their homes. Similar relationships to technology may be at play with the final significant correlation, between behaviour F1 Turning the main television off completely rather than leaving it on standby, with 73.5% of non-managers in the City Loxley building reporting this behaviour compared to 58.4% of managers, V = .148. Further exploration of the use of technology within the home is beyond the scope of this research.

5.7 Chapter summary

Chapter Five outlined situational, individual and household characteristics measured by the questionnaire survey, and examined the relationships between those characteristics and energy use behaviours reported in the office and home settings. This analysis partly addresses Objective 1 by identifying contextual influences on individual energy use in office and home settings.

Details about the buildings making up the three building groups were summarised. 337 (40.6%) of responses to the questionnaire survey came from Loxley House, 197 (23.8%) from the City Other building group (comprising 70 buildings, mixed between office and service buildings), and 285 (35.6%) from the County building group (comprising 32 buildings, primarily dedicated office buildings). All respondents from Loxley House were based in large open-plan offices, while those from the City Other building group tended to be based in smaller offices, and those from the County building group were more evenly spread across office sizes.

Levels of control over lighting, heating and computer behaviours were identified. The highest level of control for lighting was for meeting room lights, with 85.8% (City Loxley), 87.2% (City Other) and 91.2% (County) of respondents able to turn these lights off. Respondents from the

City Loxley building could not control office or toilet lights. The biggest difference between levels of control reported in the City Other and County building groups were for lights directly above the respondent's desk, with 28.6% (22.2% excluding single person offices) of City Other respondents and 62.4% of County respondents reporting control over these lights. Heating behaviours were excluded from the study, as no respondents from City Loxley and only 17.9% of respondents from City Other reported having control over heating from within their office. It was assumed that all respondents could turn off their computers and computer monitors.

Socio-demographic and other individual characteristics of the respondents to the questionnaire were summarised. Most were full-time employees in non-managerial roles who spent most of their working time in the office, with a similar spread across age ranges for all three building groups. Most were owner-occupiers with no children aged under 18 living in their home. The biggest difference between the three samples was for gender, with 57.9% (City Loxley), 71.0% (City Other) and 48.8% (County) of respondents being female. These differences were likely to originate in gender differences in the departments based in different buildings.

In the office setting, all three buildings groups recorded the highest frequency of enactment of a behaviour for A1 turning meeting room lights off, with 93.8% (City Loxley), 88.5% (City Other) and 90.6% (County) of respondents reporting that they 'Frequently' or 'Always' carried out this behaviour. The biggest difference between building groups was seen for A3 turning off toilet lights, with 62.4% (City Other) and 21.3% (County) of respondents reporting that they 'Frequently' or 'Always' carried out this behaviour. Overall, responses from the City Other building group showed the greatest variation, reflecting the mix of office and service building types in this group. Responses for all three building groups for computer-related behaviours revealed similar high frequencies of turning off B1 computers and B2 computer monitors at the end of the day, and low frequencies of B3 turning off computer monitors when away from the desk for more than ten minutes. In the home setting, similar patterns were also recorded for all three building groups, with high frequencies of turning off lights or computers, and low frequencies of turning off computer monitors when away for more than ten minutes.

Correlations between situational, individual and household characteristics and the frequency of reported performance of behaviours identified that the largest relationship was in the City Other building group, between numbers of people sharing the office and the frequency with which they reported A1 turning off the office lights. More people sharing the respondent's office correlated with lower frequencies of performing this behaviour, explaining 19.2% of shared variance.

A number of relationships were identified in the City Other and County building groups between lighting behaviours and age or length of local authority service. These suggested that age, length of current local authority service and length of all local authority service were related. This was logical; people who had spent longer in either their current employment or in all local government employment were also likely to be older. Furthermore, the positive relationships between lighting behaviours and these variables in the City Other sample, and negative relationships in the County sample, suggest that the building group is a defining feature, either because of a difference in the samples of respondents in each building group, or because differences in the buildings lead the respondents to behave differently. However, the coefficients of determination (R^2) reveal that these relationships have only a small effect, accounting for between 1.5% (County, A1 office lights, all local authority service) and 5.1% (City Other, A3 toilet lights, all local authority service) of the variance.

Older respondents in the County building group tended to report less frequent performance of light switching behaviours in the office and at home, explaining between 1.5% and 6.1% of shared variance. In the City Other building group, older respondents seemed to be more influenced by the office environment, reporting more frequent performance of light switching behaviours in the office setting, explaining between 3.8% and 5.1% of shared variance, but no significant correlations in the home setting.

Consistent but small effects were seen for correlations between gender and turning off a monitor when away for more than ten minutes. In the office setting, men reported significantly higher frequencies of this behaviour (B3) in the City Loxley and County building groups, with a similar but non-significant relationship in the City Other building group. In the County building group, a significant correlation was also identified for this behaviour in the home setting (E2).

This chapter introduced the data collected by the questionnaire survey, summarising situational, individual and household characteristics, presenting figures for the reported enactment of behaviours examined in this research, and identifying correlations between the characteristics and the enacted behaviours. The next chapter develops this further by examining the relationships between behaviours performed in the office setting and the home setting.

Chapter 6: Individual energy demand behaviours in offices and at home: an investigation of spillover

6.1 Introduction

This chapter addresses Objective 2, to investigate the connections between similar energy demand behaviours performed by individuals in different settings, namely the office and home locations. The chapter investigates uncertainty in the literature about the relationships between behaviours performed in different settings. As discussed in Section 2.3, Stern (2000) categorises pro-environmental behaviours performed within organisations as different to private-sphere environmentalism such as behaviours performed within the home. However, the notion of spillover (discussed in Section 2.5.1) suggests that the adoption of one pro-environmental behaviour can lead to the adoption of further, related behaviours. There is some evidence that behaviours sharing situational cues, or behaviours that the actor has prior experience of, might be performed similarly across different settings (Lee et al., 1995; Daneshvary et al., 1998; Tudor et al., 2007b), although these examples relate to recycling. This chapter examines how energy demand behaviours in the office setting relate to energy demand behaviours in the home setting.

The chapter focuses on two of the main buildings examined in this research, the City Council's Loxley House and the County Council's Trent Bridge House (introduced in Section 4.3). These two buildings represent different levels of control by individual building occupants over their use of energy. Occupants in Loxley House had very little control over their energy use, with building systems such as lighting controlled centrally (apart from in meeting rooms), while occupants in Trent Bridge House could control lights locally, with switches hanging from ceilings above the desks (see Figure 4.9). This chapter considers only responses from occupants of Loxley House and Trent Bridge House because control over energy use within these buildings is consistent for every occupant, while occupants of other buildings (notably the County Hall complex) have different levels of control over energy use within the same building. Additionally, these two buildings returned the largest number of questionnaire surveys, with 337 from Loxley House and 144 from Trent Bridge House, allowing meaningful statistical analyses to be conducted.

Analysis in this chapter is based on two sets of data. First are the responses received to the questionnaire survey from respondents in the two buildings. Second are interviews conducted with occupants of the two buildings. The responses to the questionnaire survey are analysed using several different statistical techniques, as identified in the relevant sections. Analysis of the interviews was conducted using thematic analysis, as discussed in Section 4.5.

Section 6.2 presents the results of analysis of the questionnaire responses, examining behaviours and some of the factors that may drive them, in the office (Section 6.2.2) and home (Section 6.2.3), and comparing the results for the two settings (Section 6.2.4). Section 6.3 discusses the results of the subsequent interviews, for behaviours in the office (Section 6.3.1) and the home (Section 6.3.2), and for links between the two settings (Section 6.3.2). A summary of the chapter drawing together findings from both sets of analyses is presented in Section 6.4.

6.2 A quantitative analysis of energy demand behaviours in office and home settings

6.2.1 Items used in the analysis

Questionnaire items used in this analysis were drawn from the larger questionnaire developed for this research (Section 4.4). Table 6.1 presents items used in the current analysis. Behaviours analysed related to lighting and computer use in office and home settings. Heating and cooling were not included as respondents did not have individual control over these in the office setting.

Items measuring personal, employment and household characteristics, attitude statements and organisational factors were also included, as they could account for differences between respondents in each building. Attitude statements measured respondents' sense of responsibility to save energy in the office and home setting, their sense of obligation to do so, and how good and important they think saving energy is. Statements measuring organisational factors addressed perceptions of the organisation's expectations of employees, the organisation's commitment to energy saving, and the importance placed on energy conservation by senior management.

Variable group	Variable item
Office-based behaviours	A1: Turn office lights off when not needed[1] A2: Turn meeting room lights off when leave room empty B2: In the office, turn off computer monitor when finished for the day B3: Turn off monitor when away from desk more than 10 minutes
Home-based behaviours	D2: At home, turn off lights in a room when leave room empty D1: At home, turn off lights in a room when not needed E1: Turn home computer off when finished using it E2: Turn off home monitor when away from desk more than 10 minutes
Personal, employment and household characteristics	B1. Gender B2. Age B3. Full or part time B4. Managerial role C1. People sharing household C2. Housing tenure
Attitude statements	AS1. Saving energy at work is not my responsibility (R) AS2. Saving energy at home is my responsibility AS3. I should do what I can to help the Council save energy AS4. I should try to save energy at home AS5. Reducing the Council's energy use is a good thing AS6. It is important to reduce the Council's energy use
Organisational factors	OF1. People who work for the Council are expected to try to conserve energy OF2. The Council is committed to saving energy OF3. Senior management see conserving energy as an important priority

[1] Only asked of respondents in Trent Bridge House (no individual control in Loxley House)
(R) Item is reverse-worded, disagreement indicates a more pro-energy saving response

Table 6.1 *Questionnaire survey items used in study of Loxley House and Trent Bridge House*

A total of 481 useable responses to the questionnaire survey were returned by occupants of the two buildings. 337 of these were from the City Council's Loxley House, 19% of the building's 1,785 occupants at the time of the survey. The remaining 144 responses were from the City Council's Trent Bridge House, 32% of the 450 occupants. Demographic characteristics of respondents from all three building groups are discussed in Section 5.3. The City Loxley building group discussed in that section is the same as the Loxley House sample utilised here. The Trent Bridge House sample, however, is a sub-set of the County building group. Demographic items for Trent Bridge House were compared to those for the whole of the County building group presented in Table 5.4.

Only one major difference was found. While women make up 48.8% of the whole County sample, they form only 39.6% of respondents from Trent Bridge House. This also is the main difference between the Loxley House and Trent Bridge House samples, with women forming 57.9% of Loxley House respondents. This may reflect a difference in the departments represented in the survey. While Loxley House accommodates a large proportion of the City Council's office-based employees, Trent Bridge House is one of several County Council office buildings containing a sub-set of employees. Departments based in Trent Bridge House include some technical services (Highways, Transport), and the predominance of men among the respondents may reflect a national gender bias in these types of employment. Nationally in 2008, women made up only 5% of senior roles in highway services and 9% in transport (LocalGov.co.uk, 2008). The effect of this gender balance difference is discussed below.

The range of respondents across each age group was similar in the two samples. Both were also predominantly made up of full-time employees (87.8% and 91.6%). Managers made up 30.1% of Loxley House and 26.4% of Trent Bridge House respondents, although in both cases the number of senior managers was extremely low (2 respondents in Loxley House and 1 in Trent Bridge House). Apart from gender differences, then, the two samples were similar.

6.2.2 Behaviours, attitudes and organisational factors in each office building

Table 6.2 presents a summary of responses given to items measuring office-based behaviours, attitudes and organisational factors. It also presents the results of a comparison of the responses in each building conducted using the Mann-Whitney U test. This is a non-parametric equivalent of the independent t-test which derives a test statistic, *U*. A statistically significant result indicates that the results cannot be said to have been drawn from the same population, and that there are differences between the two samples (Field, 2009). The effect size (r) indicates the strength of this finding, with results of less than .3 (or between 0 and -.3) indicating a small effect, .3 to .5 (or -.3 to -.5) indicating a medium effect, and above .5 (or below -.5) indicating a large effect.

Variable group	Variable item	Building	No. of responses	Mean response[1]	U	Z	p (2-tailed)	r
Office behaviours	A1: Turn office light off when not needed[2]	Loxley H Trent B.H.	- -	- -	-	-	-	-
	A2: Turn meeting room lights off when leave room empty	Loxley H. Trent B.H.	284 120	4.56 4.43	15182.5	-2.096	.033*	-0.104
	B2: Turn off computer monitor when finished for the day	Loxley H. Trent B.H.	334 144	4.25 4.79	19878.5	-4.085	.000***	-0.187
	B3: Turn off computer monitor when away more than 10 minutes	Loxley H. Trent B.H.	334 144	1.89 2.07	22076.5	-1.549	.121	-
Office attitudes	AS1. Saving energy at work is not my responsibility (R)	Loxley H. Trent B.H.	312 129	2.10 2.18	19778.5	-0.300	.763	-
	AS3. I should do what I can to help the Council save energy	Loxley H. Trent B.H.	310 130	4.17 4.40	16858.0	-2.965	.002**	-0.141
	AS5. Reducing the Council's energy use is a good thing	Loxley H. Trent B.H.	327 139	4.68 4.53	29162.0	-3.104	.002**	-0.144
	AS6. It is important to reduce the Council's energy use	Loxley H. Trent B.H.	329 139	4.81 4.65	19458.5	-3.754	.000***	-0.174
Organisational factors	OF1. People who work for Council are expected to try to conserve energy	Loxley H. Trent B.H.	326 139	3.59 3.65	22026.0	-0.504	.615	-
	OF2. The Council is committed to saving energy	Loxley H. Trent B.H.	326 138	3.72 3.63	20874.0	-1.299	.202	-
	OF3. Senior management see conserving energy as an important priority	Loxley H. Trent B.H.	326 138	3.10 2.96	20488.5	-1.610	.106	-

[1] Mean score out of 5, high score indicates agreement with statement. [2] Only asked of Trent Bridge House as Loxley House could not perform behaviour
(R) Reverse worded; disagreement indicates a more pro-energy saving response
Z Value of observation in standard deviation units (Z score), used to calculate r ($r = Z / \sqrt{N}$)
* Significant at $p < .05$ level, ** Significant at $p < .01$ level, *** Significant at $p < .001$ level
r Effect size, calculated only for stat. significant results. Small effect < .3 (or > -.3); medium effect .3 – .5 (or -.3 to -.5); large effect > .5 (or < -.5)

Table 6.2 *Comparison of responses in each building to items measuring office behaviours, office attitudes and organisational factors*

Respondents from both buildings reported high frequencies of A2 turning off meeting room lights and B2 turning computer monitors off at the end of the day. Both samples reported low frequencies of B3 turning off monitors when away for more than ten minutes. Respondents in Loxley House were not asked about A1 turning off office lights when not needed as they did not have control over this behaviour; respondents in Trent Bridge House reported high frequencies of performance of this behaviour, although slightly lower than either meeting room lights or monitors at the end of the day.

Mann-Whitney U-tests compared responses to each item in each building (Table 6.2), revealing differences between two of the three behaviours in each office. Respondents in Trent Bridge House were significantly more likely to report behaviour B2, turning off their monitor at the end of the day, than respondents in Loxley House ($p < .001$, $U = 19878.5$, $r = -0.187$). Conversely, respondents in Loxley House were significantly more likely to report behaviour A2, turning off meeting room lights ($p < .05$, $U = 15182.5$, $r = -0.104$). The effect sizes (r) are small for both behaviours. The difference between samples for behaviour B3, turning off the monitor when away for more than ten minutes, was not statistically significant.

As discussed above, a higher proportion of women responded to the survey from Loxley House than from Trent Bridge House. An examination of the relationship between gender and behaviour across all three building groups (Section 5.6) found some small but significant differences between men and women's responses for behaviours B3, Turn off monitor when away more than ten minutes, with men in both building groups reporting more frequent performance, and E2, Turn off home monitor when away more than ten minutes, with men in the County building group reporting more frequent performance. However, gender does not seem to have an effect in the analyses presented here. For behaviour B3, Turn off monitor when away more than ten minutes, no significant difference was found between the responses from Loxley House and Trent Bridge House. This is not a surprise, as the effect sizes seen in Section 5.6 were very small, and were similar for both the City Loxley and County building groups ($V = .142$ and $.153$), and so do not appear as a sizeable difference in the current analysis.

Across both buildings, respondents reported high levels of agreement with office-based attitude statements, with the exception of AS1, Saving energy at work is not my responsibility. The wording of this item was reversed, so disagreement indicated a more positive attitude towards energy saving. Most respondents disagreed with the statement, in line with positive responses to the other statements. Results of Mann-Whitney U-tests revealed no significant difference between the two samples for this statement. For the other attitude statements, however, there were small but significant differences. Respondents in Loxley House were more likely to agree

that reducing the Council's energy use was AS5 'a good thing' ($p < .01$, $U = 29162.0$, $r = -0.144$) and AS6 'important' ($p < .001$, $U = 19458.5$, $r = -0.174$), while respondents in Trent Bridge House were more likely to agree that they AS3, Should do what they can, to help the Council save energy ($p < .01$, $U = 16858.0$, $r = -0.141$).

These results distinguish between three types of attitude: an assigned responsibility to act (AS1, not my responsibility), a moral sense of obligation to act (AS3, should do what I can), and an assessment of the value of acting (AS5, a good thing, and AS6, important). The differences in behaviours in the two buildings are accompanied by differences in the respondents' sense of moral obligation to act (with respondents in Trent Bridge House feeling this more strongly) and the value of acting (with respondents in Loxley House feeling this more strongly).

As the two samples originate from different organisations, it is important to identify whether differences stem from the buildings respondents are based in, or the organisations that employ them. The three statements concerning organisational factors measured respondents' perceptions of the importance of energy saving to the organisation, through their perceptions of the expectations placed on employees (OF1), the organisation's commitment to energy saving (OF2), and the importance of energy saving to senior management (OF3). Responses were not as decisive as for the behaviour and attitude items. For OF1 and OF2, most respondents selected either '3 = Neither agree nor disagree' (Loxley House, 36.2% and 26.1%; Trent Bridge House, 35.3% and 39.1%) or '4 = Tend to agree' (Loxley House, 39.9% and 44.2%; Trent Bridge House, 35.3% and 39.1%). For OF3, responses were even more ambivalent, with 46.3% (Loxley House) and 42.0% (Trent Bridge House) selecting '3 = Neither agree nor disagree'. The similarity of responses from both samples was confirmed by non-significant results for Mann-Whitney U-tests on all three statements. Respondents' perceptions of their organisation's commitment to energy saving did not predict differences between the two samples' office-based behaviours.

6.2.3 A comparison of behaviours and attitudes at home

Table 6.3 presents results from Loxley House and Trent Bridge House respondents for behaviours and attitudes at home. Mean responses revealed high levels of reported performance of behaviours and high levels of agreement with attitude statements, with the lowest mean response for both samples being for the behaviour of turning the home monitor off when away for more than ten minutes. The statistical significance of differences between the responses to each item given by each sample was again tested using the Mann-Whitney U-test.

Variable group	Variable item	Building	No. of responses	Mean response[1]	U	Z	p (2-tailed)
Home behaviours	D1: At home, turn off lights in a room when not needed	Loxley H. Trent B.H.	316 130	4.45 4.59	19340.0	-1.146	.253
	D2: At home, turn off lights in a room when leave room empty	Loxley H. Trent B.H.	315 132	4.30 4.34	20121.5	-0.597	.554
	E1: Turn home computer off when finished using it	Loxley H. Trent B.H.	305 128	4.31 4.25	19717.0	-0.771	.449
	E2: Turn off home monitor when away from desk more than ten mins.	Loxley H. Trent B.H.	280 113	2.67 2.90	14483.0	-1.347	.177
Home attitudes	AS2. Saving energy at home is my responsibility	Loxley H. Trent B.H.	311 130	4.52 4.53	19929.0	-0.272	.790
	AS4. I should do what I can to save energy at home	Loxley H. Trent B.H.	311 130	4.46 4.58	18172.0	-1.909	.058

[1] Mean score out of 5, high score indicates agreement with statement

Z Value of observation in standard deviation units (Z score), used to calculate r ($r = Z / \sqrt{N}$)

Table 6.3 *Comparison of home-based energy use behaviours and attitudes reported by each sample*

A significant result from the Mann-Whitney U-test would have indicated that the two samples were drawn from different populations. However, all of the results were non-significant, indicating no statistical difference between the two samples. Again, gender differences seen in the behaviour reported by respondents from the full building groups did not translate into significant differences between the responses from Loxley House and Trent Bridge House. The only item that was close to significance (p = .058) was the attitude statement AS3 'I should do what I can to save energy at home', suggesting that respondents from Trent Bridge House showed slightly higher levels of agreement with this statement than respondents from Loxley House. These results reveal that, while there were significant differences between the two samples for behaviours and attitudes in the office, there were no significant differences between the two samples for behaviours and attitudes at home.

6.2.4 Behaviour in the office versus behaviour at home

The behaviours included in the questionnaire survey for the home setting were selected for their similarities to the behaviours measured in the office setting. Examining the relationships between the performance of similar behaviours in different settings tests how influential the setting of the behaviour is for its performance, and whether there are strong links between the performance of similar behaviours in different settings.

Correlations between behaviours were calculated using the non-parametric Spearman's rho (see Section 5.6). Table 6.4 presents correlation coefficients between each of the behaviours in the office and home settings, indicating statistically significant results with * or **. The size of the correlation coefficient (r) represents the level of variance shared between the two behaviours indicated by the row and column, with values closer to 0 indicating low levels of shared variance, and a value of 1 indicating identical variance (Field, 2009).

Behaviour	Building	A1	D1	A2	D2	B2	E1	B3	E2
A1: Turn office lights off when not needed	Loxley H.	-	-	-	-	-	-	-	-
	Trent B.H.	1	.27**	.25**	.14	.15	.22*	-.06	.11
D1: At home, turn off lights in a room when not needed	Loxley H.		1	.12	.66**	.07	.41**	.10	.23**
	Trent B.H.		1	.17*	.55**	.16	.54**	-.06	.30**
A2: Turn meeting room lights off when leave room empty	Loxley H.			1	.08	.02	.12	.01	.12
	Trent B.H.			1	.23*	.15	.30**	.23**	.23*
D2: At home, turn off lights in a room when leave room empty	Loxley H.				1	.12*	.25**	.15**	.17*
	Trent B.H.				1	.15	.19*	.16	.21*
B2: Turn off computer monitor when finished for the day	Loxley H.					1	.08	.33**	.13*
	Trent B.H.					1	.02	.15	.21*
E1: Turn home computer off when finished using it	Loxley H.						1	.08	.27**
	Trent B.H.						1	.06	.25**
B3: Turn off computer monitor when away from desk for more than 10 mins.	Loxley H.							1	.35**
	Trent B.H.							1	.31**
E2: Turn off home monitor when away from desk for more than 10 mins.	Loxley H.								1
	Trent B.H.								1

Spearman's rho (r). * Correlation significant at $p < 0.05$ level (2-tailed) ** Correlation significant at $p < 0.01$ level (2-tailed)
Similar-sized correlation coefficients can have different significance values because of differences in the numbers of respondents to each question.

Table 6.4 *Correlations between office and home behaviours*

The first behaviour examined in Table 6.4, A1: office lights, was only measured for Trent Bridge House as occupants of Loxley House could not control office lights. This correlated significantly with two other lighting behaviours, D1: home lights when not needed and A2: meeting room lights, although the correlation coefficient (r) indicated a small effect size, with R^2 revealing shared variance of 7.3% (D1: turn off home lights when not needed) and 6.3% (A2: meeting room lights). A1: office lights also showed a slightly weaker correlation with E1: turn home computer off, sharing 4.8% of the variance. The correlation with the other home lighting behaviour, D2: home lights when leave room empty, was not significant. This suggests that the relationship is not only related to the type of equipment (lights, computer monitors), but also to triggers for the behaviour (when not needed, when leaving a room empty).

Behaviour D1: home lights when not needed recorded the largest effect sizes for correlations in both buildings. Significant correlations were found with D2: home lights when leave room empty (indicating shared variance of 43.6% for Loxley House and 30.3% for Trent Bridge House), with E1: home computer off when finished using it (16.8% and 29.2% respectively), and with E2: home monitor when away more than ten minutes (5.3% and 9.0%). All of these correlations were between behaviours in the home setting, with the strongest being for behaviours that shared equipment and location (home lighting) but with different triggers for the behaviour (when not needed, when leaving the room empty).

The relationships between the office behaviour of A2: turn meeting room lights off when leave room empty, and the four home behaviours, are the clearest difference between the two samples, with all four correlations for Loxley House being non-significant and for Trent Bridge House being highly significant. A2: meeting room lights in Trent Bridge House correlates significantly with all four home-based behaviours, and all but one office-based behaviours (B2: computer monitor when finished for the day), while A2: meeting room lights in Loxley House does not correlate significantly with any other behaviour. Effect sizes for the six correlations for Trent Bridge House are quite small, explaining between 2.9% (D1: home lights when not needed) and 9.0% (E1: home computer off when finished using it) of shared variance.

Analysis in Section 6.2.1 identified that respondents in Loxley House reported more frequent performance of behaviour A2: Turn meeting room lights off than respondents from Trent Bridge House. This is perhaps surprising, as respondents in Trent Bridge House with individual control over office lighting might have been expected to develop stronger light-switching habits than respondents in Loxley House. One explanation is that this reflects a social desirability bias. As the occupants of Loxley House had fewer opportunities in the questionnaire to present themselves as people who perform environmentally-conscious behaviour, they might have been

more inclined to give a more pro-environmental response to this statement than the occupants of Trent Bridge House, who had already had several opportunities to demonstrate pro-environmental behaviours in the questionnaire. Alternatively, this could reflect a difference in the view of lighting in Loxley House: when the City Council acquired the building, it was promoted to employees as a more energy efficient building than those it replaced, and this emphasis on the building's energy saving features may have encouraged occupants to think more about turning lights off when leaving the meeting rooms. This is supported by the higher levels of agreement that the Council saving energy is 'a good thing' and 'important' among Loxley House repondents than among Trent Bridge House respondents (Section 6.2.1). The disruption to usual patterns of behaviour, then, is not necessarily detrimental to energy saving in Loxley House.

It is no surprise that the strongest correlations across the office and home settings in both samples is between the two versions of turning off the computer monitor when away for more than ten minutes (B3 and E2), explaining 12.2% of the variance for Loxley House and 9.6% for Trent Bridge House. The behaviours share both the type of equipment and the triggers for the behaviour. The second biggest effect size across locations for Trent Bridge House (explaining 9% of the variance) is between A2: Turn meeting room lights off when leave room empty, and E1: Turn home computer off when finished using it. These are different types of equipment, but could arguably share a trigger of the behaviour occurring when the use of the equipment has ended. However, the relationship is non-significant in Loxley House, suggesting different influences on the performance of behaviours in each office building.

Of the 49 correlations between behaviours reported in Table 6.4, more than half (27) are statistically significant. A slightly greater number of significant correlations is found between behaviours in the same setting (office and office, or home and home) than in different settings (office and home), with 15 in the same setting and 12 in different settings. This is clearer when only correlations that are significant in both buildings are considered. Of these, six are for behaviours performed in the same setting and one for behaviours in different settings. This suggests that performance of the behaviours is strongly influenced by the setting it occurs within.

Overall, there were more links between the office-based and home-based behaviours for Trent Bridge House than for Loxley House, with 8 significant correlations for Trent Bridge House and only 3 for Loxley House. The differences between office behaviours in the two samples are reflected in different patterns of correlations for each sample. There were more connections across settings for lighting behaviours in Trent Bridge House than in Loxley House, even accounting for one less lighting behaviour being measured in the Loxley House sample. This may reflect the higher level of individual control over lighting in Trent Bridge House than Loxley

House: with fewer constraints, respondents may perform established patterns of behaviour, such as habitually switching a light off when leaving a room. One explanation is that constraints on a behaviour, such as having less control over lighting, cause a disruption to the usual pattern of behaviour that has an impact beyond the specific behaviour that is constrained, affecting the performance of other related behaviours as well. This is supported by the different patterns of correlations with behaviour A2: meeting room lights seen in each sample, discussed above.

The earlier analysis (Section 6.2.1) of the responses given to items measuring behaviour, attitudes and organisational factors identified that responses to two behaviours and three attitude statements were significantly different between the two buildings. The behaviours identified were both office-based, with respondents from Loxley House reporting higher frequencies of performance of A2: Turn meeting room lights off, and respondents from Trent Bridge House reporting higher frequencies of performance of B2: Turn computer monitor off when finished for the day. Respondents in Loxley House were more likely to agree that reducing the Council's energy use was AS5 'a good thing' and AS6 'important', while respondents in Trent Bridge House were more likely to agree that they AS3 'should do what they can' to help the Council save energy. To identify whether the differences in reported performance for these two behaviours were related to the responses to these three statements, correlations between the behaviours and attitude statements were examined (Table 6.5).

Behaviour	Building	Should do what I can to help Council save energy	Reducing Council's energy use is good thing	Important to reduce Council's energy use
A2: Turn meeting lights off when leave room empty	Loxley H.	.063	.178**	.108
	Trent B.H.	.105	.107	.103
B2: Turn off computer monitor when finished for day	Loxley H.	.034	-.017	-.022
	Trent B.H.	.087	.146	.108

Spearman's rho (r).
** Correlation significant at p < .01 level (2-tailed)

Table 6.5 *Correlations between two behaviours and three attitude statements*

Only one correlation is statistically significant, for Loxley House between behaviour A2: meeting room lights and the attitude statement AS5, reducing the Council's energy use is a 'good thing' ($p < .01$, $r = .178$). The effect size from this correlation is small, accounting for just 3.2% of the variance in the ranks. Overall, then, differences between the performance of the two behaviours in the two buildings is not explained by the respondents' sense of moral obligation to save energy, or by their assessment of energy saving as 'important'. Their assessment of energy saving by the Council as 'a good thing' explains a small proportion of the difference in behaviour between the

respondents in the two buildings for meeting room lights, but none of the difference for turning off the monitor at the end of the day.

The influences on energy demand behaviours in the office setting and how these relate to behaviours performed in the home setting were explored further in semi-structured interviews conducted after the questionnaire survey had been administered. Section 6.3 discusses the results of thematic analysis of the interview data.

6.3 A qualitative analysis of energy demand behaviours in office and home settings

The qualitative analysis presented here focuses on four of the nine interviews conducted following the questionnaire survey, with two of the interviewees based in Loxley House and two based in Trent Bridge House. The remaining five interviewees were based in other City and County Council buildings, and their responses are not considered here. Analysis of such a small number of interviews is not intended to identify the full range of attitudes to and influences on energy demand among the employees of the two Councils, but rather to explore other influences on individual behaviour that were not captured by the quantitative analysis.

The interviews were conducted face-to-face in meeting rooms in the respondents'office buildings, using a semi-structured design, with responses analysed using thematic analysis. The development of the interviews, the questions asked and the methods used to analyse the responses are discussed further in Section 4.5.

Section 6.3.1 discusses the responses they gave to questions about energy use in the office setting, and Section 6.3.2 discusses responses about energy use in the home. Section 6.3.3 then discusses the similarities and differences between energy use in the office and at home identified by the respondents, and draws some conclusions about the findings from this qualitative analysis.

Some of the characteristics of the interviewees are presented in Table 6.6, along with the pseudonym by which they are known in this research.

Pseudonym	Building	Gender	Age range	Time in building	Time with Council	Manager
Jamie	Loxley H.	Male	25-34	1 year	4 years	No
Diane	Loxley H.	Female	55-64	18 months	9 years	No
Gemma	Trent B.H.	Female	25-34	2 years	2 years	No
Alan	Trent B.H.	Male	45-54	21 years	21 years	Yes

Table 6.6 *Characteristics of interviewees*

The interviewees represent a spread of ages, gender and length of time in Council employment, as well as length of time in the building they are based in (Loxley House had only been occupied by the City Council for about 2 years at the time of the interviews). Alan was a manager, but at team leader level rather than senior management; the other three interviewees did not have managerial responsibilities. Summaries of each interviewee's general approach to energy saving as they expressed it in the interviews are given below.

Jamie (Loxley House) sees saving energy as the morally 'right thing to do', although he claims to be better at behaving in accordance with this view in the office than at home, where having a pleasant environment is more important to him than saving energy. He believes that finance is the biggest driver within the organisation at present. He suggests that concern about finance is reflected in a mismatch between senior management and the rest of the organisation, with low expectations of employees' behaviour, and most employees so concerned about whether they will continue to have a job that they do not think about issues such as energy saving.

Diane (Loxley House) sees the Council's role as an example to other organisations as an important reason for energy saving to be a high priority. She thinks the Council promotes energy saving extensively within the organisation, but driven more by financial considerations than by environmental issues. Taking on responsibility for saving energy is important for Diane. She sees these responsibilities as clearly defined within people's job roles – Facilities Management deal with the day-to-day management of the building and its systems, while the commitment to energy saving within the Council's policies ensures that managers and Councillors address the issue. More generally, however, Diane suggests that the lack of ownership of energy saving is a problem. While there is an expectation that people will take responsibility for energy saving within their jobs, this is weaker in the lower levels of the organisation.

Gemma (Trent Bridge House) also sees the Council's role as an example to others as an important reason for it to save energy, and also considers it the 'right' thing to do. While energy

saving does seem high on the Council's agenda to Gemma, she suggests that this is mostly driven by financial considerations. As the most recently employed interviewee (having worked for the Council for two years), her only experience of working for the Council is during budget cuts, and this has been a prominent theme throughout her employment. Unlike Jamie and Diane, Gemma frequently refers to the colleagues she shares her office with, describing a team culture of negotiating and working together (for example, they all completed the questionnaire survey at the same time and discussed it afterwards). She suggests that policy alone is not enough to influence behaviour, but practical steps are also needed. She is happy to play her part in saving energy, if someone else takes responsibility for making it easier for her to act.

Alan (Trent Bridge House) is personally highly motivated by saving money, and thinks that the Council should be as pro-active as he is on energy bills by seeking out the cheapest deals with energy providers. Alan also suggests that environmental awareness should be a higher priority for Council employees, including testing commitment to the environment during job interviews so that they come into the organisation with an expectation that the environment and energy will be high priority issues. He suggests that incentives, such as rewards for employees who don't commute by car, or 'team challenges' to save energy in the office buildings, could be motivators, although disincentives would be demoralising. Some employees, he believes, will always try to resist changing their behaviour, although many will be willing to try to save energy.

6.3.1 Energy conservation in the office

Before the interview questions had referred to the topic, all four interviewees independently referred to the influence of budget cuts on attitudes at work. All four interviewees talked about the fear of redundancy, and that many of their colleagues were 'keeping their heads down and hoping they're still here in six months' (Jamie, Loxley House). They all also reported that this was having a detrimental effect on employee morale and motivation. When asked whether budget cuts could be used as a reason to encourage people to save energy at work, there were mixed responses. For Jamie (Loxley House) this might be acceptable to some employees, but some would complain no matter what:

> 'Most people'd be all right about it. Some people would complain, kick up a fuss, some people'd go to the unions and moan, some people would, you know, really get upset about it because they're being told what to do more than anything else.'

For Diane (Loxley House), using budget cuts to motivate people to save energy was a possibility, if the issues were explained to people so that they understood why they were being asked to behave in a certain way; if not, it could provoke a backlash against energy saving, as 'the straw that broke the camel's back'. Gemma (Trent Bridge House) also saw the levels of demoralisation as a negative influence on people's willingness to save energy:

> 'Morale is low, nobody quite knows what the future looks like, people are sick of hearing about budget cuts, about redundancies… Do people really want to help? They're at a point where they've had enough.'

External influences on people's willingness to save energy, then, included the political or economic climate that people worked within, as well as the physical, social and organisational context of their behaviour. The framing of the reasons for saving energy would be important for the implementation of any interventions to change behaviour: while the cost of energy was an important factor in how employees thought about energy even in the office setting, appealing directly to this motivation could have a negative impact on their willingness to save energy.

Interviewees were asked about their perceptions of the organisation's expectations for individual employees around energy saving. Across both buildings, interviewees reported that they did not feel that the organisation put additional expectations on employees. Diane (Loxley House) said:

> 'I guess they would just expect you to be responsible about it, just as they would anything to do with work… I mean, I don't feel I've been told to act in a certain way about it or anything.'

This sentiment was echoed by Alan from Trent Bridge House:

> 'I think [the council] just expects people to get on with the job and do the job they need to do. How that saves energy past that, uh, I don't think there's a great deal of consideration.'

Across both organisations, energy saving at work was framed in terms of being 'professional' and 'carrying out my job'. Energy efficiency was not seen as a high priority for individual employees, but was also described as a desirable outcome of professionalism: being a responsible officer who was good at their job would also result in being energy efficient. However, there was also a level of cynicism about whether the organisation really valued energy saving or environmental issues:

> Jamie (Loxley House): 'I think sometimes a Council may pay lip service to a particular green issue just purely to get money in, for themselves. It is, it's all about the cash, that's all it is. Me personally, I'd like to do it for better reasons, not purely for money, it's just that I think in this day and age especially, money's the driver for everything. I think if they could save money by turning lights on I think they would do [laugh].'

In both buildings, interviewees reported feeling that there was a divide between senior management and general employees over energy saving. Diane (Loxley House) identified a difference in expectations, suggesting that 'the lower down you get the less expectation there is… because [energy saving] is in the [corporate] plans. When you get down to your colleagues you'll always get the individual thing.'

But senior management's leadership generally was not always viewed positively by employees:

> Jamie (Loxley House): 'I think there's sometimes a disconnect between how senior managers expect people to do the job and then, the front line if you like… Over a number of issues, not just energy, just, how they work in general. I think a lot of senior managers just don't understand the day to day job enough to be able to kind of, make decisions on that basis. And they don't involve the front line people enough to help them make those decisions.'

It should be no surprise that feelings of disconnect between senior management and employees that are present more generally are also felt around the specific issue of energy saving. Here, specific behaviours are seen to contradict the generally pro-energy saving position of the organisation as a whole:

> Alan (Trent Bridge House): 'You often see empty offices with the lights left on… One of the prime culprits… is our Council senior leadership team, which is the very top level of management. They regularly meet in [a nearby room] and the lights are always left on when they finish. Which doesn't set a very good example to everybody else… How can you be motivated to do your bit if you see that people at the top aren't doing their bit?'

In both buildings, there was disagreement about whether the behaviour of colleagues influenced the performance of energy saving behaviours. Whether people encouraged their colleagues to perform these behaviours was seen as dependent on the individual's own attitudes or beliefs:

> Diane (Loxley House): 'You might get one or two people who are very energy conscious and say something, but on the whole people just look after themselves… they don't sort of put pressure on their colleagues, saying 'you haven't turned your computer off' or this, that and the other.'

Often, the behaviours were described as 'just happening', as part of the routine of day-to-day activities. Jamie (Loxley House) reported that, 'You leave a room and somebody will [turn the light off], it's not the same person every time, it's just what happens.'

One difference that did arise between the two buildings was in the perception of the negotiations that occurred around behaviours. In Trent Bridge House, this was described as a conscious consideration of colleagues' needs:

> Gemma (Trent Bridge House): 'We're fairly, you know, 'is it all right, can I open the window'… and we're aware that one of the team members gets particularly cold, so we'll always open a window that's not near her, or just tend to discuss it and see how everyone's feeling… There doesn't seem to ever be any issues about it.'

Alan from Trent Bridge House also saw the team as an important influence on behaviour, and suggested that 'team challenges' which encouraged employees to work together to save energy would be a good way to change behaviours, particularly with incentives.

In Loxley House, however, the picture was more complex. Consideration for colleagues was apparent, particularly around leaving shared equipment such as printers switched on for colleagues to use. Diane described the difference between controlling shared equipment in her old building and Loxley House, saying:

> 'I used to [turn equipment off] in my old building, because if I was the last one out of the room I knew no one else was going to be there, but because it's shared facilities [in Loxley House], you can't really, you know, turn things off, because someone else'll be along in five minutes time.'

However, this is a passive process, where building occupants leave equipment in the state it is in, rather than the active process of negotiation between colleagues described by Gemma in Trent Bridge House. For Jamie in Loxley House, having more active control over equipment such as lighting was potentially problematic:

> ‘I think if you had the ability to turn off the lights in your area, then you’d be more likely to [save energy] but then, there’d be arguments, there’d be people standing up and switching lights on and off all day, it would just get silly.’

Where in Trent Bridge House, negotiation with colleagues was seen as a normal part of daily interactions, in Loxley House, where there was no need for negotiations over lighting or temperature as they could not be controlled locally, this was seen as a potential source of conflict. This suggests that, in Loxley House, taking away that control has also affected the way the colleagues relate to each other, at least over that issue. Whether this has any further significance for workplace dynamics cannot be identified from this study, but it is an interesting area for future research into the effects of automation in offices.

6.3.2 Energy conservation at home

The use of energy in the home was only a small focus of the interviews, but did reveal some interesting similarities between the interviewees. The two interviewees from Loxley House, Jamie and Diane, expressed similar attitudes towards saving energy in the home. Both were defensive in the way they discussed energy saving in the home, stating that ‘I try, but I don’t always manage it’ (Jamie) and ‘I’m not very good really’ (Diane).

Jamie was keen to establish where his behaviour was ‘good’, in language underlining a commitment to this behaviour:

> ‘I do recycle, almost religiously, so that’s one thing I do do. Umm. But, not energy use as such.’

For Jamie, the problem was not a lack of commitment to saving energy, but the circumstances in the home defeating his attempts to do so:

> ‘I try. I mean, I’ll save energy on, like I say, I turn the laptop off, I’ll turn the computer off. The TV’s on standby, but that’s more to do with the fact that it’s just a pain to get to the plug down the bottom behind all the stuff … I try and get energy saving light bulbs but the fittings aren’t made for them all over the house, so I can’t have them everywhere.’

For Diane, the barrier was a routine that saw her spending all of her evenings in the living room and kitchen:

> ‘If I go upstairs to use the bathroom I’ll turn the [bathroom] light off and then I’ll come back down again. But rooms that I’ll be in and out of for most of the evening – I wouldn’t think of turning the living room light off, and putting it back on again, I’ll just leave it on. Probably the same with things like, you know, the television or radio. So it’s that time element.’

The ‘time element’ was not about the time taken to turn lights or appliances on and off, but the short length of time when Diane would be away from the lights or appliances. How soon they expected to return to the appliance in question was cited as an influence on whether the appliance was turned off by Diane, Jamie and Gemma.

For Gemma (Trent Bridge House), her prior experiences of the appliance in question were a major influence on her patterns of behaviour:

> ‘Maybe I’m more aware [of lighting] from an early – I remember when I was at home I used to go round the house turning the lights off, so maybe I was more aware of [lighting] before I became aware of other technologies, cos I probably wasn’t using them as much as I was using the lights?’

This raises two points. The first is that Gemma’s patterns of behaviour were established when she was very young, and have transferred with her after leaving home. The second is that Gemma sees lighting as different to other energy using technologies, because it is a very visible use of energy, and that visibility itself can act as a trigger to turn it off.

While Jamie, Diane and Gemma were all keen to discuss their patterns of use of different appliances, and how their home environment shaped those uses, Alan (Trent Bridge House) focused primarily on saving money. Alan had signed up to a group deal which offered a cheaper rate for his energy bills, and he was keen that others should follow his example. However, the focus was not so much on saving either energy or money, but avoiding unnecessary waste. Additionally, the process of considering his levels of usage led him to reduce that usage, in particular when he switched to a water meter:

> ‘It’s not so much that you wouldn’t save much, it’s like the principle of, uh, doing it, and making the effort to do it, because that’s got to be a good thing. And it makes you think about what you’re using, you know. My water consumption has gone down, because I got the bill and they told me how much I was expected to use.’

For Alan, the billing provided a motivation to reduce his consumption, of energy as well as of water. However, this is about avoiding unnecessary waste. For Alan's water usage, it seems that 'unnecessary' is anything above the level that the water company tells him he is expected to use. His consumption of water is driven not by his own assessment of his needs or what he considers appropriate, but by an outside agency's definition of appropriateness, interpreted by Alan as a norm. Furthermore, 'making the effort' is a 'good thing' in its own right, regardless of the outcome of that effort; waste avoidance is a 'principle' that underpins Alan's behaviour.

6.3.3 Links between home and office

For Alan (Trent Bridge House), the desire to avoid waste is a principle that helps to define his actions across different settings. He sees this as an extension of his own identity:

> 'Once you've developed a kind of certain behaviour or routine or whatever, I think, yeah, that's the person you are, that's part of your style, your kind of way of doing things, so I think you do, you don't, uh, I personally do what I do [in the office], and more or less I do the same at home.'

As someone whose 'style' is to try to avoid waste, Alan carries this between contexts, performing similar behaviours in the office as he does at home.

This desire for consistency between the two contexts was echoed by Gemma (Trent Bridge House), who felt that her use of energy in one location did influence her use of energy in the other location: 'Just cos it's a general, uh, attitude that you'd do it at home so I'd do it at work.' However, Gemma qualified this view: 'Maybe if I was less, less conscious of it in one place I'd be less conscious of it in the other, I don't know.'

The importance of the individual's own views was highlighted by Diane (Loxley House):

> 'I think it varies, some people are very conscious because they're conscious in their own lives, and other individuals aren't conscious in their own lives, or, say, may be conscious in their own lives but when they're at work it's someone else's responsibility, so I don't think they think about it.'

Whether people are conscious of energy issues at work depends not just on their own personal disposition, this suggests, but on their interpretation of the responsibility to act. Despite this,

Diane stated that she herself does behave consistently between the two settings. Jamie (Loxley House) was the only interviewee to admit that his behaviour was different in each location:

> 'I know that how I do at home is completely different to what I do here, because I'm shocking at home. Although there is stuff that I do at home that I should do here, it's like I would, umm, I'd turn me laptop off, at night, turn the computer completely off at night, erm, but [I don't at work]… But I wouldn't leave lights on [in the office] just for, umm, aesthetic reasons, and I wouldn't, you know, turn everything off [at home] just because it's the end of the day.'

For Jamie, energy use in the two settings is very different. In the office, this is functional: he turns equipment off (or doesn't) at the end of the day, when the task is over. However, at home, energy can have an aesthetic purpose. Jamie continues:

> 'There's two lights in the kitchen that I'll leave on all night whether I'm in the kitchen or not, just because it looks nice when you walk into the kitchen and it's, you know, you're not having to turn the lights on, it looks lived in, it looks, erm, pleasant. But I wouldn't do that [in the office], I wouldn't leave a light on at work just because it looks pleasant, because it's not me who's paying for it.'

The home is an environment where energy use can have an affective purpose, suggesting homeliness. In the office, however, Jamie sees a link between the use of energy being functional and the observation that he is not the person paying for that energy. Not paying the bill actually makes him more careful with his energy use. However, Diane (also based in Loxley House) suggests that not paying the bill makes some people less conscious of their energy use:

> 'I think the problem is, uh, ownership. I think when you're in your own home, you think about, oh, turn that off because it's going to cost me, but if you're in, er, a building like this… again, I think it varies.'

Gemma and Alan (Trent Bridge House) both also indicated that cost is more of a motivator for their own behaviour at home than in the office. For all three interviewees, the issue of cost in the office setting is linked to the lower level of responsibility that individuals feel for energy use there than in the home. This could be a further explanation for the negative effect of budget cuts on employees' willingness to save energy: while all of the interviewees saw saving money as an important motivator for the organisation, the fear of redundancy and the low levels of morale that this provoked suggests that they felt that they were suffering as a result of something that was not

their responsibility. In both buildings, interviewees talked about energy use in the offices as out of their control; being asked to take responsibility for something they felt little control over, and linking this to redundancy, could provoke a backlash against energy saving in the office setting.

6.4 Chapter summary

This chapter addressed Objective 2, investigating connections between similar individual energy demand behaviours performed in different settings. Analysis was of responses to the questionnaire survey and semi-structured interviews from respondents in two buildings, the City Council's Loxley House and the County Council's Trent Bridge House. Occupants of Loxley House were only able to control lights in meeting rooms and their own computers, while occupants of Trent Bridge House also controlled office lighting.

Respondents from Loxley House reported significantly more frequent performance of behaviour A2, turning meeting room lights off, while respondents from Trent Bridge House reported significantly more frequent performance of B2, turning off their computer monitor at the end of the day. No difference was found for B3, turning the monitor off when away more than ten minutes, or for an attitude statement measuring perceptions of responsibility to save energy in the office. Respondents in Loxley House reported more agreement that reducing the Council's energy use was 'a good thing' and 'important', while respondents in Trent Bridge House reported greater moral obligation to save energy in the office. No significant differences were found between the two samples for expectations around energy saving placed on employees, or the importance of energy saving to the organisation or to senior management. These organisational factors, then, do not explain differences in reported behaviours in the two buildings.

When moving employees into Loxley House (two years before this research), the City Council stressed the energy efficiency advantages of Loxley House. As a result, being energy efficient may have been perceived by occupants as important, leading to greater reported performance of turning off meeting room lights. This fits with the lower levels of turning off monitors at the end of the day reported in Loxley House: the building's energy efficiency was salient to building-related energy use such as lighting, but not to computer-related energy use such as monitors.

In the home setting, no significant differences were found between each sample's reported performance of four behaviours, or their agreement with two attitude statements. All differences between samples were found in the office setting. Additionally, a greater number of significant correlations was found between behaviours performed in the same setting than between

behaviours in different settings. This is notable given that the home behaviours were chosen for their seeming similarity to the office behaviours.

There was a greater number of significant correlations between office and home behaviours for Trent Bridge House than for Loxley House, with more connections across settings for lighting behaviours for Trent Bridge House. Higher levels of control over lighting in Trent Bridge House enabled respondents to perform established behaviour in both settings, while constraints on behaviour in Loxley House resulted in disruption to this behaviour in the office setting. This is supported by the lack of significant differences between samples for lighting behaviours in the home setting. However, the higher levels of meeting room lighting behaviour reported by respondents from Loxley House suggest that this is not necessarily negative for energy saving.

Correlations for behaviours in Trent Bridge House suggested that similar patterns were recorded for behaviours sharing equipment (lighting, computer monitors) and triggers for performance (finishing using equipment, leaving a room). The strongest correlations in both samples were between the two home lighting behaviours, and across settings were between the two behaviours of turning off the computer monitor when away from the desk for more than ten minutes.

Responses given by interviewees from Loxley House and Trent Bridge House were examined in Section 6.3. Two respondents were interviewed from each building; this small number did not present a complete range of attitudes to and influences on energy behaviours, but explored additional issues not captured by quantitative analysis. All of the interviewees saw the cost of energy and the impact of budget cuts as drivers for organisational energy saving. However, this was not felt by individual employees. Budget cuts and fears about redundancy were blamed for low morale and high demoralisation. Interviewees described lower levels of control over energy use in the office than at home, and suggested that responsibility for energy saving in the office did not lie with individual employees. Employees who had this responsibility within their job role, or the organisation itself, needed to make it easier to save energy. Asking individual employees who did not feel that they had control or responsibility for energy use to save energy could provoke a backlash against energy saving, particularly if linked to budget cuts.

There was cynicism about Councils' motivations for promoting energy saving. Saving money was seen as an overriding driver by all interviewees, but while one (Diane, Loxley House) believed that Council policies would ensure that environmental issues were prioritised, another (Jamie, Loxley House) believed that Councils' expressed pro-environmental motivations were merely 'lip-service'. Divisions between senior management and lower levels of employees may have been heightened by demoralisation, with dissatisfaction about how well senior management

understood lower level employees' experiences. Senior management were not perceived as leading by example. All of the interviewees equated energy saving in the office with having a 'professional' attitude and being good at their job. This is an important aspect to highlight in behaviour change interventions in the offices. Decoupling energy saving from the demotivating issue of budget cuts, and addressing questions about responsibility for and control over different kinds of energy saving would be important.

There was disagreement between interviewees about how much sharing the office environment with colleagues influenced their own energy use behaviours. A difference between the two buildings was the way that behaviours were negotiated with colleagues. In Trent Bridge House, with greater control over energy use, there was a conscious awareness of colleagues' needs, and negotiations around behaviours that affected other people. In Loxley House, consideration for others' needs was more passive, relating to leaving shared equipment such as printers switched on. Active negotiation around equipment such as lighting was perceived as leading to conflict. Taking away control, then, affected how colleagues related to each other over that issue.

While Alan (Trent Bridge House) saw energy saving as a 'principle' that was part of his identity at work or home, and Gemma (Trent Bridge House) expressed a desire for consistency in her behaviour, Diane (Loxley House) and Jamie (Loxley House) highlighted differences between the office and home settings. For Diane, not paying for energy at work made people less conscious of energy use, while for Jamie, energy use at home had affective elements (making his home 'pleasant') not relevant at work, meaning he was more inclined to save energy in the office. This highlights the range of meanings that attach to energy use, and the motivations that can result.

This chapter explored whether there was evidence for the concept of 'spillover' through two aspects: whether the performance of one behaviour influenced the performance of another, and whether the performance of behaviours was similar in different settings. Interviews suggest a range of motivations in each setting. Control over energy use is perceived to be lower in the office setting than in the home by respondents from both buildings. Control is also related to responsibility for energy saving; in the office setting, this is often assigned to someone else (the organisation; people whose job role involves energy), while at home interviewees described energy use as their own individual responsibility (or shared equally with a partner).

The results of the questionnaire survey identified connections between the performance of similar behaviours, linked to the similarity of equipment (lighting, computer monitors) or to the situational trigger (finishing using equipment, leaving a room). However, stronger connections were identified between behaviours in the same setting than across settings. This could be

evidence of one behaviour influencing the performance of another in the same location, or it could relate to the constraining or shaping influence of the setting. There is evidence, however, that spillover does not occur between the office and home settings. The constraints on behaviour in Loxley House produce differences between behaviours reported by the two samples in the office setting, but no such differences are observed in the home setting.

The connections between behaviours performed in different settings are explored further in Chapter 7, which uses factor analysis to examine the structure of the relationships between the reported performance of the behaviours. The way that the behaviours group together in factor analysis will provide further evidence for the nature of these relationships.

Chapter 7: Factor structure in the Theory of Planned Behaviour and Values-Beliefs-Norms Theory

7.1 Introduction

This chapter presents Principal Components Analysis conducted on a range of variables developed for use in this research with the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999). The analysis identifies groupings of related variables within the reported performance of behaviours, providing further insight into links between the behaviours. It also assesses the factor structures which are hypothesised by the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999) and how these fit the data collected by this research.

The chapter, then, addresses Objectives 1, 2 and 4 of this research. Objective 1 is to identify the key contextual, organisational, social and psychological/attitudinal influences on individual energy use in office settings. This chapter identifies how well influencing variables and factor groupings proposed by the two attitude-behaviour theories describe the data collected by the questionnaire survey. Objective 2 is to investigate the connections between similar individual energy use behaviours performed in different settings. This is addressed through the grouping of variables into factors that occurs within Principal Components Analysis, which identify the strongest relationships between behaviours within the data, and which group behaviours according to those relationships. Additionally, this chapter presents the first stage in the analysis of the explanatory power of the two attitude-behaviour theories (social psychological models) which forms Objective 4; this analysis is completed in Chapter 8, which uses Structural Equation Modelling to test the relationships between factors proposed by the theories.

Principal Components Analysis is a data reduction technique which groups variables according to how well they cluster together in an R-matrix, or correlation matrix (Field, 2009). These groups of variables are components, which are analogous to factors identified in Factor Analysis, with the terms often used interchangeably. Its basis in correlation means that there is an assumption of normality in the distribution of the data; where this cannot be assumed, this limits the ability to generalise the results beyond the sample collected, unless several samples return a similar factor structure. The number of factors extracted from the data is assessed using Kaiser's Criterion (giving acceptable levels of communality according to sample size and numbers of variables) and by examining a scree plot. In the analysis presented here, it cannot be assumed that the variables are fully independent, so an oblique rotation method is used (Field, 2009). The extracted factors

are presented in a pattern matrix to identify which variables form each factor, and the consistency with which grouped variables measure the same underlying construct (latent variable) is measured by calculating Cronbach's alpha (α) (Field, 2009).

In the following sections, Principal Components Analysis is used to examine three questions. Section 7.2 identifies how the reported behaviours group together, and the level of specificity at which they need to be examined. Section 7.3 tests constructs proposed by the Theory of Planned Behaviour, and Section 7.4 tests constructs proposed by Values-Beliefs-Norms Theory. Section 7.5 provides a summary of the chapter.

7.2 Principal Components Analysis of reported behaviours

Table 7.1 presents the reported behaviours measured in the three versions of the questionnaire which were included in the Principal Components Analysis, with a tick or cross indicating in which version of the questionnaire the behaviour appears (for a discussion of this, see Section 4.4.2). Four office behaviours measured in the questionnaires were excluded at an early stage. Behaviour B1: Turn off computer when finished for the day was excluded because there was very little variance in the responses, with the '5 = Always' response given by 97.3% of City Loxley, 91.9% of City Other, and 94.7% of County respondents. Similarly, there was not enough variance in responses given to behaviour B2: Turn off monitor when finished for the day for the Principal Components Analysis to run successfully, so this variable was also excluded. Behaviours C1: Turn off portable heater and C2: Turn off desk fan were also excluded. Only respondents from the County building group were asked these questions, and were given a choice of which behaviour to answer for; as a result, there were no correlations between these two behaviours.

Setting	Behaviour	C.Loxley	C.Other	County
Office	A1: Turn office lights off when not needed	x	✔	✔
	A2: Turn meeting room lights off when leave room empty	✔	✔	✔
	A3: Turn toilet lights off when leave unoccupied	x	✔	✔
	B3: Turn off monitor when away from desk more than 10 minutes	✔	✔	✔
Home	D1: Turn off lights in a room when not needed	✔	✔	✔
	D2: Turn off lights when leave a room empty	✔	✔	✔
	E1: Turn computer off when finished using it	✔	✔	✔
	E2: Turn monitor off when away more than 10 minutes	✔	✔	✔
	F1: Turn main TV off fully instead of leaving on standby	✔	✔	✔

Table 7.1 *Behaviours included in the Principal Components Analysis*

The full range of constructs for the Theory of Planned Behaviour (Ajzen, 1991), which relies on behaviour-specific statements (see Section 4.4.2), were only tested for some of the behaviours, as including them for all behaviours would have made the questionnaire too long. However, including all nine remaining behaviours at this stage allows Principal Components Analysis to identify underlying groupings within the behaviours.

Principal Components Analysis was conducted on results for each building group in turn, and the resulting component (or factor) structures compared to identify whether a common structure could be seen in all three samples. Table 7.2 presents the results of Principal Components Analysis for the County sample. As the analysis was conducted using an oblique rotation method, Direct Oblimin rotation, the output describing the factor structure is split into two matrices, the Pattern Matrix and the Structure Matrix; both are presented. 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 Kaiser-Meyer-Olkin measure verified the sampling adequacy, KMO = .658, (at the higher end of the 'mediocre' range), and all variables were above the .5 acceptable limit for KMO values, indicating that the sample size was adequate (Field, 2009). Bartlett's test of sphericity χ^2 (36) = 259.663, $p < .001$, indicated that correlations between items were sufficiently large for Principal Components Analysis to be conducted.

Initial analysis of the County building group identified that three components had eigenvalues over Kaiser's criterion of 1, explaining 29.3%, 14.8% and 12.6% of the variance in the data respectively (although as components correlated these percentages cannot be totalled). The scree plot supported the retention of three components. Given the adequate sample size, and the convergence of the scree plot and Kaiser's criterion, three components were retained in the final analysis.

	Pattern Matrix			Structure Matrix		
	1	2	3	1	2	3
D1: Home lights not needed	**.871**			**.845**		
D2: Home lights room empty	**.736**			**.728**		
E1: Home computer	**.671**			**.665**		
F1: Home TV not on standby	**.576**			**.614**		
B3: Office monitor away		**.901**			**.859**	
E2: Home monitor away		**.768**		.367	**.812**	
A3: Toilet lights			**.849**			**.786**
A2: Meeting room lights			**.671**			**.715**
A1: Office lights			**.461**	.353		**.529**
Eigenvalues	*2.640*	*1.332*	*1.135*			
% variance	*29.33*	*14.80*	*12.61*			
Cronbach's α	*.644*	*.598*	*.421*			

All factor loadings above .3 presented. Loadings used in factor identification in bold.

Table 7.2 *Pattern and Structure Matrices for Principal Components Analysis of behaviours in the County sample*

The items clustering on the same components in both matrices suggest that component 1 represents Home behaviours, component 2 represents Monitor behaviours, and component 3 represents Office lighting behaviours. The Home behaviours sub-scale had a reasonably strong reliability, α = .644, but the sub-scales for Monitor behaviours (α = .598) and, particularly, Office lighting behaviours (α = .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).

To test the validity of the factor structure identified in the County sample, Principal Components Analyses were also run on items measuring behaviour in the City Loxley and City Other samples, using the same parameters. The results of a comparison of the results from all three samples can be seen in Table 7.3. There were some differences in the behaviours tested in the other two samples. Respondents in the City Loxley sample did not have control over most of the lighting in their building, with the exception of A2 Meeting room lights; however, initial testing revealed low levels of correlation and communality for this variable, and it was excluded from the analysis. Two further variables, E1 Home computer and F1 Home TV not standby, were also excluded due to low levels of correlation and communality. Despite only four items being tested, the City Loxley sample supported the structure identified in the County sample, with two components representing Home behaviours and Monitor behaviours identified.

Similarly, two items (D1 Home lights not needed, and F1 Home TV not on standby) were excluded from the Principal Components Analysis of the City Other sample. D1 Home lights not needed was excluded because there were not sufficient numbers of responses in all of the response categories for the analysis to successfully distinguish clusters of similar responses. F1 Home TV not standby was excluded because initial tests revealed low levels of correlation and communality (Field, 2009). The size of the sample for City Loxley was smaller (between 141 and 196 for each item), and the Kaiser-Meyer-Olkin measure assessed this as at the lower end of the 'mediocre' range (KMO = .503), but Bartlett's test of sphericity χ^2 (21) = 101.091, $p < .001$, indicated that correlations between items were sufficiently large for the analysis. The City Other sample supported the three factor structure identified in the County sample, although the smaller sample size and small number of items had a detrimental effect on the Cronbach's α tests.

Factor	**Row item**	**City Loxley**	**City Other**	**County**
1: Home behaviours	Items	D1: Lights not needed D2: Lights room empty	D2: Lights room empty E1: Home computer	D1: Lights not needed D2: Lights room empty E1: Home computer F1: Home TV standby
	Eigenvalues	*1.938*	*1.940*	*2.640*
	% variance	*48.45*	*27.71*	*29.33*
	α	*.843*	*.355*	*.644*
2: Monitor behaviours	Items	B3: Office monitor D2: Home monitor	B3: Office monitor D2: Home monitor	B3: Office monitor D2: Home monitor
	Eigenvalues	*1.204*	*1.429*	*1.332*
	% variance	*30.09*	*20.42*	*14.80*
	α	*.575*	*.501*	*.598*
3: Office lighting behaviours	Items	-	A3: Toilet lights A2: Meeting room lights A1: Office lights	A3: Toilet lights A2: Meeting room lights A1: Office lights
	Eigenvalues	-	*1.115*	*1.135*
	% variance	-	*15.92*	*12.61*
	α	-	*.596*	*.421*

Table 7.3 *Factor structure identified by Principal Components Analysis of behaviours*

The results of the Principal Components Analyses on responses to behaviour items in the questionnaire surveys support the presence of a stable factor structure within the behaviours measured. This structure identifies that behaviours group together at a specific level; not only are the groups formed from similar types of equipment, but the context that the behaviour occurs in also has an effect on the groups. This is not true for all of the equipment; computer monitors

behaviour appears to be stable across both the work and home contexts, although a distinction between the two locations may be hidden by the small number of items measuring this construct.

The identification of distinct groupings of behaviour, stable across all three samples, suggests that examination of energy demand behaviours needs to be conducted at this level of specificity, and that any attitude-behaviour models or Structural Equation Models built to explain or predict such behaviours will also need that level of specificity. Furthermore, this provides some evidence that energy demand behaviours performed in an office are different to energy demand behaviours performed in a home setting, even where the actions themselves are physically similar.

7.3 Principal Components Analysis of constructs from the Theory of Planned Behaviour

This section examines the factor structure within the constructs hypothesized by the Theory of Planned Behaviour (Ajzen, 1991) (Section 3.3.1). Because the previous examination of reported behaviours revealed a factor structure based on specific behaviours, it could not be assumed that one model of general energy demand behaviours would fit the data. The items measuring different constructs within the Theory of Planned Behaviour were measured at the level of specific behaviours. As these could not be expected to combine to form a single measurement of each construct, the numbers of variables being used to measure each construct were reduced.

7.3.1 Attitudes, Subjective Norms and Perceived Behavioural Control

The statements measuring the Theory of Planned Behaviour items were not applied to all of the behaviours described in the previous section, as this would have made the questionnaires too long. Table 7.4 presents the behaviours used in this part of the study.

Behaviour	**C.Loxley**	**C.Other**	**County**
A1: Office lights not needed	x	✔	✔
A2: Meeting room lights leave empty	✔	x	x
B3: Monitor away 10 minutes	✔	✔	✔
D1: Home lights not needed	✔	✔	✔
E2: Home monitor away 10 minutes	✔	✔	x

Table 7.4 *Behaviours examined in PCA of Theory of Planned Behaviour elements*

Table 7.5 lists the statements measuring each construct used with each of the behaviours tested. The statements measuring the three TPB constructs ATT: Attitudes, SN: Subjective Norm, and PBC: Perceived Behavioural Control were analysed together, as they appear at the same point in the structure of the Theory of Planned Behaviour model (see Section 3.3.1). Responses from the three building groups were analysed in turn.

Construct	**Statement**
ATT: Attitude	ATT1a: *Behaviour* is appropriate ATT1b: *Behaviour* is worthwhile ATT1c: *Behaviour* is convenient ATT1d: *Behaviour* is satisfying ATT2a: *Behaviour* helps Council save energy ATT2b: *Behaviour* helps household save energy
SN: Subjective Norm (office-based behaviours)	SN1: People who are important to me would *behaviour* SN2: The people I work with do *behaviour* SN3: Senior management do *behaviour* SN4: People who are important to me think I should *behaviour* SN5: The people I work with think I should *behaviour* SN6: Senior management think I should *behaviour*
SN: Subjective Norm (home-based behaviours)	SN7: The people I live with think I should *behaviour* SN8: People who are important to me think I should *behaviour* SN9: The people I live with do *behaviour* SN10: People who are important to me do *behaviour*
PBC: Perceived Behavioural Control	PBC1: I would find *behaviour* difficult (R) PBC2: *Performing behaviour* is up to me

(R) Reverse-scored item (re-coded so that high score is more pro-energy saving response)

Table 7.5 *Statements measuring TPB constructs for each behaviour examined in PCA*

For each statement, respondents were asked to indicate how strongly they agreed or disagreed on a scale (1 = Strongly disagree, 5 = Strongly agree). One statement, PBC1: I would find (behaviour) difficult, was reverse-worded, so that, unlike the other statements, a low score was a more pro-environmental response than a high score. For this analysis, this statement was reverse-scored, so that like the other statements a high score indicated a more pro-energy saving response.

Table 7.6 presents the Pattern Matrix for the results of the Principal Components Analysis conducted on the County sample, with all factor loadings above .3 (or below -.3) presented, and the loadings used in component identification in bold. Following data screening, 35 statements

measuring the Theory of Planned Behaviour items were utilised. The County version of the questionnaire did not include Theory of Planned Behaviour elements relating to E2: Home monitors when away, but otherwise was the same as for City Loxley and City Other. The analysis was conducted with data excluded pairwise to minimise losses due to missing responses, providing a sample of between 193 and 284 for each item.

Principal Components Analysis was conducted using Direct Oblimin rotation, with factors extracted above an eigenvalue of 1.0. The Kaiser-Meyer-Olkin measure verified the sampling adequacy, with a 'good' KMO value of .747 and, importantly given the range of sample sizes for different items, all variables above the .5 acceptable limit for KMO values (Field, 2009). Bartlett's test of sphericity (χ^2 (595) = 2605.934, $p < .001$) indicated that correlations were sufficiently large. Analysis identified nine components with eigenvalues over Kaiser's criterion of 1.0, explaining between 17.4% and 2.9% of the variance (see Table 7.6); this was supported by the scree plot, so nine components were retained. The Structure Matrix (not included here) supported the structure identified in the Pattern Matrix.

	1	2	3	4	5	6	7	8	9
Office monitor appropriate	**.843**								
Office monitor worthwhile	**.841**								
Office monitor convenient	**.806**								
Office monitor satisfying	**.700**				-.456				
Office monitor difficult (R)	**.614**								
Office monitor help council	**.538**								
Home light live with perform		**-.928**							
Home light important perform		**-.900**							
Home light important should		**-.867**							
Home light live with should		**-.850**							
Office light work with should			**.798**						
Office light important should			**.785**						
Office light mgmnt perform			**.718**						
Office light work with perform			**.628**						
Office light mgmnt should			**.608**						
Office mon. work with should				**-.807**					
Office mon. mgmnt perform				**-.806**					
Office mon. mgmnt should				**-.798**					
Office mon. important should				**-.643**					
Office mon. work with perform				**-.624**		.372			
Home light satisfying					**-.778**				
Office light satisfying					**-.708**				
Home light convenient					**-.599**				
Home light worthwhile						**-.765**			
Home light appropriate						**-.753**			
Home light help household						**-.525**			
Home light difficult (R)						**-.463**		-.436	
Office light appropriate							**.914**		
Office light worthwhile							**.870**		
Office light convenient					-.521		**.544**		
Office light difficult (R)							.328	**-.604**	
Home light up to me								.510	**.331**
Office light up to me									**.755**
Office mon. up to me									**.669**
Office light help council			.318						**.386**
Eigenvalues	*6.091*	*3.417*	*3.096*	*2.896*	*1.865*	*1.722*	*1.637*	*1.348*	*1.036*
% of variance	*17.404*	*9.762*	*8.845*	*8.273*	*5.329*	*4.921*	*4.678*	*3.851*	*2.959*
Cronbach's alpha	*.867*	*.914*	*.772*	*.802*	*.681*	*.611*	*.670*	*-**	*.487*

All loadings above .3 are presented. Loadings of items used in factor identification in bold type.
(R) denotes reverse-scored items. * No alpha score can be calculated when only one item in the component.

Table 7.6 *Pattern matrix for main Theory of Planned Behaviour items in County sample*

Overall, the Pattern Matrix reveals that the coherence of the components is reasonably strong, distinguishing between different kinds of behaviours, and between two of the three Theory of Planned Behaviour constructs, ATT: Attitude Towards the Behaviour, and SN: Subjective Norm. The distinctions between behaviours seen here support the distinctions identified in the Principal Components Analysis of the performance of those behaviours, discussed in the previous section, with home and work behaviours grouping separately even where the behaviours themselves, such as turning off lights, were very similar.

The components with the least coherent groupings of items (components 8 and 9) also have the weakest Cronbach's alpha scores and account for the smallest amount of variance. Notably, they also contain items intended to tap the Theory of Planned Behaviour construct PBC: Perceived

Behavioural Control, which does not show clearly in the factor structure. The measurement of this construct is weak, with the reverse-scored item PBC1: I would find it difficult to (perform the behaviour) grouping with items designed to tap the ATT: Attitude Towards the Behaviour construct. This may be because of the small number of items measuring this construct, or it may reflect differences in the strengths of responses given when one item is reverse-scored.

Principal Components Analyses were also conducted on the City Loxley and City Other samples, and the results compared to the County results. This comparison supports the findings in the County sample, with items grouping around specific behaviours and with the two Theory of Planned Behaviour constructs ATT: Attitude Towards the Behaviour and SN: Subjective Norm most clearly defined. Again, the Theory of Planned Behaviour construct PBC: Perceived Behavioural Control is not clearly identified in the structure. The City Loxley sample also reveals a distinction between Home Monitors and Office Monitors which was not seen in the analysis of the behaviours. In that analysis there were only two items measuring monitor behaviours, but with more items measuring each behaviour the setting once again separates two otherwise similar behaviours. A summary of the TPB constructs identified by the Principal Components Analysis in each sample is presented in Table 7.7.

Behaviour	Construct	Detail	City Loxley	City Other	County
A1: Office lights when not needed (City Other, County), or A2: Meeting room lights when leave empty (City Loxley)	Att: Attitudes towards the behaviour	Items *Eigenvalue* *α*	Appropriate Worthwhile *2.241* *.676*	Appropriate Worthwhile Satisfying Convenient *2.637* *.857*	Appropriate Worthwhile Convenient *1.637* *.750*
	SN: Subjective Norm	Items *Eigenvalue* *α*	Snr mgmt. should Work with should Important should Work with do Snr mgmt. do Important do *3.796* *.792*	Work with do Important should Work with should Snr mgmt. should Important do Snr mgmt. do *6.614* *.848*	Work with should Important should Snr mgmt. do Work with do Snr mgmt. should *3.096* *.772*
	PBC: Perceived Behavioural Control	Variables Eigenvalue α	Did not resolve	Did not resolve	Did not resolve
B3: Office monitor when away more than 10 minutes	ATT: Attitudes towards the behaviour	Items *Eigenvalue* *α*	Worthwhile Appropriate Convenient Satisfying Helps Council *1.909* *.855*	Appropriate Convenient Worthwhile Satisfying *3.665* *.935*	(Office) Appropriate Worthwhile Convenient Satisfying Helps Council Difficult (R) *6.091* *.867*
	SN: Subjective Norm	Items *Eigenvalue* *α*	Work with should Important should Work with do Snr mgmt. should Important would *3.883* *.857*	Snr mgmt. should Work with should Snr mgmt. do Work with do Important do Important should *1.242* *.880*	Work with should Snr mgmt. do Snr mgmt. should Important should Work with do *3.096* *.772*
	PBC: Perceived Behavioural Control	Variables Eigenvalue α	Did not resolve	Did not resolve	Did not resolve
D1: Home lights when not needed	ATT: Attitudes towards the behaviour	Items *Eigenvalue* *α*	Worthwhile Appropriate Convenient *1.396* *.780*	Convenient Satisfying *1.797* *.824*	Worthwhile Appropriate Helps household Difficult (R) *1.722* *.611*
	SN: Subjective Norm	Items *Eigenvalue* *α*	Live with do Important do Important should Live with should *3.047* *.912*	Important do Live with do Live with should Important should *3.226* *.795*	Live with do Important do Important should Live with should *3.417* *.914*
	PBC: Perceived Behavioural Control	Items *Eigenvalue* *α*	Did not resolve	Did not resolve	Did not resolve
E2: Home monitor when away more than 10 minutes	ATT: Attitudes towards the behaviour	Items *Eigenvalue* *α*	Worthwhile Appropriate Satisfying Convenient Helps household *9.265* *.903*	Did not resolve	-
	SN: Subjective Norm	Items *Eigenvalue* *α*	Important should Live with do Important do *1.705* *.959*	Did not resolve	-
	PBC: Perceived Behavioural Control	Variables *Eigenvalue* *α*	Did not resolve	Did not resolve	-

Table 7.7 *Summary of Theory of Planned Behaviour factors identified in PCA results*

Principal Components Analysis of the three constructs from the Theory of Planned Behaviour reveals that the specificity identified among the behaviours can also be found among the variables designed to measure influences on those behaviours. This confirms that any analysis of energy demand behaviour and its antecedents needs to be conducted at a behaviour and setting specific level. The analyses also reveal that two of the three Theory of Planned Behaviour constructs, ATT: Attitude Towards the Behaviour and SN: Subjective Norm, are well defined within the data, at a behaviour and setting specific level, but the third construct, PBC: Perceived Behavioural Control, is not well-defined. This will affect the analysis of the complete Theory of Planned Behaviour model using Structural Equation Modelling in Chapter 8.

7.4 Principal Components Analysis on constructs from Values-Beliefs-Norms Theory

Values-Beliefs-Norms Theory (Stern et al., 1999) (see Section 3.3.2) presents a causal chain of constructs believed to influence the performance of pro-environmental behaviours, moving from the more general Worldviews (W) and Values (V) to the more behaviour-specific Ascription of Responsibility to act (AR) and Pro-environmental Personal Norms (PN).

The first two constructs in the chain, W: Worldviews and V: Values, are comprised of smaller sub-scales. The first step in the analysis is to check whether these sub-scales together form the constructs hypothesised by the theory. Because of the number of sub-scales and constructs measured in the theory, and because the questionnaire measuring the items had to be of a reasonable length, many sub-scale items are measured using only two statements. This is not ideal for the analysis, as this can weaken the components (as discussed in Section 7.2).

Following the analysis of sub-scales forming W: Worldviews and V: Values, further analysis examines the three remaining constructs in Values-Beliefs-Norms Theory, AC: Awareness of Consequences, AR: Ascription of Responsibility and PN: Personal Norm. As with the previous analyses, this seeks a consistent structure across all three samples that can then be further tested using Confirmatory Factor Analysis and Structural Equation Modelling.

7.4.1 Values

Statements measuring V: Values can be seen in Table 7.8. The question asked was ‘Please rate each item according to how important the statement is as a guiding principle for you’, scored on a

5-point Likert scale (1 = Not at all important, 5 = Extremely important). Further details about the development of these statements, and their basis in the literature, can be found in Section 4.4.2.

Sub-scale	**Statement**
V1: Openness to change	V1a: Curious, interested in everything, exploring
	V1b: A varied life, filled with challenge, novelty and change
V2: Self-enhancement	V2a: Influential, having an impact on people and events
	V2b: Wealth, material possessions, money
V3: Conservation (traditional)	V3a: Honouring parents and elders, showing respect
	V3b: Self-discipline, self-restraint, resistance to temptation
	V3c: Family security, safety for loved ones
V4: Self-transcendence (biospheric)	V4a:Protecting the environment, preserving nature
	V4b: Respecting the earth, harmony with other species
V5: Self-transcendence (altruistic)	V5a: Social justice, correcting injustice, care for the weak
	V5b: A world at peace, free of war and conflict

Table 7.8 *Statements measuring sub-scales within the Values construct in Values-Beliefs-Norms Theory*

Table 7.9 presents the Pattern Matrix for the Principal Components Analysis conducted on the City Loxley sample, with all factor loadings above .3 (or below -.3) presented, and the loadings of items used in component identification in bold. Data was excluded listwise, n = 303, and the analysis was conducted using Direct Oblimin rotation. Initial analysis specifying eigenvalues of > 1.0. did not return a satisfactory structure, with 36 (65%) nonredundant residuals greater than 0.05. Examination of the scree plot suggested that 3 or 5 components could be extracted, and a 5 factor solution could be identified with eigenvalues above .7, as proposed by Jolliffe (Field, 2009). The Kaiser-Meyer-Olkin measure verified the sampling adequacy with a strong KMO value of .838 and all but one item (wealth material) above the .5 acceptable limit for KMO values (Field, 2009). Bartlett's test of sphericity (χ^2 (55) = 1019.912, $p < .001$), indicated that correlations between items were sufficiently large. The sample size was adequate and the communalities sufficient, with a marginal result of 30 (54%) of nonredundant residuals with absolute values greater than 0.05, and as a result the five factor solution was accepted. Examination of the Structure Matrix (not included here) supported the components identified in the Pattern Matrix.

Items	1	2	3	4	5
V4b: Respect earth	**.909**				
V4a: Protect environment	**.901**				
V5a: Social justice	**.674**				
V5b: World at peace	**.589**				
V1b: Varied challenge		**.861**			
V1a: Curious interested		**.797**			
V2b: Wealth material			**.932**		
V2a: Influential		.453	**.490**		.313
V3b: Self-discipline				**.950**	
V3c: Family security					**-.820**
V3a: Honour respect					**-.587**
Eigenvalues	*4.094*	*1.282*	*1.233*	*.787*	*.762*
% variance explained	*37.22*	*11.65*	*11.21*	*7.16*	*6.93*
Cronbach's alpha	*.838*	*.630*	*.319*	-*	*.649*

All loadings above .3 are presented. Loadings of items used in factor identification in bold type.
* Cronbach's alpha cannot be calculated for single items.

Table 7.9. *Pattern matrix for Values construct of VBN in City Loxley sample*

The five components identified correspond to the expected sub-scales, with two exceptions. Firstly, the sub-scales of V4: Self-transcendence (biospheric) and V5: Self-transcendence (altruistic) are combined in the sample into one sub-scale, component 1, representing a more general self-transcendence value construct. This is not unexpected; biospheric and altruistic values both reflect self-transcendence values, and have been observed to correlate in many studies (Steg et al., 2012). Research has identified that biospheric values are generally more predictive of pro-environmental attitudes, beliefs, preferences and behaviours than altruistic values (De Groot and Steg, 2007, 2008; Nilsson et al., 2004; Steg et al. 2005). However, the key difference between them arises when altruistic and biospheric values are in conflict, for example when choosing between donating money to environmental or humanitarian organisations, or between purchasing organic or fair trade products (Steg et al., 2012). Whether such conflicts could be characterised in an office setting is not clear: behaviours such as leaving lights on when they are not really needed out of consideration for other office occupants, rather than turning them off to save energy, might fall into this category, but might also be influenced by habit, difficulties perceived in negotiating with other occupants, a lack of feeling of personal responsibility, or the passive nature of leaving lighting on rather than acting to turn it off.

Secondly, the sub-scale of V3: Conservation (traditional) is split across components 4 and 5, with the V3b: Self-discipline item separated from the V3c: Family security and V3a: Honour respect

items. This may reflect that the latter two items mention family, and so may have drawn similar responses, while self-discipline seems a less related topic. The weakest component however was component 3, containing items tapping the V2: Self-enhancement construct. This had the lowest alpha score, and also contained the V2b: Wealth material item which at .440 did not quite meet the acceptable limit of .5 for the KMO value in the initial analysis. However, overall the components identified in the City Loxley sample supported the Values construct.

Principal Components Analyses were also run on the City Other and County samples, and the results compared to the City Loxley sample. The smaller size of the City Other sample for these items (n = 158) was a problem for confirming the suitability of the factor structure, with examination of a scree plot to identify the factor structure being less reliable with a sample of less than 200 (Field, 2011). As with the City Loxley sample, the V2b: Wealth material item did not correlate well with other items, and it was excluded from this analysis. The strongest component identified in the City Other sample included three of the four V4 and V5 Self-transcendence items (Cronbach's alpha = .789), while the second strongest component (Cronbach's alpha = .673) included the two items mentioning family from the V3: Conservation (traditional) sub-scale alongside the V5a: Social justice item from the V5: Self-transcendence (altruistic) sub-scale.

The mix of items across the components meant that the only sub-scale seen in the City Loxley sample that was also present in this sample was the combined V4 and V5 Self-transcendence sub-scale. The County sample also identified the combined Self-transcendence sub-scale, with all four items loading onto this component (Cronbach's alpha = .812). A four-component solution was found, but the remaining three components did not match the structures seen in the City Loxley or City Other results. It is likely that the small number of items included to measure each sub-scale weakened the strength of the sub-scales. However, as these are sub-scales rather than constructs in their own right within the Values-Beliefs-Norms Theory this should not weaken the overall model.

7.4.2 Worldviews (New Ecological Paradigm)

This section presents the Principal Components Analysis carried out on the W: Worldviews construct, which is based on a widely-tested scale, the New Ecological Paradigm (see Section 4.3.2 for a discussion of its basis in the literature). The scale is made up from five sub-scales examining different types of worldview. The shortened version of the scale presented here has two or three items measuring each of the subscales. Table 7.10 presents these items.

Construct	Statement
W1: Reality of limits to growth	W1a: We are approaching the limit of the number of people the earth can support
	W1b: The earth is like a spaceship with limited room and resources
W2: Anti-anthropocentrism	W2a: Humans have the right to modify the natural environment to suit their needs (R)
	W2b: Plants and animals have as much right as humans to exist
W3: Fragility of nature's balance	W3a: When humans interfere with nature it often produces disastrous consequences
	W3b: The balance of nature is strong enough to cope with the impacts of modern industrial nations (R)
W4: Rejection of exemptionism	W4a: Human ingenuity will ensure that we do NOT make the earth unliveable (R)
	W4b: Despite our special abilities humans are still subject to the laws of nature
W5: Possibility of an ecological crisis	W5a: Humans are severely abusing the environment
	W5b: The so-called 'ecological crisis' facing humankind has been greatly exaggerated (R)
	W5c: If things continue on their present course, we will soon experience a major ecological catastrophe

(R) Items reverse-scored so higher score indicates more pro-environmental worldview

Table 7.10 *Items measuring sub-scales in the Worldviews construct from Values-Beliefs-Norms Theory*

The Principal Components Analysis was conducted using the procedures already described, first with the City Loxley sample (n = 303). A first run of the analysis using an Eigenvalue of 1.0 returned results with low communalities, so the analysis was re-run with an Eigenvalue of .7. Examination of the Scree Plot supported the identification of six factors. The Pattern Matrix containing the results is presented in Table 7.11.

Items	1	2	3	4	5	6
W3a: Humans interfere	**.826**					
W5c: Eco catastrophe	**.650**				-.359	
W5a: Humans abusing	**.596**		-.303			
W5b: Crisis exaggerated (R)		**.892**				
W3b: Balance of nature (R)		**.777**				
W1a: Approaching limit			**-.870**			
W1b: Earth like spaceship			**-.698**			
W2a: Right to modify (R)				**.786**		
W4a: Human ingenuity (R)				**.727**		
W4b: Special abilities					**-.831**	
W2b: Plants animals rights						**.898**
Eigenvalues	*4.063*	*1.359*	*.885*	*.830*	*.762*	*.713*
% variance	*36.937*	*12.353*	*8.042*	*7.548*	*6.931*	*6.484*
Cronbach's alpha	*.721*	*.664*	*.673*	*.583*	-	-

All loadings above .3 are presented. Loadings of items used in factor identification in bold type. (R) denotes reverse-scored items.

Table 7.11 *Pattern matrix for Worldviews sub-scale from Values-Beliefs-Norms Theory in City Loxley building group*

The factors identified by the Pattern Matrix are not a good reflection of the structure predicted by the New Ecological Paradigm scale, apart from the W1: Limits to growth subscale which can be seen in component 3. One reason may be that some items used were reverse-worded; although the direction of the scoring has been reversed so that a higher response indicates a more pro-environmental response like the rest of the scale, the reverse-scored items resolve together as components, reflecting a difference in the way people respond to negatively-worded questions. The use of a small number of items to measure each sub-scale, necessary to keep the questionnaire at a manageable length, also reduced the ability of the analysis to resolve the factors as predicted.

Principal Components Analysis was then conducted using the City Other and County samples. The City Other sample was much smaller (n = 155, compared to n = 303 for City Loxley and n = 247 for County), and the success of Principal Components Analysis can be affected by sample size. There were also problems meeting Kaiser's Criterion for the City Other sample. Kaiser's Criterion recommends communalities greater than .7 for samples below 250, but the City Other sample had a mean communality of .495 (Field, 2009). The analysis did not resolve into a clear factor structure, and given the difficulties with running the analysis and the small size of the sample, the City Other sample was excluded from this part of the analysis.

The analysis of the County sample was more successful. An initial run of the analysis with an Eigenvalue of 1 produced results with low communalities (mean of .478). The analysis was re-run with an Eigenvalue of .7 and specifying that five factors were sought. This was confirmed by examination of the Scree Plot. The re-run analysis returned communalities of .733 on a sample bigger than 250, meeting Kaiser's Criterion. The nonredundant residuals over .5 in the reproduced correlations matrix were a little high at 64%, but the components did resolve into five factors. The component structure identified did not reflect the structure theorised by the New Ecological Paradigm, but did have some similarities to that identified in the City Loxley sample.

Overall, the factor structure identified by the Principal Components Analysis only weakly reflected the structure predicted by the New Ecological Paradigm. This was perhaps to be expected, given that only two or three items had been included to measure each sub-scale, and that reverse-scored items had further weakened the correlations between item scores. However, as these items formed sub-scales that were part of a larger theoretical model, and as the sub-scale and the theoretical model had been tested in previous research, the weakness of some individual parts of the overall model would not be a problem for subsequent Structural Equation Modelling.

7.4.3 Awareness of Consequences, Ascription of Responsibility and Personal Norm

The next stage in the analysis examined three separate constructs which were not defined by sub-scales. Although the items are separate constructs, Values-Beliefs-Norms Theory places them in a causal chain, and so hypothesises that there are relationships between the constructs. This was likely to make the factor structure harder to identify, as items were likely to correlate between constructs as well as with other items within their own constructs. Table 7.12 presents the items used to measure each construct.

Construct	Statement
AC: Awareness of Consequences	AC1a: The Council's energy consumption affects the environment
	AC2a: My household's energy consumption affects the environment
	AC3a: The exhaustion of fossil fuels is a problem
	AC3b: Environmental quality will improve if we use less energy
AR: Ascription of Responsibility	AR1a: When I'm at work, it's not my responsibility to conserve energy (R)
	AR2a: Conserving energy at home is my responsibility
	AR3a: I feel jointly responsible for the exhaustion of energy sources
	AR3b: My contribution to the energy problem is negligible (R)
	AR3c: It's not just the government and industry that are responsible for high energy consumption levels, but I am too
PN: Personal Norm	PN1a: I should do what I can to help the Council save energy
	PN2a: I should do what I can to save energy at home
	PN3a: I feel morally obliged to save energy, regardless of what others do
	PN3b: Conserving energy and natural resources is important to me
	PN3c: I would be a better person if I saved energy

(R) denotes reverse-scored items

Table 7.12 *Statements measuring AC, AR and PN in Values-Beliefs-Norms Theory*

Principal Components Analysis was conducted first on the results from the City Loxley building group. Initial screening of the data found that there was not enough variance across some of the items to produce reliable solutions. The initial fourteen items listed in Table 7.12 were reduced to nine items, two for AC: Awareness of Consequences, three for AR: Ascription of Responsibility, and four for PN: Personal Norm. The reduction in number of items increased the difficulty of identifying the factor structure, as fewer items weakens the factors.

An initial Principal Components Analysis with an Eigenvalue of 1.0 met the conditions of the Kaiser criterion but returned nonredundant residuals of 53% and did not produce clear results. The Scree Plot supported the existence of a three-factor solution. The analysis was re-run specifying three factors, with an Eigenvalue of .7. The solution was a better fit with Kaiser's criterion and reduced the nonredundant residuals to an acceptable 41%. The Pattern Matrix is presented in Table 7.13.

	1	2	3
AC2a: Household energy affects environment	.888		
AC3b: Enviro quality will improve if use less energy	.813		
AR3c: Not just govt, industry responsible, but me too	.808		
PN3a: I feel morally obliged to save energy	.792		
PN3b: Conserving energy/resources important to me	.776		
AR3a: Jointly responsible exhaustion energy sources	.708		
PN1a: I should help Council save energy	.596		
AR1a: At work not my responsibility to save energy (R)		.986	
PN3c: I would be better person if I saved energy			.967
Eigenvalues	4.557	1.045	.782
% variance	50.637	11.609	8.687
Cronbach's alpha	.893	-	-

(R) denotes reverse-scored items
All loadings above .3 are presented. Loadings of items used in factor identification in bold type.

Table 7.13 *Pattern matrix for AC, AR and PN items for City Loxley sample*

Examination of the structure matrix revealed that all of the items were interrelated, and as expected this made it difficult to identify a clear factor structure. Although they did not form separate factors, groupings according to the construct could be seen in the pattern matrix: the two AC: Awareness of Consequences items resolved at the top of the matrix, with the strongest factor loadings (.888 and .813), with two general Personal Norm items appearing as the next grouping, with similar loadings of .792 and .776. The construct that did not resolve clearly was AR: Ascription of Responsibility, which appeared in the third, sixth and eighth positions in the matrix.

The analysis was then conducted using the results from the City Other building group. The sample was again smaller for this building group (n = 163), and data screening identified three variables without sufficient variance to be included in the analysis. The analysis was run on the remaining eleven variables. The communalities had a mean of .727, and 30 (54%) of nonredundant residuals were over .5 in the reproduced correlations matrix, suggesting that the data was borderline acceptable for conducting the analysis.

As with the City Loxley building group, the results for City Other resolved into one main factor (Cronbach's alpha .891), with 7 of the 11 items within this factor, and the remaining four spread among three weak factors. Additionally, like the City Loxley results, the items grouped within the one factor according to the constructs they were designed to tap: first were three AC: Awareness of Consequences items (AC3a, AC1a and AC3b with factor loadings of .913, .887 and .824), then were two PN: Pro-environmental Personal Norm items (PN3a and PN3b, with

loadings of .627 and .623), and finally there were two AR: Ascription of Responsibility items (AR3a and AR3c, with weak factor loadings of .524 and .443). Like the City Loxley analysis, this did not find a strong factor structure, but it did identify groupings within the single main factor that supported the three constructs of AC, AR and PN.

The analysis was then conducted using the results from the County building group. Again, a number of statements had to be excluded because there was not enough variance to conduct the analysis, leaving seven statements (two each from AC and PN, and three from AR). As with the previous two building groups, the analysis resolved into one main factor, including five of the seven items, with the other two items each forming single-item factors. The pattern within the main factor again grouped the items according to two of the constructs, although in this matrix the AR construct, which had been weakest in the previous two sets of results, came back as the strongest, and the AC construct was the weakest. Items AR3a and AR3c resolved first within the factor (with loadings of .904 and .894), followed by two PN items, PN3b and PN3c (loadings of .707 and .694). The two AC items (AC2a and AC3a) did not resolve into the same factor.

7.4.4 Factor structure in Values-Beliefs-Norms Theory

Principal Components Analysis of items tapping constructs within Values-Beliefs-Norms Theory provides overall support for the factor structure proposed by the theory. While the factor structures identified did have some weaknesses, the reasons for these are known. To keep the length of the questionnaire manageable, only a small number of items were used to measure each construct, and this weakened the distinction between factors. Some items were reverse-scored, and while re-coding the responses meant that higher scores were pro-environmental or pro-energy saving across all of the statements, there may have been differences in the way that respondents responded to positively and negatively worded statements. Additionally, some questionnaire items referred to the office location or to the Council as an organisation, while others referred to the household, and this may have weakened connections between items tapping the same constructs.

The particular findings for each construct also need to be considered. In the V: Values construct, two of the sub-scales consistently resolved together: V4: Self-transcendence (biospheric) and V5: Self-transcendent (altruistic). This is not a surprise, as the two concepts are related, referring to a ‘valued other’ that Schwartz’s (1977) original formulation saw as another person (altruistic) but that Stern et al. (1999) developed to include the ‘valued other’ of the environment, nature or animals. Differences between biospheric and altruistic values are found most clearly where there

is conflict between the environmental and humanitarian outcomes of a behaviour, although differences have been identified in some studies for pro-environmental beliefs, attitudes, preferences and behaviours (Steg et al., 2012). An analysis that included more items designed to tap the altruistic and biospheric aspects of the self-transcendent sub-scales would be likely to identify a difference between the two aspects. Such differences are not, however, likely to be an important factor in the current research.

The analysis of V: Values also identified that the sub-scale measuring V2: Self-enhancement was the weakest. This may reflect a bias within the responses, related either to the types of people who are likely to complete a questionnaire survey or to the wider question of the types of people employed in local government. Both are feasible explanations for respondents being less motivated by concepts such as V2a: Influential, having an impact on people and events, or V2b: Wealth, material possessions, money. People responding to the questionnaire survey (or most importantly, reaching the end of the survey, where these questions were located) might have more strongly pro-environmental or pro-energy saving attitudes than the general population, and those attitudes may equate to less interest in personal influence or material possessions. Likewise, people who choose to work in local government may be less interested in gaining personal influence or personal wealth, as other industries may be more attractive to people who are motivated by those values. A third possibility is that employment in local government encourages individuals to ascribe to that view: consciously or unconsciously, they may feel that it is not desirable for a local government employee to be motivated by personal influence or wealth. It is not possible from this data to assess the effect of any of these explanations.

The weakest of the constructs examined was W: Worldview, based on Dunlap et al.'s (2000) New Ecological Paradigm scale. The Principal Components Analyses did not resolve into good representations of the sub-scales within this scale. The full scale uses more items to measure each aspect, and the shorter version used here made it more difficult to identify the expected relationships. Additionally, many items were reverse-worded, and while they were reverse-coded so that higher individual scores represented more pro-environmental or pro-energy saving responses, it does seem that the reverse-wording affected the responses given.

The final three constructs in Values-Beliefs-Norms Theory, AC Awareness of Consequencues, AR Ascription of Responsibility, and PN Personal Norms, were analysed together, as they were not based on sub-scales. In all three building groups, a strong factor structure was not identified. The difficulty identifying the constructs was expected, as Values-Beliefs-Norms Theory places the constructs in a causal chain, implying strong correlations between constructs. Additionally, there were only small numbers of items measuring each construct, with some of those items

referring to the office location and some referring to the household location. However, in all three analyses, two of the three constructs could be discerned in groupings within the main factor, suggesting that the constructs were well enough defined to use with the Values-Beliefs-Norms theoretical model.

The factors identified here, for both the Theory of Planned Behaviour and Values-Beliefs-Norms Theory, provide the basis for further analysis of the relationships between influencing variables and the performance of behaviours, conducted in the following chapter. This chapter has tested the factor structures within the two theories; Chapter 8 will apply Structural Equation Modelling techniques to the data to explore the patterns of relationships between the factors.

7.5 Chapter Summary

This chapter presented a series of Principal Components Analyses identifying groupings between items measured in the questionnaire survey. These analyses addressed Objectives 1, 2 and 4 by identifying how well the descriptions of influencing variables and factor groupings proposed by the two attitude-behaviour theories described the data collected, and by grouping the behaviours according to similarities in their reported performance.

The analysis of the reported performance of the behaviours found evidence of a stable factor structure across the three building groups. This grouped the behaviours at a specific level, according to the type of equipment (e.g. lighting) and the setting in which the behaviour occurred (e.g. the office, the home). The two similar behaviours of turning off a computer monitor when away more than ten minutes (B3: in the office, and E2: in the home) resolved into a single two-item factor. However, when analysis of the behaviour-specific Theory of Planned Behaviour items was conducted, the larger number of items measuring each behaviour allowed office performance and home performance to resolve as separate factors. These factor structures support Stern's (2000) classification of behaviours performed within an organisational setting as different to behaviours performed in the household setting (private-sphere environmentalism; see Section 2.2), even where the behaviours themselves are physically very similar.

These findings identify that energy demand behaviours are not one homogenous group, but differ according to the type of equipment or appliance being used (lighting; computer monitors) and the setting that the behaviour occurs within (the office; the home). The definition of the behaviour is bound up with the context of its performance, as well as physical aspects of the behaviour and the equipment/appliance in question. Research examining the performance of behaviours needs to

take into account not just the specific behaviour (e.g. turning off a light) but also the context in which that behaviour occurs (e.g. in an office; at home).

This specificity has implications for the application of attitude-behaviour theories to understand the antecedents of such behaviours. For the Theory of Planned Behaviour, this means that each construct needs to be considered at a specific level: for example, the Personal Norm is not a generalised norm, but one specific to lighting behaviour when leaving a meeting room empty in the office setting, or to computer monitor behaviour when leaving the computer for more than ten minutes in the home setting. Values-Beliefs-Norms Theory, however, proposes a movement from stable values and worldviews towards more behaviour-specific feelings of responsibility and obligation (see Section 3.3.2). For the Theory of Planned Behaviour, a questionnaire needs to measure each construct at a behaviour-specific level, which can make a questionnaire unfeasibly long and repetitive. For Values-Beliefs-Norms Theory, however, the same level of specificity is not required to measure the more stable values and worldviews.

Across all three building groups, a stable structure was found for two of the three main constructs identified in the Theory of Planned Behaviour. The constructs of ATT: Attitude towards the behaviour and SN: Subjective Norm were found in all three building groups. The construct PBC: Perceived Behavioural Control did not resolve strongly in any of the building groups, probably because it was only measured by two statements for each specific behaviour, one reverse-scored. While reverse-scored items had been coded so that a higher score still indicated a more pro-energy saving response, the negative wording of these statements did seem to affect the strength of responses given by respondents. Nevertheless, the factor structures identified did provide general support for the structures proposed by the Theory of Planned Behaviour.

Principal Components Analysis on constructs proposed by Values-Beliefs-Norms Theory also provided general support for the proposed structure. Analysis of the Values-Beliefs-Norms Theory constructs identified some weaknesses, but reasons for these were known. In particular, the sub-scales used for Values and Worldviews were based on larger, well-tested scales (Schwartz's 1977 values scale, and Dunlap et al.'s 2000 New Ecological Paradigm; see Section 4.3.2). To keep the questionnaire at a manageable length, these scales were short, and as a result, some of the sub-scales were measured using only two items, including reverse-worded items.

Principal Components Analysis of the Values construct identified a factor combining altruistic and biospheric values in all three building groups. This was not unexpected; altruistic and biospheric values are two aspects of the concept of self-transcendence. In the literature, the difference between them was clearest where there was conflict between altruistic and biospheric

actions; in an office setting, it was not clear how such conflicts would manifest. Behaviours such as leaving lights on when not needed out of consideration for other occupants' preferences, rather than turning them off to save energy, could reflect habit, difficulties negotiating in a shared office, a lack of personal responsibility to act, or even the passive nature of not performing a behaviour.

The results of analysis of the Values and Worldviews from the three samples provided some support for the structures proposed by Values-Beliefs-Norms Theory but did not match them exactly. Again, this may have resulted from small numbers of items measuring each sub-scale and the use of reverse-worded items. Given the wide testing of Schwartz's (1977) Values scale and Dunlap et al.'s (2000) New Ecological Paradigm (used to measure Worldview) in the published literature, and further work conducted by Stern et al. (1999) in developing and testing Values-Beliefs-Norms Theory, the partial support for these constructs seems adequate for their use in the Structural Equation Modelling in Chapter Eight.

The final group of items from Values-Beliefs-Norms Theory, measuring AC: Awareness of Consequences, AR: Ascription of Responsibility, and PN: Personal Norm, form part of a causal chain in the theory and therefore correlate, making factor identification more difficult. For all three samples, they resolved into just one main factor, but within this factor the items grouped according to two of the three constructs. For the City Loxley and City Other building groups, AC: Awareness of Consequences and PN: Personal Norm grouped together while AR: Ascription of Responsibility was weaker; for the County building group, AR: Ascription of Responsibility and PN: Personal Norm grouped together and AC: Awareness of Consequences was weaker.

Principal Components Analyses conducted in this chapter provide general support for the factor structures proposed by the Theory of Planned Behaviour and Values-Beliefs-Norms Theory. Additionally, the analysis identified that behaviours are specific not just to the particular activity or equipment in question, but also to the setting that the behaviour occurs within. This distinction between office and home based behaviours provides further support for the findings about the relationships between behaviours in different settings identified in Chapter 6. This analysis has prepared the way for Structural Equation Modelling in Chapter 8 to analyse the relationships between behaviours and the influences proposed by the two attitude-behaviour theories.

Chapter 8: A Structural Equation Modelling analysis of the Theory of Planned Behaviour and Values-Beliefs-Norms Theory

8.1 Introduction

The analysis in this chapter tests whether the data collected in this research supports the relationships between variables proposed by models based on the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999).

Analysis of the Structural Equation Models addresses the first four objectives in this research. Objective 1 relates to the identification of key influences on individual energy use behaviours in office settings, and analysis presented here tests the explanatory power of contextual and psychological/attitudinal variables proposed by the two theories as influences on behaviour. Objective 2 investigates the connections between similar behaviours performed in different settings, the office and the home; a comparison of Structural Equation Models for behaviours in each location reveals similarities and differences in the behaviours performed in each setting and the variables that influence them. Objective 3 relates to the influence of actual and perceived control over behaviour; perceived control is a particular focus of the Theory of Planned Behaviour (Ajzen, 1991). Objective 4 assesses how well the two social psychological models of individual behaviour applied in this research (the Theory of Planned Behaviour and Values-Beliefs-Norms Theory) explain the individual energy use behaviours reported in this research.

Section 8.2 introduces the methods of Structural Equation Modelling used in this chapter. Section 8.3 presents a Structural Equation Modelling analysis of individual energy demand by office-based workers, testing relationships between influencing variables proposed by the Theory of Planned Behaviour (Ajzen, 1991). Section 8.4 presents a Structural Equation Modelling analysis based on Values-Beliefs-Norms Theory (Stern et al., 1999). Section 8.5 summarises the findings of the chapter.

8.2 Structural Equation Modelling

Structural Equation Modelling is a confirmatory statistical technique which can test whether the relationships between variables proposed by an existing theory or model fit the data collected to measure those variables. Structural Equation Models are similar in form to path analysis models, but include latent variables (unobserved variables identified by measuring several observed variables representing different aspects of the latent variable). A series of structural or regression

equations representing the causal processes are presented pictorially in the model. If the model is an adequate fit to the data collected, this supports the plausibility of the relationships between the variables proposed by the model; if not, the model is rejected (Byrne, 2010).

The analysis of the Structural Equation Model is a two-stage process. The first stage tests the measurement model, a factor analytic model based on Confirmatory Factor Analysis, confirming whether the observed variables do form the factor or component structure (the latent variables) proposed by the model. Factor analysis is useful for identifying latent variables because it groups together variables that correlate highly with one another but not with other variables. It 'achieves parsimony by explaining the maximum amount of common variance in a correlation matrix using the smallest number of explanatory constructs' (Field, 2009). The first stage in the Structural Equation Modelling confirms whether the factor structures identified by the Principal Components Analysis in Chapter 7 are also supported by the Confirmatory Factor Analysis.

The second stage tests a full latent variable model comprising both a measurement model and a structural model, allowing the researcher to test the influence of one latent structure on another to model causal direction (Byrne, 2010). A major advantage of Structural Equation Modelling over methods such as multiple regression lies in its handling of causal relationships. While methods used in experimental psychology can infer causality by systematically manipulating variables measured in the experiment, non-experimental studies where variables are observed in real-world settings cannot conduct the same manipulation, and as a result cannot make the same inferences about causality (Field, 2011). Structural Equation Modelling cannot transform correlational data into causal data, as some researchers' use of the results imply (Hox and Bechger, 1998), but it does enable the inference of causality from the relationships between variables presented in the model (Field, 2011). The second stage in Structural Equation Modelling, then, tests relationships between variables proposed by the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999) to identify how well the models fit the collected data.

The Structural Equation Modelling presented here is conducted using IBM's AMOS v20 software package, using the Maximum Likelihood estimation method. Bootstrapping using the Maximum Likelihood method is applied to the analysis, allowing AMOS to calculate the two-tailed significance values of indirect and direct effects, and addressing the assumption of multivariate normality. Bootstrapping creates multiple subsamples from the data, allowing the comparison of parametric values over repeated samples; as a computer-intensive technique, it is free from the constraining statistical assumption of normality of distribution (Byrne, 2010).

At both the Confirmatory Factor Analysis (measurement model) and Structural Equation Modelling (structural model) stages, goodness-of-fit statistics assess how well the hypothesised model fits the data. A number of different goodness-of-fit indices can be used, with much discussion in the literature of their performance under different conditions, such as with different sample sizes, estimation procedures or violations of multivariate normality (Byrne, 2010). The cut-off values associated with each index are also the subject of much discussion (Hu and Bentler, 1999; Fan et al., 1999; Marsh et al., 2004), highlighting that goodness-of-fit indices only give an indication of the lack of fit of a model, and should be seen as 'rules of thumb' rather than hard and fast values (Marsh et al., 2004). In particular, the χ^2 test is sensitive to sample size; because it is based on central χ^2 distribution which assumes the model fits perfectly in the population, problems achieving model fit with this indicator are common (Byrne, 2010). Assessment of the overall fit of the model, then, needs to be made on theoretical and practical grounds as well as statistical ones (Byrne, 2010). The indices used in this research and the levels at which they indicate good fit are presented in Table 8.1.

Index	Details	Indicators of good fit
χ^2	Likelihood ratio test statistic	$p > .05$
RMSEA	Root Mean Square Error of Approximation	< .05, or .05 - .08
CFI	Comparative Fit Index	> .95
RMR	Root Mean Square Residual	> .05
PNFI	Parsimony Normed Fit Index	Around .50

Table 8.1 *Goodness-of-Fit Indices used in analyses*

If a hypothesised model is judged not to be a good fit to the data, post-hoc adjustments to the model can be made to find a structure that improves the fit. AMOS produces Modification Indices, which outline which parameters can be introduced to or removed from the model in order to improve the fit (Byrne, 2010). AMOS presents all possible modifications that will affect the model fit, whether or not they are appropriate; post-hoc modifications to the model, then, have to be theoretically as well as statistically justified (Byrne, 2010). Once the adjustments are made, the model is re-estimated and Goodness-of-Fit statistics examined once more.

One issue of particular importance for Structural Equation Modelling, and for the use of AMOS, is the handling of missing data. While some statistical methods can work on pairwise deletion (removing cases with missing responses only from analysis of those specific variables), this will not work with Structural Equation Modelling, as all variables are tested simultaneously. Additionally, the AMOS software does not allow methods such as listwise deletion or single imputation to deal with missing data, but instead uses Maximum Likelihood estimation to replace

missing data (Byrne, 2010). While this provides a theoretical basis for the estimation of replacement values, it does have one major disadvantage; the AMOS software cannot estimate the replacement values and also calculate Modification Indices. As Modification Indices are an important tool in assessing whether a model would be improved by changing individual parameters, the benefits of the Modification Indices seem to outweigh the disadvantages of deleting cases with missing responses. This means that sample size is important for each analysis, as a missing response to one variable will exclude a case from the whole analysis.

8.3 A Structural Equation Modelling Analysis of the Theory of Planned Behaviour

This section presents a Structural Equation Modelling analysis of the relationships between variables hypothesised by the Theory of Planned Behaviour (Ajzen, 1991). The first stage of the analysis is a measurement model assessed using Confirmatory Factor Analysis, which confirms whether the variables observed in the data form the factors (latent variables) proposed by the theoretical model. The second stage is a structural model assessed using Structural Equation Modelling, which tests the relationships between variables proposed by the theoretical model.

As discussed above, the handling of missing data is an important issue for Structural Equation Modelling. For the AMOS software to calculate Modification Indices, cases with one or more missing responses to statements measuring the variables used in the model were excluded from the analysis. Table 8.2 presents the percentage of missing responses for each of the behaviours measured using items from the Theory of Planned Behaviour.

Behaviour	**City Loxley (337)**		**City Other (197)**		**County (285)**	
	n	**% missing**	**n**	**% missing**	**n**	**% missing**
A1: Office lights	-	-	162	17.8	241	15.4
A2: Meeting room lights	267	20.8	-	-	-	-
D1: Home lights	164	51.3	101	48.7	154	46.0
B3: Office monitors	292	13.4	165	16.2	242	15.1
E2: Home monitors	150	55.5	80	59.4	-	-

Table 8.2 *Percentage of cases with missing responses by behaviour for the Theory of Planned Behaviour*

Overall, the rates of missing responses varied greatly between behaviours, but were similar across the building groups. As the questions related to behaviours at home were highlighted in the questionnaire as optional, a lower response rate was expected for these questions. Although

even the lowest rate of missing data (13.3%) is above the 10% maximum rate suggested by Byrne (2010), there are no formal guidelines for what constitutes an acceptable level of missing data. Low numbers of responses overall can lead to very small numbers of respondents falling into particular response categories, weakening the ability of the analysis to identify relationships among the data. For the current analysis, it was decided that where samples were of a sufficient size that there were enough responses in each response category for the analysis to be successful, the samples would be used. As a result, the City Loxley building group for home monitors (55.5% of cases with missing responses, 150 responses remaining) was excluded from the analysis.

While there were sufficient numbers of responses from the City Loxley and County building groups for most analyses to be conducted, the responses from the City Other building group were much weaker. Principal Components Analyses conducted in Chapter 7 identified that the City Other building group was a much weaker sample, with less clearly identified factor structures than the other two samples. This is partly due to its smaller sample size, but also reflects that the City Other sample includes responses from a large number of buildings. The 197 responses came from 70 buildings, with the largest single representation from one building from the Lawrence House office building with 20 responses (see Section 5.2). Throughout this research, the context in which the behaviour under examination occurs has been found to be important. The spread of respondents to the City Other questionnaire across so many buildings seems to account for the less coherent data collected from this building group. Given this, and the smaller sample size, the City Other sample as a whole was excluded from the Structural Equation Modelling.

The analysis, then, examines structures underlying the data returned by respondents in the City Loxley and City Other building groups. Table 8.3 presents the behaviours examined in these analyses, and the types of models used for each. Previous examination of the factor structures in this data (see Section 7.2) identified that the behaviours grouped at a specific level, with the setting and the type of behaviour forming part of that specificity. As a result, the models built to test the relationships proposed by the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999) also needed to be tested at that same level of specificity. Where the same behaviours were examined in both samples, a multigroup analysis could be conducted; otherwise, an individual model was created.

Behaviour	Setting	Sample(s)	n	Type of model
Turn off lights	Meeting room	City Loxley	267	Individual
	Office	County	241	Individual
	Home	City Loxley County	164 154	Multigroup
Turn off computer monitors	Office	City Loxley County	292 242	Multigroup

Table 8.3 *Details of Structural Equation Model required for each behaviour for the Theory of Planned Behaviour*

The estimations were conducted for each model in turn, and are presented in the following sections. The presentation of the Structural Equation Models includes path diagrams which illustrate the relationships between variables proposed by the models. Table 8.4 presents the geometric symbols and basic configurations which are used by convention to illustrate different components of the path diagram (Byrne, 2010).

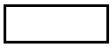
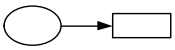
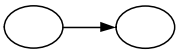
Symbol/configuration	Description
	Unobserved latent variable
	Observed variable
	Impact of one variable on another
	Covariance or correlation between pairs of variables
	Path coefficient for regression of an observed variable onto an unobserved latent variable (or factor)
	Path coefficient for regression of one factor onto another factor
	Measurement error associated with an observed variable
	Residual error in the prediction of an unobserved variable

Table 8.4 *Geometric symbols and basic configurations used in path diagrams*

Figure 8.1 presents a hypothesised model of the relationships between variables based on the Theory of Planned Behaviour (Ajzen, 1991). The figure includes items used to measure the two office-based behaviours of turning off lights and turning off computer monitors. The actual items

used to test each version of the models were specifically worded for each behaviour. The versions of the model used to analyse home-based behaviours were similar, with differences in the wording of one item measuring ATT: Attitude Towards the Behaviour and in the referant groups included in items measuring the SN: Subjective Norm. Following the results of the Principal Components Analysis, some individual items were excluded from some models; these are discussed in the relevant sections.

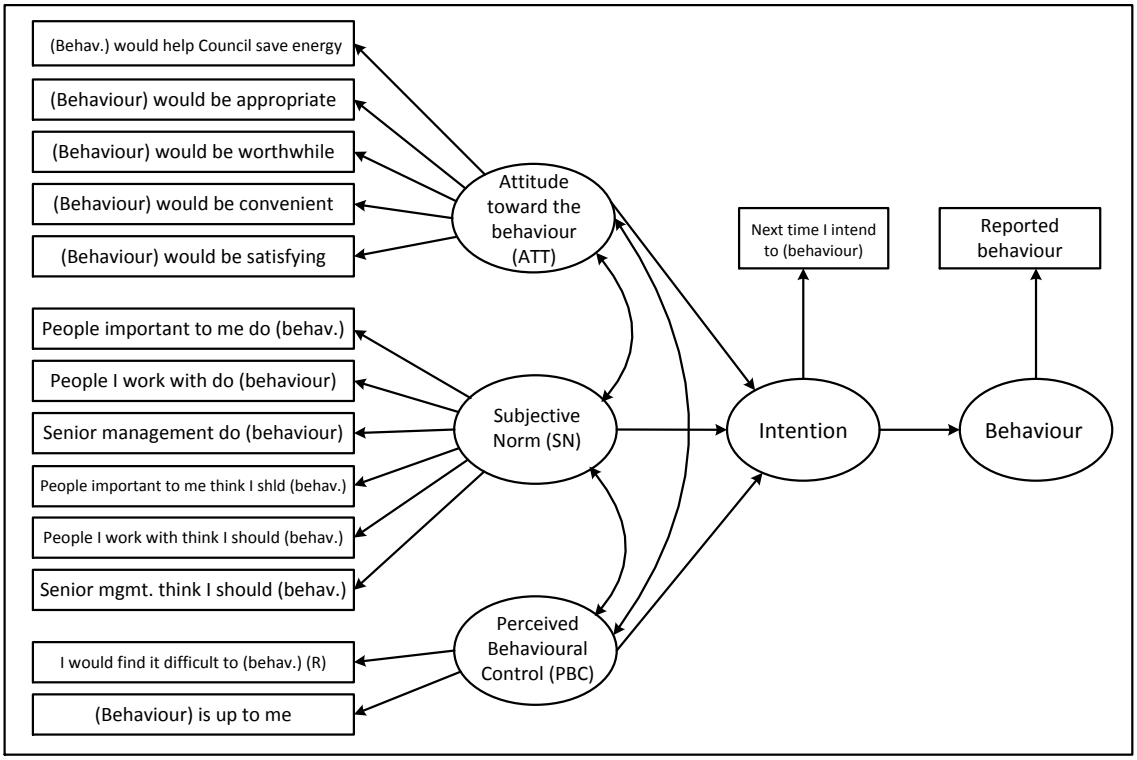


Figure 8.1 *Path diagram presenting hypothesised model of behaviours in the Office setting based on the Theory of Planned Behaviour*

The following sections present the Structural Equation Modelling analysis using the Theory of Planned Behaviour (Ajzen, 1991). Section 8.3.1 presents individual analysis of Meeting room lights in the City Loxley sample. The process and results of the estimation of this model are discussed in greater detail than for subsequent models, to illustrate the techniques used.

8.3.1 Meeting room lights in City Loxley sample

As the office lighting behaviours surveyed in the questionnaire are not the same for both building groups, they cannot be compared statistically, although comparisons can be made in a discussion of the results of analyses for each behaviour. The analyses and their results are presented and discussed in turn below, with A2: Meeting room lighting behaviour in the City Loxley building

group presented in this section, and A1: Office lighting behaviour in Section 8.3.2 with a comparison of the results for both lighting models.

After exclusions for missing responses, the City Loxley sample for Meeting Room Lights included 267 participants. Sample size in Structural Equation Modelling relates to the stability of parameters estimated in the analysis (Schreiber et al., 2006). Parameters to be estimated in the hypothesised model were 28 factor loadings, 5 covariances and 16 variances, totalling 49 parameters. This provided 5.4 participants per parameter, well below the 10 participants per parameter recommended by Schreiber et al. (2006). However, replication with multiple samples can demonstrate the stability of the results (Schreiber et al., 2006); in this study, the relationships hypothesised by the Theory of Planned Behaviour are tested with several samples and several behaviours, and consistent results across the different models would suggest stability.

The first stage in Structural Equation Modelling is estimation of a measurement model using Confirmatory Factor Analysis. One limitation of the AMOS software is that it does not allow factors to be tested in the measurement model if they only include two observed variables, although they can be included in the structural model. The Theory of Planned Behaviour construct PBC: Perceived Behavioural Control in this study only has two observed variables (see Figure 8.1 above). For the measurement model stage of the Structural Equation Modelling, then, the factor structures suggested by the Principal Components Analysis (Section 7.3.1) for the ATT: Attitude Towards the Behaviour and SN: Subjective Norm constructs were tested.

The variables used in this analysis are presented along with the results of the Confirmatory Factor Analysis (measurement) model for Meeting Room Lights for City Loxley in Figure 8.2 and Table 8.5. Two variables were excluded from the ATT: Attitude Towards the Behaviour construct. The variable ATT2a: Would help Council save energy was excluded because it did not resolve into the same factor as the other four items in the Principal Components Analysis (see Section 7.3.1). The variable ATT1b: Would be worthwhile was excluded because initial estimations of the Confirmatory Factor Analysis (measurement) model returned a negative variance for the error term for this item. There are a number of possible causes for this, including underidentification or misspecification of the model (Kolenikov and Bollen, 2012). Given the stage of the analysis at which this problem occurred, exclusion of the item was the most efficient resolution.

Following these exclusions, the measurement model was re-estimated, and was judged not to be a good fit the data (χ^2 107.168, DF 26, $p < .001$, RMSEA .108, CFI .864). The Modification Indices suggested including correlation between error terms. The respecified model (χ^2 40.387, DF 23, $p = .014$, RMSEA .058, CFI .971, RMR .040, PNFI .598) met the threshold levels

identified in Table 8.1 for all but the χ^2 statistic. Figure 8.2 presents a graphic of the re-specified measurement model, with standardised results and measurements of goodness-of-fit. Table 8.5 presents standardised and unstandardised coefficients for the measurement model.

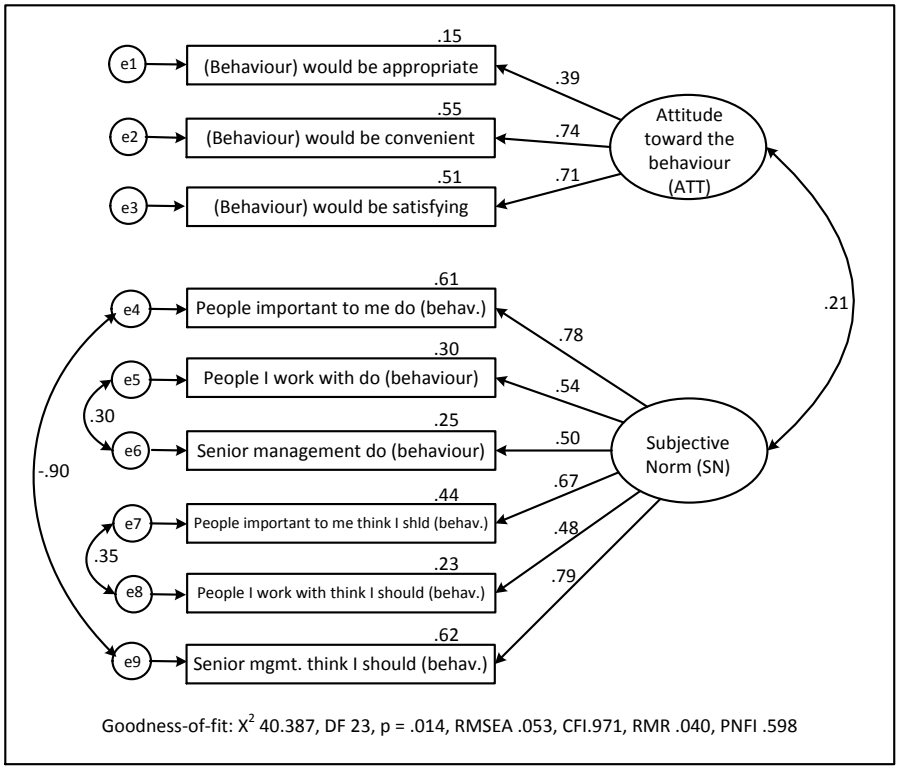


Figure 8.2 *Standardised results of measurement model (Confirmatory Factor Analysis) for City Loxley Meeting Room Lights for the Theory of Planned Behaviour*

Observed variable	**Latent construct**	***β***	***B***	**SE**
ATT1a: Meeting light appropriate	Attitude towards behaviour	.391	.203	.042
ATT1c: Meeting light convenient	Attitude towards behaviour	.745	.992	.189
ATT1d: Meeting light satisfying	Attitude towards behaviour	.712	1.00*	-
SN1: M. light important to me do	Subjective Norm	.780	1.527	.236
SN2: M. light work with me do	Subjective Norm	.544	1.057	.157
SN3: M. light management do	Subjective Norm	.505	.962	.150
SN4: M. light important think I should	Subjective Norm	.666	1.317	.146
SN5: M. light work with think I should	Subjective Norm	.480	1.00*	-
SN6: M. light mgmnt think I should	Subjective Norm	.791	1.626	.250

β Standardised coefficients, *B* unstandardised coefficients, *SE* standard error
* Factor loadings constrained to 1.00 for analysis do not have a SE

Table 8.5 *Standardised and unstandardised coefficients for measurement model (Confirmatory Factor Analysis) for City Loxley Meeting Room Lights for the Theory of Planned Behaviour*

The results of the Confirmatory Factor Analysis support the factor structure identified in the Principal Components Analysis (Section 7.3), which is also consistent with the factor structure hypothesised by the Theory of Planned Behaviour (Ajzen, 1991). This structure, then, can be used as the basis for the estimation of a structural model.

A structural model was developed which included the measurement model, with an additional two-item factor measuring Perceived Behavioural Control. The three latent constructs (ATT: Attitude Towards the Behaviour, SN: Subjective Norm, and PBC: Perceived Behavioural Control) directly influence the observed variable of INT: Intention to Perform the Behaviour, and indirectly through INT: Intention influence the observed variable of the Behaviour. Initial estimation of this model produced a marginal fit to the data (χ^2 123.601, DF 57, $p < .001$, RMSEA .066, CFI .912, RMR .049, PNFI .623).

Modification Indices suggested the addition of a correlation path between error terms e6 and e10 (M.I. 12.478). Re-estimation of the model produced an improved fit to the data (χ^2 103.810, DF 56, $p < .001$, RMSEA .057, CFI .937, RMR .047, PNFI .629). While the χ^2 statistic was significant ($p < .001$) and so did not indicate an adequate fit, other fit statistics were within (RMSEA, PNFI) or very close to (CFI, RMR) threshold levels. Modification Indices indicated that further modifications would not make sizeable improvements, so this model was accepted. Figure 8.3 presents the structural model, with standardised results and goodness-of-fit statistics.

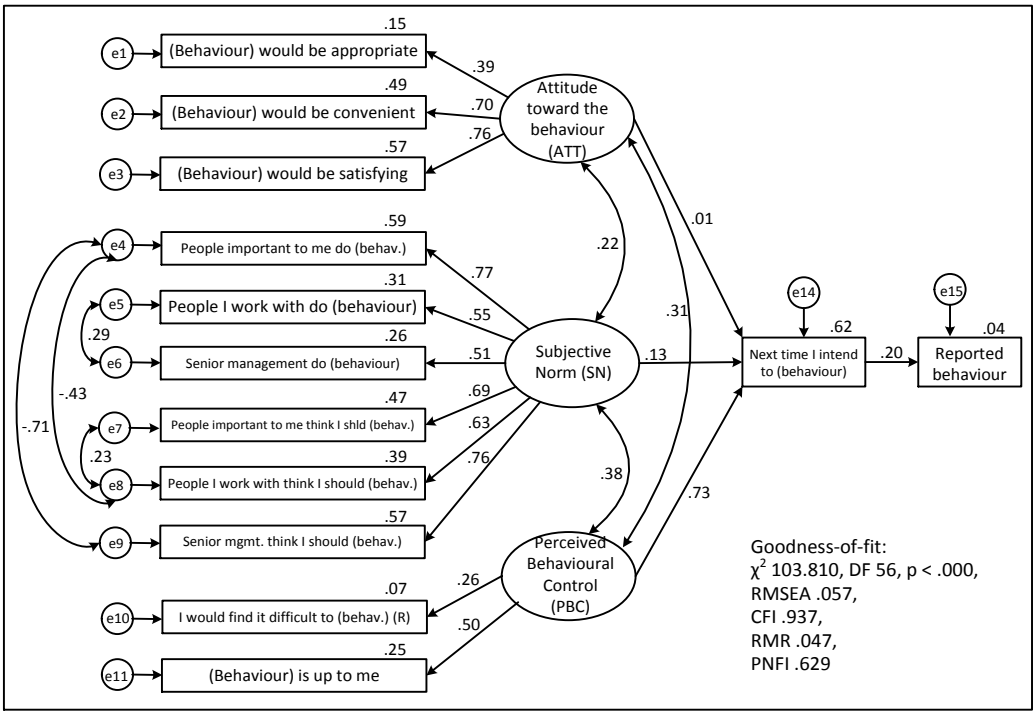


Figure 8.3 *Standardised results of structural model (Structural Equation Model) for City Loxley Meeting Room Lights for the Theory of Planned Behaviour*

Figure 8.3 shows that 62% of the variance associated with Intention is accounted for by ATT: Attitudes, SN: Subjective Norm and PBC: Perceived Behavioural Control, but only 4% of the variance associated with performance of the Behaviour is accounted for by Intention. This suggests that the hypothesised role of intention as a direct antecedent of behaviour, as proposed by the Theory of Planned Behaviour, is not supported by the data for Meeting Room Lights in the City Loxley sample.

Furthermore, an examination of the loadings of each latent variable onto Intention suggests that the largest influence on Intention originates with PBC: Perceived Behavioural Control (.73), with much lower estimates for Attitudes (.01) and Subjective Norm (.013). However, these results do not reveal whether these effects are statistically significant. Table 8.6 presents standardised and unstandardised estimates with results of significance tests for the main parameters in the model.

Parameters			***β***	***B***	**St. Err**	**C.R.**	***p* (sig)**
INT: Intention	<--	ATT	.008	.008	.137	.057	.955
INT: Intention	<--	SN	.128	.154	.186	.830	.407
INT: Intention	<--	PBC	.730	1.020	.560	1.821	.069
Behaviour	<--	INT	.204	.199	.058	3.407	.000
ATT: Attitudes	<-->	SN	.222	.124	.045	2.781	.005
SN: Subjective Norm	<-->	PBC	.381	.153	.051	2.999	.003
PBC: Perceived Behav. Control	<-->	ATT	.311	.150	.069	2.177	.029

β Standardised coefficients, *B* Unstandardised coefficients,
C.R. Critical Ratio (*B*/St. Error)

Table 8.6 *Standardised and unstandardised coefficient estimates of model parameters for City Loxley Meeting Room Lights*

Table 8.6 reveals that coefficient estimates for Intention on Behaviour, and for the three covariances between latent variables identified in the Confirmatory Factor Analysis, are all statistically significant. However, coefficient estimates for ATT: Attitudes and SN: Subjective Norm on INT: Intention are both not significant, while coefficient estimates for PBC: Perceived Behavioural Control on INT: Intention are close to significance ($p = .069$). The coefficients for INT: Intention on Behaviour are highly significant ($p < .001$). This suggests that, in this model, ATT: Attitudes and SN: Subjective Norm do not predict INT: Intention, while there is some evidence that PBC: Perceived Behavioural Control provides a better prediction of INT: Intention. To examine this further, Table 8.7 presents estimates for standardised direct, indirect and total effects.

Latent variables	Direct effect on				Indirect effect on Behaviour		Total effect on Behaviour	
	Intention		Behaviour					
	Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*
ATT: Attitudes	.008	.968	-	-	.002	.969	.002	.969
SN: Subjective Norm	.128	.533	-	-	.026	.437	.026	.437
PBC: Perceived Behav. Control	.730	.008	-	-	.149	.014	.149	.014
INT: Intention	-	-	.204	.014	-	-	.204	.014

Table 8.7 *Estimates of standardised direct, indirect and total effects for City Loxley Meeting Room Lights for the Theory of Planned Behaviour*

Table 8.7 confirms that the Direct effects on Intention and Indirect effects on Behaviour of the latent variables ATT: Attitudes and SN: Subjective Norm were not statistically significant. The Direct effect on INT: Intention and Indirect effect on Behaviour of the latent variable PBC: Perceived Behavioural Control were statistically significant, however. The Direct effect of INT: Intention on behaviour was also statistically significant, but had a much weaker effect than PBC: Perceived Behavioural Control.

This suggests that the relationships between variables hypothesised by the Theory of Planned Behaviour do not provide a satisfactory explanation of the influences on intentions and behaviours found within the data. Whether this is to do with the particular behaviour of turning off meeting room lights, or is a feature of responses given by the City Loxley sample, or whether it reflect a problem with the explanatory power of this hypothesised model, will become clearer after an examination of the Structural Equation Models for the remaining behaviours and samples. However, the results do suggest that the latent variable PBC: Perceived Behavioural Control is an important influence on INT: Intention, and indirectly on behaviour.

8.3.2 Office lights in County sample

This section presents analysis of A1: Office lighting behaviour in the County building group, following the procedures described in the previous section. Problems arising in the estimation of the structural model and the nature and implications of these problems are discussed.

After exclusions for missing data, the sample size for A1: Office lights in the County building group was 241. Parameters to be estimated were 26 factor loadings, 5 covariances and 15 variances, totalling 46 parameters, or 5.2 respondents per parameter. Again, this was below the recommended ten respondents per parameter, but with multiple models being tested this would not present a major problem.

Following the factor structure identified in Principal Components Analysis in Section 7.3, Confirmatory Factor Analysis was conducted with three observed variables measuring the latent variable ATT: Attitudes Towards the Behaviour, and with five observed variables measuring the latent variable SN: Subjective Norm. Examination of the Goodness-of-Fit indices for a model with covariance between the latent variables ATT: Attitudes and SN: Subjective Norm revealed an adequate fit to the data (χ^2 46.033, DF 19, $p < .001$, RMSEA .077, CFI .957, RMR .059, PNFI .631). The measurement model supported the structure identified in the Principal Components Analysis, and analysis proceeded to the structural model on that basis.

The two items measuring PBC: Perceived Behavioural Control, and parameters connecting the latent variables, were added to the model to match relationships proposed by the Theory of Planned Behaviour (as illustrated in Figure 8.1). However, initial estimation of this model failed to converge within 49 iterations. Further investigation identified that the error term on INT: Intention was estimating a negative variance. Such results are frequently found in Structural Equation Models; known as Heywood Cases, they are mathematically impossible results that can be caused by several issues, including model misspecification, model underidentification, outliers or sampling fluctuations (Kolenikov and Bollen, 2012). By holding the value of the error term on INT: Intention to zero, it was possible to make the model converge, and the goodness-of-fit statistics suggested that this produced an adequately fitting model (χ^2 111.673, DF 48, $p < .001$, RMSEA .074, CFI .924, RMR .089, PNFI .638). Table 8.8 presents the standardised and unstandardised coefficients estimated for the main parameters in this re-specified model.

Parameters			***β***	***B*** [b]	**St. Err**	**C.R.**	***p* (sig)**
INT: Intention	<--	ATT	-.300	-.577	.361	-1.596	.111
INT: Intention	<--	SN	-.447	-.766	.403	-1.904	.057
INT: Intention	<--	PBC	1.387	2.960	.628	4.716	.000
Behaviour	<--	INT	.316	.335	.065	5.167	.000
ATT: Attitudes	<-->	SN	.144	.050	.027	1.867	.062
SN: Subjective Norm	<-->	PBC	.689	.215	.054	3.986	.000
PBC: Perceived Behav. Control	<-->	ATT	.479	.133	.043	3.089	.002

β Standardised coefficients, *B* Unstandardised coefficients,
C.R. Critical Ratio (*B*/St. Error)

Table 8.8 *Standardised and unstandardised coefficient estimates of model parameters for County Office Lights for the Theory of Planned Behaviour*

Inspection of standardised coefficients in this table revealed a further problem with the re-specified model. The estimate for PBC: Perceived Behavioural Control onto Intention was

reported as an impossibly high 2.960, and was moving in the opposite direction and at a different magnitude to the other two latent variables. This again suggested a problem with the specification of the model. Several problems with the PBC: Perceived Behavioural Control variable could be causing this misspecification. Firstly, it was measured using only two variables. As discussed in Section 7.3, Principal Components Analysis revealed that the Theory of Planned Behaviour items grouped according to both specific behaviour and setting. Scales that might otherwise have included data for several behaviours or locations were disaggregated, reducing the numbers of items tapping each latent variable. As a result, only two items measured PBC: Perceived Behavioural Control for each specific behaviour and location. Secondly, one of those items was negatively worded and then reverse-scored so that, like the other items, a higher score indicated a more pro-environmental response. Consequently, the two PBC: Perceived Behavioural Control items did not group as a strong factor in the Principal Components Analysis.

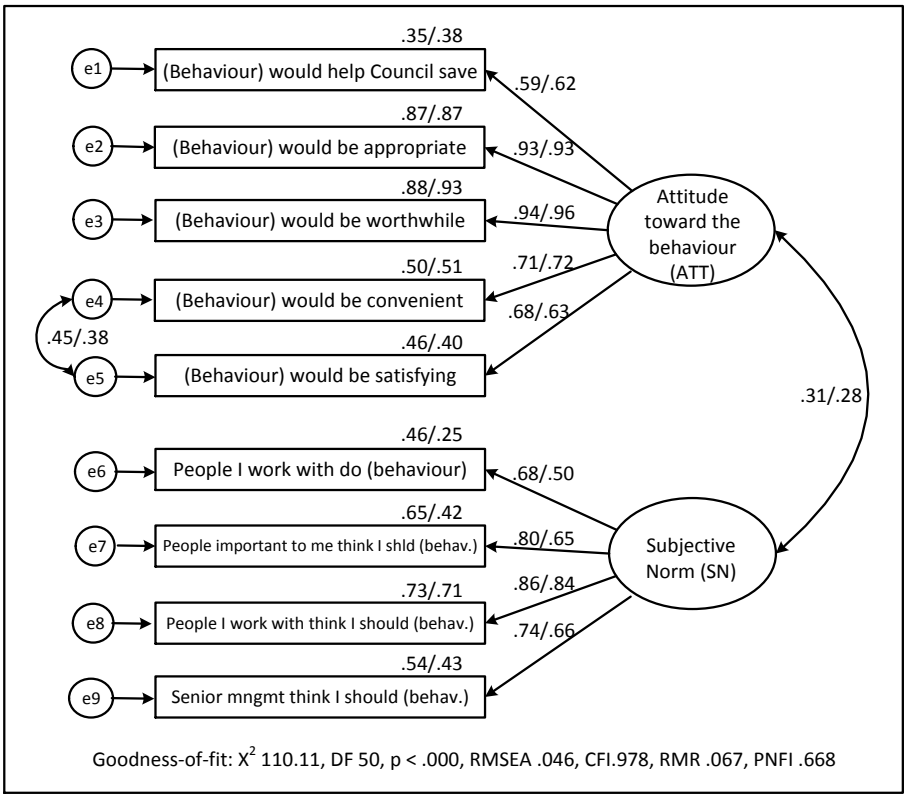
Furthermore, the other two latent variables (ATT and SN) were also measured by a smaller number of items than initially expected, with items excluded following the Principal Components Analysis. Three items measured ATT: Attitudes rather than the hypothesised five, and five measured SN: Subjective Norm rather than the hypothesised six. The smaller number of observed variables throughout contributed to underidentification of the Structural Equation Model, and the weakness of PBC: Perceived Behavioural Control exacerbated this effect. Consequently, results produced by controlling for negative error variance cannot be relied upon as an accurate explanation of the data. For Office lights in the Loxley building group, then, the predictive ability of the model based on the Theory of Planned Behaviour cannot be adequately assessed.

8.3.3 Computer monitors in the office location for both samples

The estimation of a model for B3: Computer monitor behaviours in the office location could avoid some issues of underidentification by being run as a multigroup model. This allowed estimation for both building groups to occur simultaneously in the same model, with responses from each group treated separately within the combined model. This method also allows a direct comparison of the fit of the hypothesised model to each group. As the multigroup method is slightly different to the individual method applied in the two previous sections, this section will present details of the procedures and analyses used.

To apply a multigroup analysis, the same variables are used to measure both groups, and the same paths are included for both groups in the measurement and structural models. The measurement model (Confirmatory Factor Analysis) was again based on the factor structure

identified by Principal Components Analysis (Section 7.3.1), with only items that appeared in the factor structures for both building groups used in the analysis. This gave five items to measure ATT: Attitudes and four to measure SN: Subjective Norm. The initial multigroup model estimated was close to acceptable (χ^2 211.568, DF 52, p < .001, RMSEA .070, CFI .943, RMR .082, PNFI .669). Modification Indices for both groups suggested that adding a covariance between error terms e4 and e5 would improve the fit of the model (City Loxley MI 58.891, Par Change .403; County MI 35.769, Par Change .353). The model was re-specified and was a good fit to the data (χ^2 110.11, DF 50, p < .001, RMSEA .046, CFI .978, RMR .067, PNFI .668). Figure 8.4 presents standardised results for both groups, and Table 8.9 presents standardised and unstandardised coefficients for both groups.



Standardised results given for City Loxley/County

Figure 8.4 *Standardised results of group comparison measurement model (Confirmatory Factor Analysis) for City Loxley and County Office Monitors for the Theory of Planned Behaviour*

Observed variable	Latent variable	City Loxley			County		
		β	***B****	**SE**	***β***	***B****	**SE**
ATT2a: Would help Council	ATT	.594	.656	.067	.615	.776	.087
ATT1a: Appropriate	ATT	.935	1.237	.085	.932	1.343	.109
ATT1b: Worthwhile	ATT	.938	1.213	.083	.963	1.358	.109
ATT1c: Convenient	ATT	.707	1.140	.073	.717	1.201	.094
ATT1d: Satisfying	ATT	.678	1.000	-	.633	1.000	-
SN2: Work with me do	SN	.675	1.041	.093	.503	.915	.132
SN4: Important think I should	SN	.805	1.152	.087	.651	.970	.113
SN5: Work with think I should	SN	.855	1.246	.091	.844	1.377	.149
SN6: Mgmt. think I should	SN	.736	1.000	-	.659	1.000	-

β Standardised coefficients, *B* unstandardised coefficients, *SE* standard error
* Factor loadings constrained to 1.00 for analysis do not have a SE

Table 8.9 *Standardised and unstandardised coefficients for group comparison measurement model (Confirmatory Factor Analysis) for City Loxley and County Office Monitors*

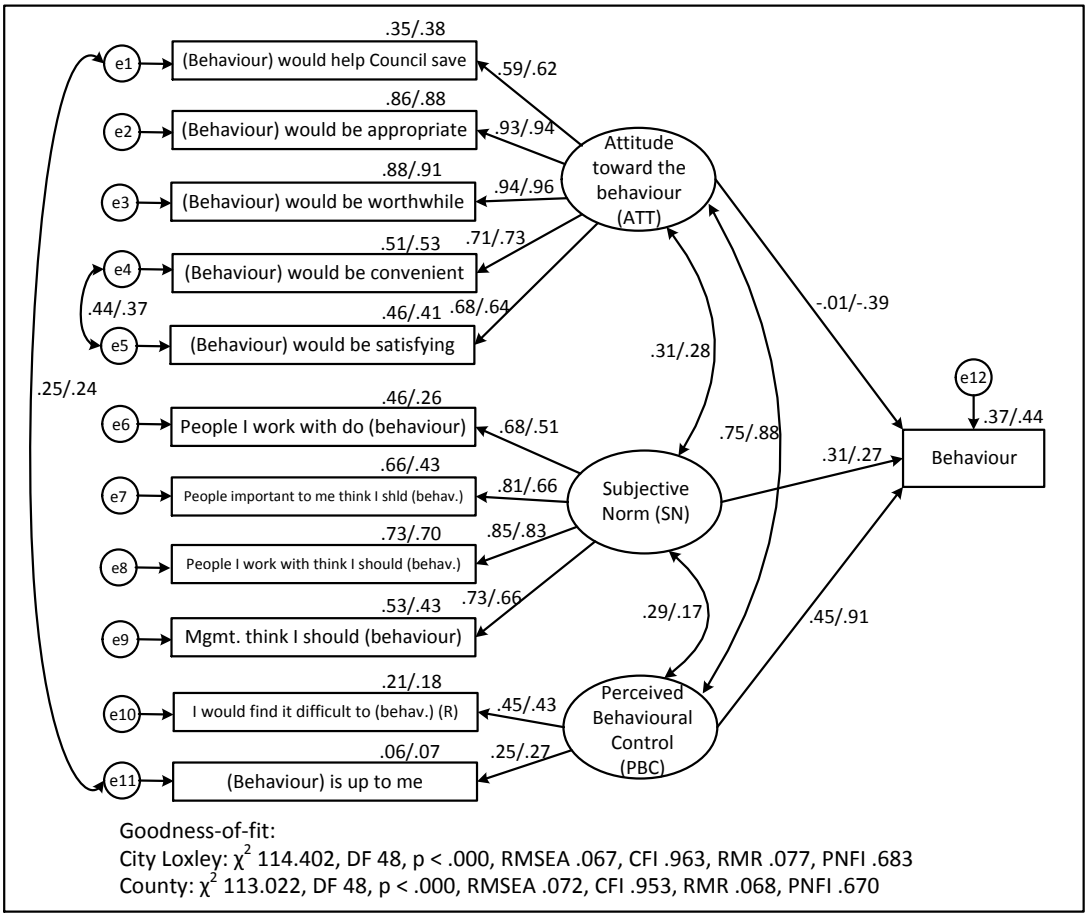
The results confirm that the factor analysis identified by the Principal Components Analysis matches the structure identified by the Confirmatory Factor Analysis. The model fit statistics, however, are based on both groups together in the model. The next stage in a multigroup model tests for configural invariance; that is, whether there is a significant difference between the fits of the model as applied to each group, using the Tau-equivalent test (Byrne, 2010). A new model in which factor loadings are constrained to be equal in both groups is created. The Tau-equivalent test reveals whether there is a significant difference between the factor loadings of the original, unconstrained version of the model and the new, constrained version of the model. A non-significant result suggests that there is configural invariance between the two models, and gives further support to the structure of the model as a good description of the underlying data.

The results of the Tau-equivalent test for the equivalence of the factor loadings in the Office Monitors multigroup model were not significant (χ^2 7.161, DF 7, p = .412), suggesting that there was configural invariance across the two groups. A further Tau-equivalent test was conducted to test for invariance across error terms on observed variables, and this too was non-significant (χ^2 7.189, DF 9, p = .617). This confirms that the factor structure tested by the Confirmatory Factor Analysis is a good description of the data, and holds true for both the City Loxley and County groups. The measurement model was then used as the basis for the structural model.

The procedure for running a multigroup version of a structural model is the same as for the single version of the model, previously described, with the exception that the software links to two data sources instead of one and tests the fit of the model against both data sources simultaneously. The

structural model was specified according to parameters hypothesised by the Theory of Planned Behaviour (as shown in Figure 8.1). However, the analysis failed to converge. An investigation identified a problem with the latent variables ATT, SN and PBC and their relationship with the INT: Intention construct. The model as specified did not fit the data for either building group.

The model was re-specified without the construct of INT: Intention, so that the latent variables directly influenced the performance of the behaviour rather than being mediated by the formation of intentions. This model did converge; the results are presented in Figure 8.5.



Standardised results given for City Loxley/County

Figure 8.5 *Standardised results of structural models (Structural Equation Models) without Intention construct, for City Loxley and County Office Monitors*

While the model did converge when specified in this way, examination of the results reveals a problem with the relationship between ATT: Attitudes and Behaviour, illustrated by negative figures on the path between the two constructs. Examination of the table of standardised and unstandardised coefficient estimates of the model parameters (Table 8.10) also reveals a problem with the relationship between PBC: Perceived Behavioural Control and Behaviour, identified by

high Standard Errors for this parameter. Both problems appear in the results for both building groups, suggesting that this is a problem with the specification of the model.

City Loxley			***β***	***B***	**St. Err**	**C.R.**	***p* (sig)**
Behaviour	<--	ATT	-.009	-.013	.290	-.043	.966
Behaviour	<--	SN	.313	.575	.143	4.037	.000
Behaviour	<--	PBC	.449	2.339	1.409	1.661	.097
ATT: Attitudes	<-->	SN	.313	.187	.042	4.448	.000
SN: Subjective Norm	<-->	PBC	.292	.049	.024	2.002	.045
PBC: Perceived Behav. Control	<-->	ATT	.746	.158	.049	3.196	.001
County			***β***	***B***	**St. Err**	**C.R.**	***p* (sig)**
Behaviour	<--	ATT	-.394	-.641	.776	-.825	.409
Behaviour	<--	SN	.265	.637	.332	1.919	.055
Behaviour	<--	PBC	.910	4.023	2.368	1.699	.089
ATT: Attitudes	<-->	SN	.281	.129	.036	3.576	.000
SN: Subjective Norm	<-->	PBC	.165	.028	.025	1.127	.260
PBC: Perceived Behav. Control	<-->	ATT	.884	.220	.060	3.646	.000

β Standardised coefficients, *B* Unstandardised coefficients, C.R. Critical Ratio (*B*/St. Error)

Table 8.10 *Standardised and unstandardised coefficient estimates of model parameters, without Intention construct, for City Loxley and County Office Monitors*

A problem with the misspecification of a model does not necessarily indicate a problem with the hypothesised structure of relationships between the latent variables within the Theory of Planned Behaviour, but is more likely a result of the measurement of the latent variables in the data itself. Discussion in this chapter and in Chapter 7 has identified a several weaknesses in factor structures resulting from small numbers of items measuring each latent construct, from reverse-scored responses, and from low levels of variance in some responses. In combination, these factors may have led to the failure of some models to properly converge, making it difficult to assess the explanatory power of the Theory of Planned Behaviour for some behaviours.

Further analysis can be conducted using the data collected here to identify whether different structures between the variables offer a better explanation of the data. This would be a useful extension to the current research, but is beyond the scope of the thesis presented here.

8.3.4 Lighting in the home location for both building groups

Analysis of home lighting behaviour for the City Loxley and County respondents was conducted using the multigroup method described in the previous section. Again, the measurement model (Confirmatory Factor Analysis) was based on the factor structure identified by Principal

Components Analysis (Section 7.3.1). The initial multigroup model estimated was acceptable on all goodness-of-fit indices apart from χ^2, which was approaching acceptability (χ^2 52.411, DF 36, $p < .038$, RMSEA .038, CFI .989, RMR .053, PNFI .620).

A Tau-equivalent test for configural invariance between the groups was non-significant (χ^2 3.157, DF 6, $p < .789$), indicating no significant difference between the variance in the factor loadings for both groups. A further Tau-equivalent test for invariance in error terms was also non-significant, although it was approaching significance (χ^2 21.650, DF 14, $p = .086$), suggesting that although there was invariance in the error terms between the two groups, there were small (non-significant) differences present. Overall the results provided further evidence that the measurement model (Confirmatory Factor Analysis) was a good description of the factors in the data, and that this held equally well across both building groups.

Given the similarities in the data from the two groups identified by this analysis, and the problems identified in the models developed to examine other reported behaviours in this research, it is no surprise that problems in the structural model (Structural Equation Model) are found for both the City Loxley and County results. The structural model was run as a multigroup model, as previously described, but did not resolve before the iteration limit was reached. As with previous models, this suggested problems with the specification of the model. The models were re-run as single group models and, as expected, did not converge for either group.

The model for the results from the City Loxley building was re-run without the mediating variable of Intention, so that the three latent variables (ATT, SN and PBC) directly influenced the performance of the behaviour. Again, the model failed to resolve within 49 iterations. The model was then re-specified with Intention but without the performance of the behaviour, so that the model was predicting only stated intention rather than reported behaviour. The model again did not run, this time because one estimated variable failed to be positive. However, the software did not report which variable was causing the problem, and without this information it was difficult to continue attempting to find a working model.

The model for the results from the County building group was then re-run, with similar results. However, it was possible to make this model resolve by using the PBC: Perceived Behavioural Control item '(behaviour) is up to me' as a single observed variable rather than as a contributor to the PBC latent variable. While the model did run successfully, however, it was not a good fit to the data (χ^2 155.365, DF 33, $p < .001$, RMSEA .156, CFI .824, RMR .119, PNFI .579). Examination of the Modification Indices did not identify any modifications that could provide worthwhile or theoretically justified improvements.

The conclusion from the development of the models to examine home lighting behaviour, then, is that the models based on the Theory of Planned Behaviour once again do not provide a satisfactory explanation of the observed data. This may reflect a weakness in the measurement of some of the variables in the model, or it may reflect an underlying problem with the use of a model based on the Theory of Planned Behaviour for this particular behaviour. The similar patterns of results and problems across the two building groups could support either conclusion. The successful model for the County sample using one observed PBC item, which revealed that the model itself did not provide a good explanation of the data, offers some support for this being a problem with the relationships proposed by the model. However, the small numbers of items measuring some variables could also cause this problem.

8.3.5 Using the Theory of Planned Behaviour to analyse lighting and monitor behaviours

Of the four Structural Equation Models tested in this section using the structural model suggested by the Theory of Planned Behaviour, only one was completely successful. The model for Meeting room lights in the City Loxley building group (Section 8.3.1) found that 62% of the variance associated with INT: Intention is accounted for by ATT: Attitudes, SN: Subjective Norm and PBC: Perceived Behavioural Control, while INT: Intention itself accounted for just 4% of the variance in Behaviour. Of these relationships, however, only the influence of PBC on INT and of INT on Behaviour were found to be statistically significant. This suggests that the model hypothesised by the Theory of Planned Behaviour does not provide a satisfactory explanation of the relationships between ATT: Attitudes towards the behaviour, SN: Subjective Norm, PBC: Perceived Behavioural Control, and their effect on both INT: Intention to perform the behaviour and the recorded performance of that behaviour. However, it does suggest that the PBC: Perceived Behavioural Control item is the most influential of the latent variables on the performance of the Meeting room lights behaviour in the City Loxley building group.

The remaining three models, for County Office lights, Office monitors in both building groups, and Home lighting in both building groups, did not produce successful solutions. In all three models, the measurement model (Confirmatory Factor Analysis) confirmed the factor structure but the structural models either failed to converge, or returned negative error variances, or negative factor loadings and unfeasibly high Standard Error terms. For the analysis of Office lighting in the County building group, the problem lay with the weak formation of the PBC: Perceived Behavioural Control variable. For the multigroup model examining Office monitor behaviours, the problem lay with the INT: Intention variable. It was difficult to identify the root

of the problem for the Home lighting model. Although the model for the County results did resolve after respecifying to use one observed PBC item, the goodness-of-fit indices suggested that, while the model did run, it provided a poor explanation of the observed data.

For meeting room lights, then, there was some evidence that Perceived Behavioural Control was the strongest influence on intention to perform the behaviour. For home lighting, however, this did not seem to be the case. The results for office lighting and for computer monitors in the office setting were not conclusive, as it was difficult to identify whether problems with the models originated in the way the variables were measured or proposed relationships between variables.

This mixed evidence of the success of the Theory of Planned Behaviour in explaining relationships between variables makes it difficult to assess the usefulness of the Theory of Planned Behaviour's explanation of influences on the performance of the energy demand behaviours examined in this research. Further work might be able to identify more clearly defined relationships between individual variables in the models, however such exploratory work is beyond the scope of this thesis. Future research that used larger numbers of items to test some of the model structures might have more success, although it is not clear whether small numbers of items are the root of the problems in the models examined here.

The following section examines how well an alternative model of influences on behaviour explains the data collected in this research. Section 8.4 uses Structural Equaion Modelling to examine the explanatory power of Stern et al.'s (1999) Values-Beliefs-Norms Theory.

8.4 A Structural Equation Modelling Analysis of Values-Beliefs-Norms Theory

This section presents an analysis of relationships between variables in a hypothesised model of the influences on energy demand behaviours based on Values-Beliefs-Norms Theory (Stern et al., 1999). Although the basic model is different to that proposed by the Theory of Planned Behaviour (Section 8.3), the procedure for running the analysis is the same, with the measurement model (Confirmatory Factor Analysis) tested first and then the structural model (Structural Equation Model).

As with the responses to the items measuring the Theory of Planned Behaviour, there were high numbers of missing responses to the items measuring Values-Beliefs-Norms Theory. Where there

was a missing response, the whole case had to be excluded to allow the AMOS software to run. Table 8.11 presents the percentage of cases with missing responses for each behaviour.

Behaviour	City Loxley (337)		City Other (197)		County (285)	
	n	% missing	n	% missing	n	% missing
A2: Meeting room lights	252	25.2	143	27.4	201	29.5
A1: Office lights	-	-	149	24.4	223	21.8
D1: Home lights	287	14.8	163	17.3	238	16.5
B3: Office monitors	292	13.3	168	14.7	242	15.1
E2: Home monitors	254	24.6	143	27.4	207	27.4

Table 8.11 *Percentage of missing responses to items measuring Values-Beliefs-Norms Theory for each behaviour*

The exclusion of cases with missing data meant that the numbers of respondents for all of the behaviours in the City Other building group was too low for Structural Equation Modelling to be likely to be successful (Byrne, 2010). As with the analysis for the Theory of Planned Behaviour, then, the City Other building group was excluded from this analysis. Numbers of respondents for all of the other behaviours, however, were sufficient for the analysis to be conducted.

The Values-Beliefs-Norms model presents a series of latent variables in a causal chain, moving from more stable values and worldviews through gradually more behaviour-specific constructs to the Personal Norm, which is hypothesised to directly affect behaviour. The hypothesised model is presented in Figure 8.6.

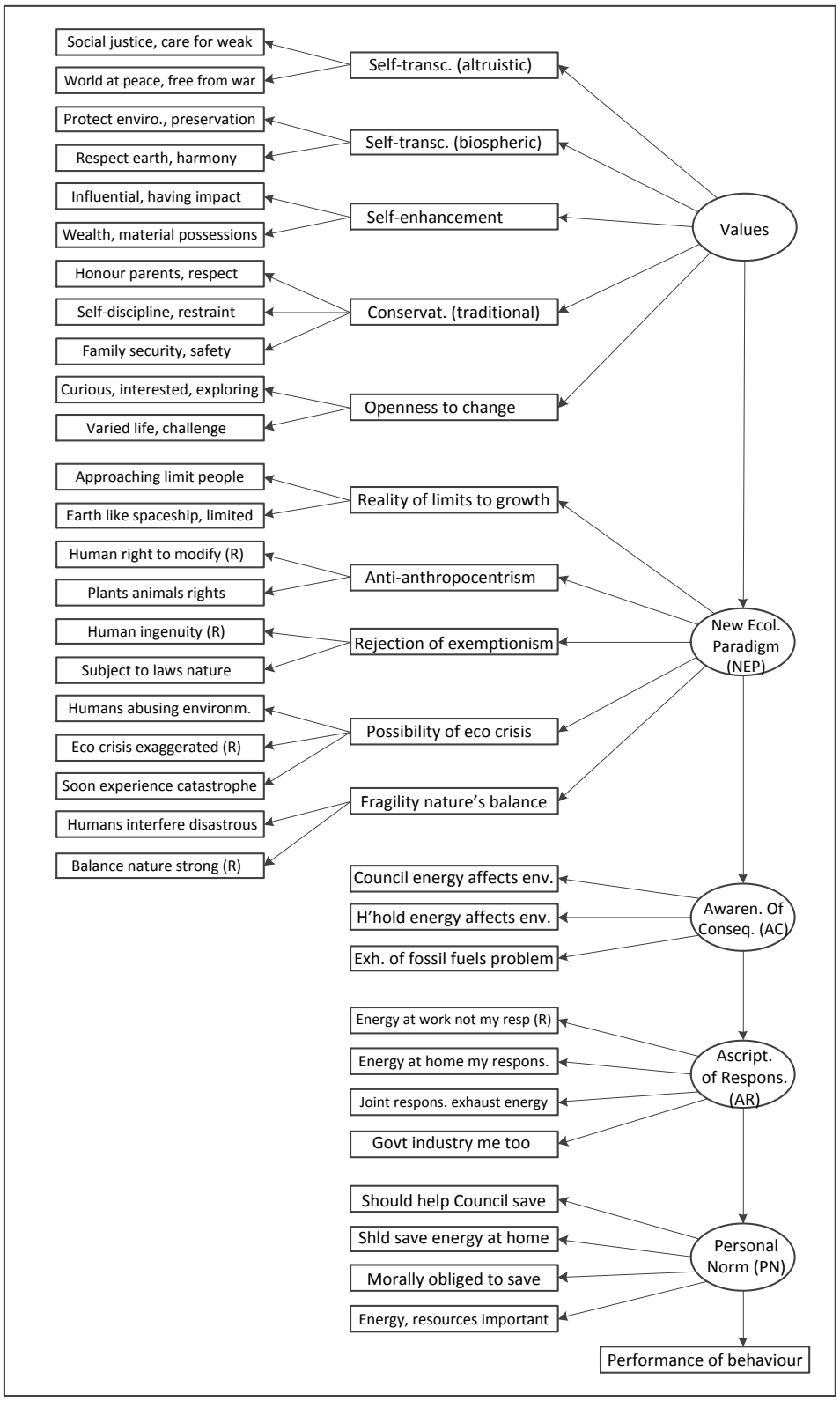


Figure 8.6 *Path diagram presenting hypothesised model of behaviours based on Values-Beliefs-Norms Theory*

Unlike models based on the Theory of Planned Behaviour, variables from Values-Beliefs-Norms Theory used to measure all but the performance of the behaviour itself are the same for each

behaviour measured. This means that the factor structure can be confirmed once for all of the models, simplifying the process of model estimation. Multi-group models were used to examine four behaviours, A2: Meeting room lights, D1: Home lights, B3: Office monitors, and E2: Home monitors, allowing direct comparisons between the fit of the model for the two building groups. In addition, an individual model was applied to A1: Office lights for the County building group only; the City Loxley building group was not asked this question.

The factor structure is a second-order structure (Byrne, 2010); the five factors making up the V: Values latent variable and the five making up the W: Worldview latent variable are themselves constructed from sub-scales. To reduce the number of parameters estimated (reducing the risk of the model being unidentified), sub-scales for these variables were converted into summary scales by calculating the mean response for each respondent to the items making up the sub-scale (Whitfield et al., 2009). This meant that factors making up the V: Values and W: Worldview latent variables could be treated as indicators rather than as an additional level of latent variables.

Given the greater simplicity of analysis offered by the single set of measured variables for all but Behaviour, each stage of the analysis is presented together. The results of one analysis are presented in detail to illustrate the procedure, and summary results for the remaining behaviours are presented afterwards. The behaviour selected to illustrate the process is B3: Office monitors, because it is directly under the control of individuals in both building groups. It was anticipated that there would be no significant differences between the two samples for this behaviour.

The procedure followed the same steps used in the analysis of multi-group models for the Theory of Planned Behaviour. The first stage was the estimation of a measurement model (Confirmatory Factor Analysis) based on the structure presented in the hypothesised model. As this did not include any behaviour-specific items, estimating the measurement model once would confirm whether the model was adequate for the estimation of all of the behaviours. The samples used for each behaviour were slightly different, as missing responses were excluded for each behaviour individually. However, the measurement model tested the factor structure rather than the predictive power of the model, so this was not a problem at this stage.

Goodness-of-fit indices for this measurement model suggested that it was close to fitting the data (χ^2 1012.767, DF 412, $p < .001$, RMSEA .052, CFI .880, RMR .058, PNFI .727). However, examination of the Modification Indices suggested a number of improvements, and the re-specified model was a better fit to the data (χ^2 994.811, DF 362, $p < .001$, RMSEA .057, CFI .873, RMR .117, PNFI .703). While the χ^2 result was significant and the CFI was below .95, indicating a poor fit, the other goodness-of-fit statistics indicated a reasonable fit to the data. Examination of

the Modification Indices suggested no theoretically-justified improvements, so the model was accepted. Results are presented in Figure 8.7.

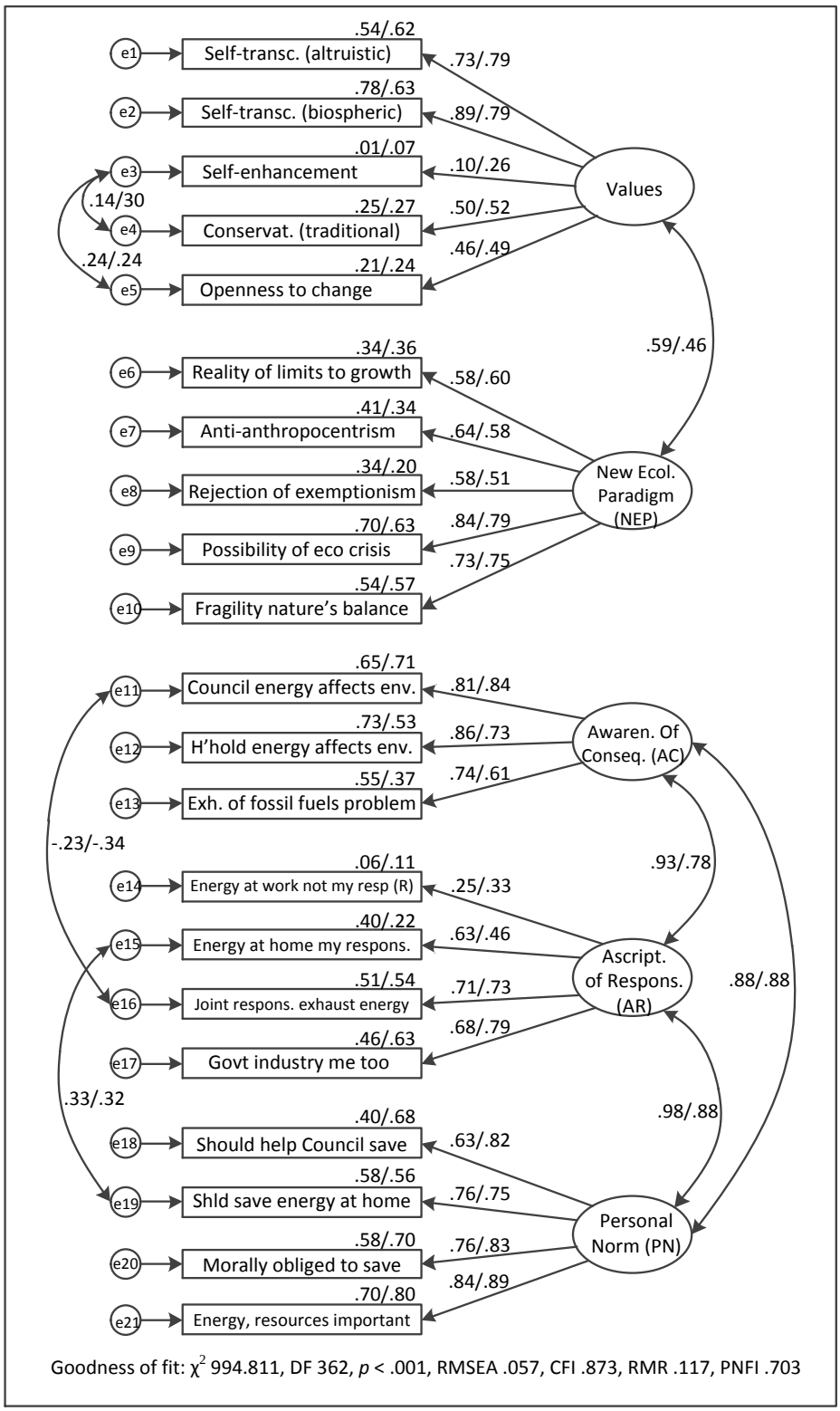


Figure 8.7 *Standardised results of multi-group measurement model (Confirmatory Factor Analysis) for Office Monitors*

The results of the Confirmatory Factor Analysis supported the factor structure proposed by Values-Beliefs-Norms Theory. Factor loadings and covariances for each group suggested that results were very similar for both the City Loxley and County samples. A Tau-equivalent test was run to identify whether there was configural invariance between the two groups. Assuming the default model to be correct, the Tau-equivalent test was non-significant (χ^2 20.377, DF 16, p = .204) indicating no significant difference between factor loadings for each model.

Estimating the structural models involved the addition of the different behaviours, so a separate model needed to be run for each behaviour. Apart from Office lights in the County sample, these were again run as multi-group models. The model for Office monitors was estimated, and goodness-of-fit indices indicated that this was an adequate fit to the data (χ^2 855.457, DF 402, p < .001, RMSEA .046, CFI .910, RMR .047, PNFI .734). Modification Indices did not identify any theoretically-justified modifications to improve the fit. The results are presented in Figure 8.8.

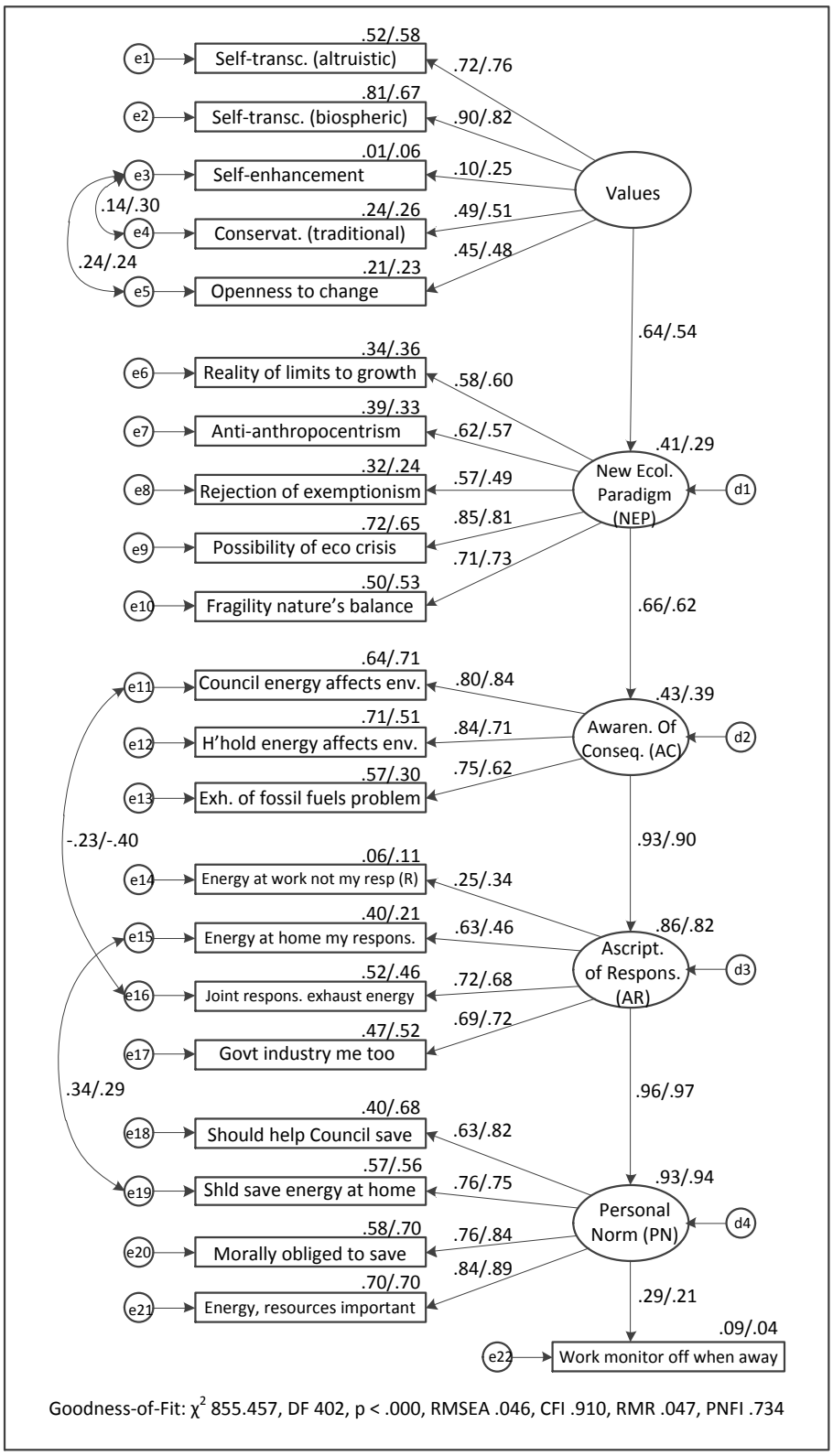


Figure 8.8. *Standardised results of structural model (Structural Equation Model) for a Multi-group model for Office Monitors based on Values-Beliefs-Norms Theory*

A Tau-equivalent test was conducted to check whether there was configural invariance between the two groups in the model. Assuming the default model to be correct, the result of the Tau-

equivalent test, χ^2 18.879, DF 16, p = .275, was non-significant, indicating that there was no significant difference between the factor loadings for each group.

Initial examination of Figure 8.8 reveals that the direct effect of PN: Personal Norm on the performance of the behaviour is weak, accounting for only 9% (City Loxley) or 4% (County) of the variance in the behaviour. Regression estimates for both groups (Table 8.12) reveal that all of the main parameters in the model were highly statistically significant ($p < .001$ or $p < .01$). These figures also reveal the comparative weakness of direct relationships identified between Personal Norm and Behaviour in both groups.

City Loxley			*β*	*B*	St.Err	C.R.	*p*
W: Worldview	<--	V	.640	1.066	.174	6.134	.000
AC: Awareness of Conseqs.	<--	W	.657	.694	.080	8.671	.000
AR: Ascription of Respons.	<--	AC	.930	.988	.091	10.908	.000
PN: Personal Norm	<--	AR	.963	1.067	.087	12.313	.000
Behaviour	<--	PN	.293	.539	.111	4.862	.000
County			*β*	*B*	St.Err	C.R.	*p*
W: Worldview	<--	V	.539	.943	.184	5.127	.000
AC: Awareness of Conseqs.	<--	W	.623	.635	.099	6.742	.000
AR: Ascription of Respons.	<--	AC	.904	1.099	.130	8.454	.000
PN: Personal Norm	<--	AR	.968	.996	.079	12.631	.000
Behaviour	<--	PN	.205	.379	.121	3.118	.005

β Standardised coefficients, *B* Unstandardised coefficients, C.R. Critical Ratio (*B*/St. Error)

Table 8.12 *Standardised and unstandardised coefficient estimates of model parameters for Multi-group Values-Beliefs-Norms model for Office Monitors*

The Values-Beliefs-Norms model, however, presents a chain of influences, so it is indirect as well as direct relationships portrayed in the model which are of interest. Table 8.13 presents the standardised indirect and direct effects of each variable on the Office monitor behaviour.

Group	**Indirect effects on behaviour**								**Direct effects**	
	V		**W**		**AC**		**AR**		**PN**	
	Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*
City Loxley	.110	.006	.172	.018	.262	.014	.282	.018	.293	.018
County	.060	.010	.112	.011	.179	.011	.199	.014	.205	.012

Total effects of latent variables on behaviour, based on standardised results

Table 8.13 *Total effects on Office monitor behaviour based on Values-Beliefs-Norms Theory for Multi-group model*

As expected, the figures reveal a gradual increase in influence on behaviour as each stage in the chain is measured. However, while they show strong explanatory power for the latent variables, culminating in standardised coefficients of .963 and .968 for PN: Pro-environmental Personal Norm in the two building groups, this explanatory power drops when the relationship between PN: Personal Norm and the performance of the Office monitor behaviour is considered. The total direct and indirect effects on behaviour are estimated at .293 (City Loxley) and .205 (County); while both effects are statistically significant ($p < .05$), they only represent a small effect, and particularly so when the magnitude of the relationships between latent variables is considered. This suggests that while Values-Beliefs-Norms Theory provides a good description of the relationships between the latent variables, those latent variables themselves are not major influences on whether or not the behaviour of switching off an office monitor is performed.

To identify whether this is true for all behaviours examined in this research, or whether it is specific to this behaviour, the same analysis was conducted on the remaining behaviours. The measurement model (Confirmatory Factor Analysis) did not need to be repeated, so analysis moved straight to the specification of the structural models (Structural Equation Modelling). To aid comparisons across behaviours, results for all of the behaviours (including the Office monitor results already described) are presented. Table 8.14 presents Goodness-of-fit indicators for all of the models (four multi-group models and one, Office lights, individual model).

Model	χ^2	**DF**	***p***	**RMSEA**	**CFI**	**RMR**	**PNFI**
A2: Meeting room lights	827.682	402	.000	.048	.904	.052	.723
A1: Office lights[1]	392.012	201	.000	.065	.910	.054	.725
D1: Home lights	917.842	442	.000	.045	.910	.047	.736
B3: Office monitors	855.457	402	.000	.046	.910	.047	.734
E2: Home monitors	788.064	402	.000	.046	.910	.048	.791

All are multigroup models using both samples, except [1] individual model using County sample only

Table 8.14 *Goodness-of-fit indicators for Structural Equation Models for all behaviours using Values-Beliefs-Norms Theory*

Table 8.14 reveals similar levels of fit across all of the models, providing support for the generalisability of findings already discussed across the other behaviours tested. Tau-equivalent tests were then conducted on the multi-group models to confirm whether the models held true across both building groups. The results are presented in Table 8.15.

Model	χ^2	DF	*p*
A2: Meeting room lights	31.458	16	.012
D1: Home lights	20.229	16	.210
B3: Office monitors	18.879	16	.275
E2: Home monitors	22.159	16	.138

Table 8.15 *Results of Tau-equivalent tests for configural invariance for multigroup measurement models*

The Tau-equivalent tests were all non-significant, indicating configural invariance, apart from the results for A2: Meeting room lights. The significant result for this behaviour indicated that the model was not an equally good fit for the data from both building groups. The goodness-of-fit statistics for the original model and the Tau-equivalent model were compared to confirm this difference between the groups (Table 8.16).

Model	χ^2	DF	*p*	RMSEA	CFI	RMR	PNFI
Original	827.682	402	.000	.048	.904	.052	.723
Tau-equivalent	859.141	418	.000	.048	.900	.056	.746

Table 8.16 *Comparison of goodness-of-fit statistics for Original and Tau-equivalent versions of the Meeting room lights model*

The slightly worse fit of the Tau-equivalent model compared to the Original model indicates that there is a difference between the two groups, but that this difference is small. The model, then, provides a better explanation of the influences on Meeting room lights behaviour in one of the building groups than in the other. Further examination of the results is required to identify which set of data the model best fits. Table 8.17 presents standardised regression estimates for each stage in the causal chain, for all of the behaviours examined in this analysis. This table allows for a comparison of the relationships between the latent variables across all of the models and both building groups.

Model	Sample	W<--V		AC<--W		AR<--AC		PN<--AR		Behav.<--PN	
		Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*
A2: Meeting room lights	City Loxley	.647	.000	.644	.000	.942	.000	.963	.000	.141	.032
	County	.534	.000	.619	.000	.861	.000	.970	.000	.185	.011
A1: Office lights	City Loxley	-	-	-	-	-	-	-	-	-	-
	County	.549	.000	.657	.000	.902	.000	.968	.000	.172	.012
D1: Home lights	City Loxley	.639	.000	.649	.000	.933	.000	.958	.000	.330	.000
	County	.523	.000	.614	.000	.902	.000	.970	.000	.357	.000
B3: Office monitors	City Loxley	.640	.000	.657	.000	.930	.000	.963	.000	.293	.000
	County	.539	.000	.623	.000	.904	.000	.968	.000	.205	.005
E2: Home monitors	City Loxley	.640	.000	.643	.000	.938	.000	.948	.000	.364	.000
	County	.603	.000	.612	.000	.941	.000	.972	.000	.267	.000

Table 8.17 *Standardised regression estimates for latent variables in all models based on Values-Beliefs-Norms Theory*

The final column in Table 8.17 shows the final stage in the causal chain, and indicates how strong the relationship between PN: Pro-environmental Personal Norm and the performance of the behaviour is. For the Meeting room lights behaviour, this final column reveals that this relationship, while significant for both building groups, is relatively weak for both, and is weaker for the City Loxley building group than for the County building group (as seen by a lower regression estimate and a weaker level of significance in the City Loxley group results). This indicates that the model based on Value-Beliefs-Norms presents a better explanation of the data from the County building group than from the City Loxley building group.

Table 8.17 also reveals the much lower level of explanation offered by the relationship between PN and Behaviour than between any of the other parameters in the model. This is true across all of the behaviours examined. The relationships between PN and Behaviour are stronger in the behaviours which occur in the household setting than in the office setting, and are weakest of all for lighting behaviours in the office setting. This fits with the importance of the office context, and the lower levels of control over individual behaviour in the office context, identified in previous analysis in this thesis. Where levels of individual control over the behaviour are weakest (for office and meeting room lighting, occurring in the office setting in a shared context) the effect of values, worldviews and personal norms is also weakest. Where the levels of individual control might be expected to be strongest (in the household context, or, in the office location, when controlling individual computer equipment) the effect of values, worldviews and personal norms are also strongest. Even where behaviours in the two settings are very similar (B3: Office

monitors and E2: Home monitors), the effect is still stronger in the home location (estimates of .364 and .267) than in the office location (estimates of .293 and .205).

Table 8.18 presents direct, indirect and total effects for each of the latent variables on the performance of the behaviours. The effects are based on standardised results, and on indirect effects apart from for PN: Personal Norm, which records the effect of the direct relationship between PN and the performance of the behaviour.

Model	**Sample**	**V**		**W**		**AC**		**AR**		**PN**	
		Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*	Est.	*p*
A2: Meeting room lights	C. Loxley County	.053 .051	.028 .007	.082 .095	.028 .012	.128 .154	.032 .012	.136 .179	.036 .016	.141 .185	.038 .018
A1: Office lights	C. Loxley County	- .054	- .032	- .099	- .033	- .150	- .031	- .167	- .027	- .172	- .025
D1: Home lights	C. Loxley County	.123 .100	.005 .008	.192 .192	.009 .014	.295 .312	.012 .015	.317 .346	.011 .014	.330 .357	.011 .012
B3: Office monitors	C. Loxley County	.110 .060	.006 .010	.172 .112	.018 .011	.262 .179	.014 .011	.282 .199	.018 .014	.293 .205	.018 .012
E2: Home monitors	C. Loxley County	.133 .090	.008 .003	.208 .149	.004 .003	.323 .244	.007 .011	.345 .259	.007 .008	.364 .267	.005 .008

Total effects of latent variables on behaviour, based on standardised results, and on indirect effects (apart from PN which are direct effects)

Table 8.18 *Total effects on behaviour in all models based on Values-Beliefs-Norms Theory*

These results provide further support for a difference between office-based and home-based behaviours. For every latent variable, a stronger effect was seen for the home-based behaviours than for the office-based behaviours. While all of the effects are statistically significant, none are very large; the largest indirect effect is seen for D1: Home lights in the County sample, with an estimate of .346 for AR: Ascription of Responsibility, while the largest direct effect is for the same behaviour and sample, with an estimate of .357 for PN: Personal Norm.

The influences on behaviour proposed by Values-Beliefs-Norms Theory, then, do explain some of the variations in the performance of all of the behaviours examined, but the level that they explain is quite low. This reveals a weakness of Values-Beliefs-Norms Theory, namely its focus on the individual actor and their internalised motivations for performing a behaviour. The research in this thesis has identified the importance of the physical, social and organisational context that the behaviour takes place within, the level of control that the individual has over the performance of that behaviour, and their perceptions of their control over its performance.

Values-Beliefs-Norms Theory in this study has revealed that factors based on individual values and moral beliefs do have an influence on behaviour, but this influence is small, and affected by the context that the behaviour occurs within.

8.5 Chapter Summary

This chapter used Structural Equation Modelling to test relationships between variables proposed by the Theory of Planned Behaviour and Values-Beliefs-Norms Theory.

Of the four models developed with items measuring constructs from the Theory of Planned Behaviour, only two ran successfully (one of those only partially). Analysis of results from City Loxley for the behaviour of A2: Turning off meeting room lights identified that the three latent variables of ATT: Attitude towards the behaviour, SN: Subjective Norm, and PBC: Perceived Behavioural Control explained 62% of the variance associated with INT: Intention to perform the behaviour. However, only 4% of the variance associated with performance of the behaviour was explained by INT: Intention to perform. Of these variances, only the influence of INT: Intention on the performance of the behaviour was significant, while the effect of PBC: Perceived Behavioural Control on INT: Intention was close to significance ($p = .069$). This suggests that, for meeting room lights in the City Loxley building, ATT: Attitude and SN: Subjective Norms do not predict the intention to perform the behaviour, while PBC: Perceived Behavioural Control provides a better explanation of this intention.

The relationship between the formation of an intention and the reported performance of the behaviour, while significant, was weak, offering little support for the Theory of Planned Behaviour's hypothesis that behaviour is predicted by the formation of an intention to perform the behaviour. However, this may reflect a problem in the framing of the questions asked of respondents: the measurement of behaviour related to ways they had behaved in the past, while the measurement of intention related to how they intended to behave next time. In addition to changes between previous and future behaviours, asking people about intentions can also inflate positive responses by encouraging respondents to given a more socially acceptable answer.

The analysis of behaviour D1: Home lighting for the model based on the Theory of Planned Behaviour was only partially successful. The model did not converge when specified as a multigroup model, but when the model was respecified for the County sample using one PBC item ('behaviour is up to me') as an observed variable, the model did converge successfully, but was a poor fit to the data. For Home lighting, then, the model based on the Theory of Planned

Behaviour did not adequately describe the observed data. It was not clear whether this was because the proposed relationships did not hold true, or whether problems with the way the variables were measured created problems for the running of the model.

Overall, then, the analysis of the models based on the Theory of Planned Behaviour provided little support for the relationships proposed by the theory. There was evidence that the relationship between Intention and Behaviour was weaker than the theory proposed, although this could have been the result of the way these constructs were measured. There was also some evidence for the importance of PBC: Perceived Behavioural Control on the performance of the behaviour of turning off meeting room lights, and some evidence that this relationship did not hold true for the behaviour of turning off home lights. This is suggestive for other findings in this research which highlight the importance of the setting or context for the performance of a behaviour, and the importance of individual control (or the perception of control). However, these results may have been affected by problems that also prevented other models from converging properly, such as small numbers of items measuring variables, low levels of variance in responses, and the use of reverse-scored items.

Individual control and context or setting were also important for models based on Values-Beliefs-Norms Theory. The causal chain proposed by Values-Beliefs-Norms Theory was supported by the analysis for all of the behaviours examined, with a gradual increase in explanatory power at each stage of the chain until the final step, where PN: Personal Norm linked to the reported performance of the behaviour. While the relationships were significant throughout, this final step revealed a marked drop in the magnitude of loadings recorded. The Values-Beliefs-Norms model, then, provided a good explanation of the relationships between the latent variables, but these variables only had a weak influence on the performance of the behaviour.

The results from the Values-Beliefs-Norms models revealed that where individuals had the lowest levels of individual control over the performance of a behaviour, moral and value-based influences had their weakest relationship with the performance of the behaviour. The effect of the causal chain was weakest on lighting behaviours, with less individual control, and strongest on computer monitor behaviours, with higher levels of individual control. A consistent difference was also seen the office and home setting, even where the behaviour itself appeared to be very similar (e.g. turning off a monitor when away from the computer for more than ten minutes). Behaviours in the home setting were more influenced by constructs tapping moral and value-based constructs than behaviours in the office setting. This supports Stern's (2000) categorisation of environmentally-significant behaviours within organisational contexts as different to private-

sphere environmentalism behaviours occurring in the household setting, even where the physical behaviour itself appears to be the same.

In testing the relationships proposed by the models based on the Theory of Planned Behaviour and Values-Beliefs-Norms Theory, this chapter set out to explore four of the objectives for this research identified in Section 1.3. First was the identification of influences on individual energy use in office settings, second was the connection between similar behaviours performed in different settings, third was the influence of actual and perceived control on the performance of energy demand behaviours, and fourth was how well the social psychological models explained the reported behaviour. This chapter provides further support for the importance of setting and issues of control, and their influence on the performance of energy demand behaviours. That these issues have been shown to be important even in the models based on Values-Beliefs-Norms Theory, which makes little allowance for external influences beyond those that shape individual values, worldviews or personal norms, is testament to how much individual behaviour is shaped by the setting the behaviour occurs within and the levels of control that individuals have over the performance of the behaviour.

Chapter 9: Discussion

9.1 Introduction

This chapter presents a discussion of the main findings of the research, drawn from all of the chapters according to common themes identified in those chapters. This discussion then leads into the conclusions discussed in Chapter 10.

Section 9.2 discusses findings relating to the energy use behaviours reported in the research, drawn from both quantitative and qualitative data. Section 9.3 explores the influences of the physical context that the behaviours occur within, and in particular the physical environments in each building, and the levels of control over energy use that individuals had in those buildings. Section 9.4 discusses the importance of setting to the performance of behaviours, relationships between the office and household setting, and whether there is evidence of spillover between behaviours and between settings. Section 9.5 addresses organisational and social aspects of energy use in the office setting. Section 9.6 discusses individual-level influences on energy demand behaviours, particularly as identified by the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999). The chapter concludes with Section 9.7, which outlines some of the limitations of the research.

9.2 Energy use behaviours

The research examined two main groups of behaviours, lighting and computer behaviours, in two settings, the office and the home. Patterns of reported performance of the behaviours reflected the similarities between the behaviours and the settings they occurred within. High levels of performance were reported for lighting behaviours in the office setting; the most variation in these responses came from respondents in the City Other building group, reflecting the wider range of buildings and differences in design, layout and control systems in this building group.

It was assumed that all respondents had a high level of individual control over their use of computer equipment. Across all three building groups, similar patterns of behaviour were reported in the office setting, with high levels of performance of turning off computers and computer monitors at the end of the day, and much lower levels of turning off computer monitors when away from the desk for more than ten minutes.

In the home setting, similar patterns of behaviour were seen for respondents from all three building groups for all reported behaviours. Home lighting behaviours were reported to be performed more frequently than home computer behaviours, and there was a greater spread of responses to the home computer behaviour questions. The most similar responses across locations were for turning off computer monitors when away more than ten minutes. Turning the home computer off when it was finished with was not performed as often as turning the office computer off at the end of the day, probably reflecting differences between finishing use in an office setting (signalling the end of the working day and leaving the environment where the computer is) and the home setting (where respondents remain in the same environment as the computer, and where computers can be used for many different activities).

Principal Components Analysis grouped reported performance of behaviours into factors of lighting behaviours in the office setting, computer behaviours, and behaviours in the home. Subsequent analysis using a larger number of items measuring constructs from the Theory of Planned Behaviour found that the factors grouped according to both the behaviour and the location, with office lighting behaviours, office computer monitor behaviours, home lighting behaviours and home computer monitor behaviours each forming separate factors.

Behaviours, then, were defined partly by the type of equipment involved (e.g. lighting) and the setting that the behaviour occurred within (e.g. the home), but also by the actions involved (e.g. turning off the equipment) and by the particular triggers that prompted the performance of the behaviour (e.g. finishing a task, leaving a room). These triggers were not necessarily conscious: interviewees described behaviours as routine or habitual, while in shared environments some behaviours were seen as automatic; turning off meeting room lights 'just happens'. The behaviours could also be influenced by prior experience; one interviewee reported childhood experience of always turning lights off which transferred with her into the office setting.

The specificity with which behaviours grouped into factors supports Stern's (2000) categorisation of environmentally-significant behaviours performed within organisational settings, such as offices, as different to private-sphere environmentalism, such as energy saving behaviours performed in household settings. Even where the equipment, the action involved, and the trigger for the behaviour were the same across settings, such as turning off a computer monitor when away from the desk for more than ten minutes, the behaviours grouped into different factors when performed in different settings. This suggests that there are different influences on the performance of the behaviour in each setting. As a result, interventions need to address the contextual influences arising from the particular setting in order to change energy demand behaviours, even when the behaviours themselves are superficially similar in each setting.

9.3 The physical context: buildings and individual control over energy use

The setting in which the behaviour occurs is a major influence on the performance or non-performance of the behaviour. The relationship between individual attitudes, contextual constraints on behaviour and the performance of behaviour have been recognised in the literature on this topic (see the discussion of ABC Theory in Section 3.2). The research presented in this thesis supports the conclusion from the literature that the design of the building or its control systems influence whether the behaviour is likely to be performed. The results from the City Other building group make this clear. This building group was made up of a large number of buildings: the 197 respondents came from 70 different buildings. Many of these buildings were not dedicated office buildings, but provided a specialist service as well as containing office accommodation, such as libraries and children's centres. Reported behaviour showed greater levels of variation across the response categories from the City Other building group than from either the City Loxley or County building groups.

In the City Other building group, the number of people who shared the respondent's office correlated negatively with turning office lights off when they weren't needed; the more people shared the office, the less frequently the respondent reported performing the behaviour. This could be a social effect, with more people in the office making the behaviour more difficult to negotiate, or it could reflect a reduction in the level of individual responsibility for turning off lights felt by occupants of an office that is shared with lots of people. A similar result was seen in the County building group for the office behaviour of turning off toilet lights when leaving them unoccupied. This could also reflect social effects, or a different effect: in larger buildings, the toilet facilities may be correspondingly larger (more cubicles), while smaller, individual toilet facilities may trigger behaviour which is closer to that performed in domestic bathrooms. Further research could explore whether more domestic scales or designs of facilities in office settings encourage individuals to act as they would at home. The finding that behaviours in the home and the office are fundamentally different may mean that such crossovers in behaviour do not occur.

Chapter 6 compared results for two specific buildings: the City Council's Loxley House, with lower levels of individual control over energy use for lighting, and the County Council's Trent Bridge House, with higher levels of individual control. For the three office behaviours examined, respondents from Trent Bridge House turned off the computer monitor at the end of the day more frequently than those from Loxley House, while those from Loxley House turned off meeting room lights when leaving the room empty more frequently than those from Trent Bridge House. There was no significant difference between responses from the two buildings for turning off a

computer monitor when away from the desk for more than ten minutes; this was no surprise, as respondents in both buildings were able to control this behaviour individually.

Further differences were found between responses given by occupants from each building for statements measuring different attitudes. Respondents from Loxley House more frequently agreed that the Council saving energy was 'good' and 'important', while those from Trent Bridge House more frequently agreed that they 'should do what they can' to help the Council save energy. No significant difference was found for a statement measuring the respondents' sense of responsibility for saving energy at work. Respondents from Loxley House, then, showed stronger agreement with statements about the value of the Council saving energy, while those from Trent Bridge House showed stronger agreement that they had a sense of moral obligation to help the Council save energy.

These attitudes may have stemmed from the nature of the buildings themselves. Loxley House was promoted to employees as a more energy efficient building than previous Council offices, with much made of the automated and centralised features, while problems with the performance of Trent Bridge House were known to all employees as they affected the temperature throughout the building. In Loxley House, then, energy saving was a feature of the automated or centrally-controlled building, and so could be seen as distant from the individual employee. In Trent Bridge House, there were high levels of individual control over the building's systems, and at the same time, an appreciation that the building itself performed poorly; energy saving could not be left to the building, but was something many individual employees felt obliged to act around.

However, this explanation seems to be contradicted by the frequency with which respondents in Loxley House reported turning off meeting room lights, which was significantly higher than for the same behaviour in Trent Bridge House. There are two explanations for this. One is that the Loxley House responses reflect a social desirability bias: this was the first opportunity in the questionnaire survey that respondents from Loxley House had to display their pro-energy saving behaviours, while those in Trent Bridge House had already been asked about several behaviours that respondents in Loxley House could not perform. The other is that the perception of Loxley House as an energy efficient building led occupants to attach more importance to energy saving within the building, so they reported more frequent performance of the behaviour and expressed more agreement with attitude statements professing this view. This is supported by the significantly lower levels of reported performance of switching off monitors at the end of the day in Loxley House than in Trent Bridge House; while lighting behaviours relate to the building and its status as 'more energy efficient', computer monitors are not part of the building's systems.

That these differences lie with employee responses to the buildings, rather than in differences between the organisations they work for, is supported by there being no significant differences between the two sets of responses to statements measuring the expectations placed on employees around energy saving, the organisation's commitment to energy saving, and the importance of energy saving to senior management.

Differences in questionnaire responses were examined using Structural Equation Modelling, which compared results across the City Loxley and County building groups. A multigroup model of the behaviour of turning off meeting room lights using Values-Beliefs-Norms Theory identified a small but statistically significant difference between the reports of behaviour by respondents from each building group. The model gave a weak explanation for the behaviours reported by respondents in both building groups, but was a better fit to the responses given by respondents in the County building group than in the City Loxley building group. This suggested that, while moral or value-based differences between respondents do not account for much of the differences in the reported performance of the behaviour, they are more important where building occupants have a higher level of control over their behaviour.

9.4 The importance of setting and the concept of spillover

Section 2.5 discussed ideas developed in the literature about the relationships between different behaviours. One, discussed above, is that the performance of behaviours can be triggered by the situation in which they occur: as someone leaves a room, the act of leaving the room may trigger them to turn off the light. Prior experience of a behaviour has been found to be a factor influencing the performance of recycling behaviours (Lee et al., 1995; Tudor et al., 2007b); such prior experience could also be a factor in the performance of energy saving behaviours.

A related, but slightly different, concept is that of spillover, whereby adopting one pro-environmental behaviour is said to lead to the adoption of further pro-environmental behaviours (Thøgersen and Ölander, 2003). Some research suggests that when a person adopts a pro-environmental behaviour, their self-construal becomes that of someone who behaves in a pro-environmental way, and as a result, they go on to perform more pro-environmental behaviours (Arnocky et al., 2007). This implies an at least partly conscious process: the individual must interpret their own behaviour as pro-environmental, draw from that a self-construal that they are a person who performs pro-environmental behaviours, and then apply that self-construal to the performance of another behaviour perceived as pro-environmental. It is not clear that people see the energy saving behaviours discussed in this research as pro-environmental. For the interview

subjects, the main focus was on saving money or avoiding waste, with pro-environmental reasons for saving energy generally seen as desirable but given as an afterthought. However, a self-construal as 'someone who doesn't waste energy' or 'someone who saves money by saving energy' could have an equally strong effect.

For this research, the office or home setting in which the behaviours occur has been shown to affect the way that the behaviours are categorised. Behaviours in organisational settings are different to private-sphere environmentalism behaviours performed in household settings, as Stern (2000) proposes. Even where the physical behaviours theselves are similar, they are performed differently in each setting. The discussion of behavioural triggers and spillover, then, leads to two areas to examine: connections between different behaviours, and connections between behaviours performed in different settings.

The comparison of behaviours in Loxley House and Trent Bridge House, presented in Chapter 6, found that respondents in Loxley House reported higher frequencies of turning off meeting room lights, and respondents from Trent Bridge House reported higher frequencies of turning off the computer monitor at the end of the day. No significant differences were found for turning off the computer monitor when away from the desk in the office setting, or for the three home-based behaviours. Correlations revealed a greater number of significant relationships between behaviours in the same setting than in different settings. This suggested that the performance of behaviour was heavily influenced by its setting. A greater number of significant correlations linked behaviours across settings for the responses from Trent Bridge House than from Loxley House, suggesting greater consistency across behaviours and settings in the responses from Trent Bridge House. One explanation is that higher levels of individual control over energy use in Trent Bridge House meant that respondents' behaviour was less constrained, leading them to act consistently with patterns of behaviour established in other settings. Respondents in Loxley House, however, were more constrained, and their usual patterns of behaviour were disrupted.

Correlations with the behaviour of turning off meeting room lights supports this explanation. There is a significant difference between reported frequencies this behaviour in each building. For Trent Bridge House, this behaviour correlates with all but one other behaviour, while for Loxley House, this behaviour does not correlate with any other behaviour. The performance of this behaviour in Loxley House, then, does not relate to the pattern of performance of the other behaviours. Where the behaviour is constrained, it affects the performance of that behaviour, but the effect does not affect the performance of other behaviours.

Differences between the performance of computer behaviours in the two buildings could offer some evidence of spillover within Trent Bridge House. In that building, respondents' behaviours were less constrained, and they performed more computer related behaviours. This could suggest that having more opportunities to perform switching-off behaviours leads to more frequent performance of the behaviours. However, this may not be evidence of spillover per se: in office buildings where occupants are able to perform more switching off behaviours, the performance of such behaviours may be more salient to the occupants. They are able to switch more equipment off, and as a result, they are more conscious of switching-off as an activity, and are therefore more likely to perform such behaviours. This is not conclusive, however; it may simply be that different practices or routines have been established in these offices. Further research examining practices around turning off equipment in office settings could explore this further.

Structural Equation Modelling was conducted on responses to items measuring constructs in Values-Beliefs-Norms Theory (Stern et al., 1999) by respondents in the City Loxley and County building groups. This identified that moral or value-based differences between respondents from each building group did not account for differences in the frequency of reported performance of behaviours. Estimates for relationships between PN: Personal Norms and the performance of each behaviour were much lower than for the relationships between other latent variables, highlighting the weakness of the Values-Beliefs-Norms model as an explanation of the influences on these behaviours. The results were weaker in the office setting than in the home setting, and were weakest of all for office lighting behaviours. Where levels of individual control are weakest, the explanation of behaviour offered by individual values and normative beliefs is also weakest.

Furthermore, where the behaviours themselves are very similar, for example for computer monitors in both locations, the effect of individual values and normative beliefs is still stronger in the home location. This is further evidence supporting the finding that behaviours in office and home settings are fundamentally different, even where the behaviour itself seems similar.

9.5 Organisational and social aspects of energy use in the office

In addition to the nature of the building itself, the office setting has two further main aspects that influence behaviour. The first is the organisational nature of the setting, and how that influences the energy use behaviours of individual office occupants. The second is the social nature of the office as a shared space where occupants need to cooperate with colleagues.

Interviewees reported few expectations on their energy use behaviour from organisational or managerial sources. None of the interviewees reported being encouraged to save energy by the organisation or by their managers. Responsibility for energy saving was seen as specific to people with certain job roles, rather than shared out across the organisation. Indeed, perceptions of low levels of control over individual energy use by employees of both Councils were a reason not to assign responsibility for energy saving to individuals: with low morale due to budget cuts and fears of redundancy, assigning responsibility for energy saving to individual employees who felt little control over their energy use could provoke a backlash against energy saving.

Despite this, in both organisations interviewees perceived energy efficiency as desirable, and linked it to their standing as professionals. Energy saving was something 'responsible' and 'professional'; being good at their job could also result in being energy efficient. While interviewees began their discussions of energy saving by framing it in terms of the need to save money, many followed this up by stating that, while finance was important, they personally had 'better reasons' for supporting energy saving. Energy saving, then, was a desirable attribute, both as part of being a professional and as an issue in its own right.

The number of people who shared the respondent's office was found to have a relationship with the reported frequency of the performance of several behaviours. For office lights in the City Other building group, toilet lights in the County building group, and turning off monitors when away ten minutes in the City Other building group, greater numbers of people sharing the office correlates with lower levels of reported performance of the behaviour. These effects are only found for office-based behaviours. For lighting behaviours, this may result from the number of people who the respondents would need to negotiate with in order to turn off the lights: more people would make this more difficult. For toilet lights, this may reflect differences in the design or layout of facilities in different sizes of offices. For computer monitor behaviour, however, this could reflect a norm within certain offices, or differences in routines or habitual practices, or monitors being left on to indicate someone's presence.

The difficulty of negotiating with colleagues was an interesting area discussed in the interviews. For Gemma in Trent Bridge House, negotiation was a part of being in an office environment: it was natural to consider other people's needs and to discuss actions that would affect them. This sentiment was echoed by other respondents. For Jamie in Loxley House, however, such negotiations were unworkable: his office had no control over lighting, and he felt that having control would lead to conflict and disruption. Respondents based in buildings with high levels of individual control over behaviour, then, expressed conscious consideration of colleagues' needs. In Trent Bridge House, negotiation was seen as normal, something that people 'just get on with',

whereas in Loxley House it was a potential source of conflict. This suggests that the physical environment of the office, and the levels of control that individual occupants have over systems such as lighting, can affect the culture or norms within the office. This is worth considering when organisations look to increase automation or centralised control of systems such as lighting in office buildings: changes may affect more than just the energy-using systems, shaping how colleagues interact.

9.6 Individual-level influences on energy use behaviours

Analysis of the effects of attitudes or personal values on the performance of behaviours were explored using both qualitative methods (interviews and open-ended questions in the questionnaire survey) and quantitative methods (statistical analysis including assessment of the explanatory power of two attitude-behaviour theories).

In the questionnaire survey, a number of open questions were asked to elicit respondents' own views about their energy use in office settings (see Section 4.4.5). Open-ended questions, whether asked in an interview or a questionnaire, can draw out different sets of responses to those perceived to be of importance by the researcher at the start of their enquiry (Whitmarsh, 2009). The questionnaire survey asked respondents the open question 'What do you think are the biggest influences on your energy use at work?' 641 respondents from both Councils listed 892 separate items, which were sorted and categorised to produce a summary of the main influences identified. The three most popular influences listed were no surprise, relating to the need to use energy to carry out a job role (e.g. to make a computer work) (135 mentions), to be comfortable in the office (e.g. provision of warmth or light) (90), and as a result of poorly maintained or designed buildings (e.g. perceived wasting of energy by old, draughty buildings) (72). However, the next most popular influence identified was people's own attitudes and values (70). This category did not include stated concern for the environment or for finite energy sources, which together were the seventh most popular response, mentioned a further 55 times. Many respondents did not expand on their response beyond stating 'my own attitudes' or 'my own values', but of those who did, a desire to avoid waste was frequently stated.

The number of responses giving 'own attitudes and values' (70) was very close to the number of responses which referred to the respondent's lack of control over energy use (66 mentions). This is interesting because, although they are mentioned a similar number of times, they are contradictory: the lack of control over behaviour can confound the desire to act in accordance with own attitudes and beliefs. This reflects the main division identified throughout this research,

between those office workers able to control their own energy use (and therefore able to act in accordance with their values or attitudes) and those who have less control over their energy use.

The tenth most popular response was 'financial cost of energy' (48). As employees do not experience the cost of energy directly themselves, it might be expected that financial cost would have little influence on energy demand behaviours in workplace settings. However, the responses indicated that financial cost was a concern to the employees surveyed. Many questionnaire respondents referred to budget cuts and redundancies, while all of the interviewees reported that the financial climate was having an adverse effect on their colleagues' morale. Indeed, it was suggested that, rather than make people more likely to save energy in order to save money, the financial situation and its impact on morale was reducing people's willingness to save energy. This was linked to perceptions of low levels of individual control over energy use. Asking employees who felt this low level of control to take responsibility for saving energy, and linking this to the budget cuts that left them at risk of redundancy, would be likely to cause further stress and demoralisation among employees, which could lead to a backlash against energy saving. Encouraging energy saving during a period of budget cuts and redundancies, then, requires that energy saving be decoupled from the stress employees feel around budget cuts, and that control over energy use and responsibility for energy saving actions are carefully addressed.

Structural Equation Modelling was used to test the influence of variables including individual-level psychological/attitudinal variables, as proposed by the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999). The Theory of Planned Behaviour proposed that ATT Attitude, SN Subjective Norms and PBC Perceived Behavioural Control led to the formation of an intention to perform a behaviour, in turn leading to the performance of that behaviour. There were problems with the specification of the structural models developed to analyse these relationships between variables, and as a result only one of the models produced reliable results. This model, examining the performance of turning off meeting room lights, found that the three latent variables (ATT, SN and PBC) accounted for 62% of the variance associated with intention, but that intention only accounted for 4% of the variance in behaviour. Of these only the influence of intention on behaviour was statistically significant ($p < .001$), while PBC Perceived Behavioural Control was close to significance ($p = .069$).

The relationship between the formation of an intention and the performance of the behaviour, then, was statistically significant, but as it only explained 4% of the variance in behaviour did not support the model proposed by the Theory of Planned Behaviour. This could be explained by temporal differences between intention and behaviour items: intention was formed for the next time the behaviour was performed, whereas behaviour referred to performance in the past. The

difference between intention and behaviour could result from differences between past behaviour and future intentions, or it could reflect inaccurate estimates of future behaviour.

Equally, this may reflect a weakness in this method of examining attitudes and behaviours. As discussed in Section 3.4, Kaiser et al. (2010) argue that gaps between stated attitudes towards the performance of a behaviour and the performance of that behaviour arise from the nature of the measurement instruments. It is easier for a respondent to state support for a behaviour than it is to carry out the behaviour; as a result, the stated support may simply reflect the ease of agreeing to have an intention, rather than that the behaviour will be performed. However, the weakness of the relationship between intention and the reported performance of the behaviour suggests that the model does not explain the processes leading to the performance of the behaviour.

Nevertheless, these results do suggest that the construct of Perceived Behavioural Control is an important influence on the behaviour of turning off meeting room lights. This fits with other findings in this research, which emphasise the importance of actual and perceived control, and identify effects related to the different levels of control felt by respondents.

Analysis of Values-Beliefs-Norms Theory was more successful. All of the models specified ran successfully, and produced consistent results. Values-Beliefs-Norms Theory examines the individual-level, internalised motivations for the performance of a behaviour, moving from relatively stable values and worldviews to behaviour-specific feelings of responsibility and obligation. The models revealed that, while the proposed relationships between latent variables were good explanations for the data, the influence of those latent variables did not explain much of the variance in the performance of the behaviours. Only a small proportion of the performance of behaviours could be explained by the actor's internalised values, beliefs and interpretation of norms around that behaviour. This highlights a weakness of Values-Beliefs-Norms Theory, which is its reliance on internalised motivations and the lack of consideration of contextual factors such as the respondent's perceptions of control over the performance of that behaviour.

9.7 Limitations of the research

The research presented in this thesis is bounded by a number of limitations. The first is in the use of self-reported behavioural data, rather than measured or observed data. This was unavoidable, given the concerns of the participating organisations about the acceptability of measuring actual behaviour at a time when employees were facing redundancies, and given the impracticality of measuring behaviour at a detailed level across several different buildings. However, much of the

analysis presented here compares self-reported behaviours across different building groups or settings; while such results still need to be treated with some caution, the comparison of like with like reduces the effect of inflation of results which can be associated with self-reported data.

A further limitation in the data collected in the questionnaire survey is the small number of items used to measure some constructs in the attitude-behaviour theories. This caused some problems for the Structural Equation Models, limiting the findings from the models using the Theory of Planned Behaviour (Ajzen, 1991). However, the models using Values-Beliefs-Norms Theory (Stern et al., 1999) ran successfully, and both groups of models provided support for findings from other parts of this research.

The findings of this research are based on responses from employees within two local authorities, and the comparisons across two organisations are a strength of this research. Consistency in the results for each organisation support the generalisability of the findings to other office-based organisations. However, there are characteristics of the organisations, and the respondents from each organisation, that could limit the extent of that generalisability.

Both organisations are local authorities, within similar political, policy and budgetary environments; organisations outside the public sector, or in parts of the public sector with different priorities such as the National Health Service, might be influenced differently by political, policy and budgetary environments. However, the actual behaviours examined in the research are general office behaviours rather than specific practices linked to the type of organisation, and this suggests that the findings may be relevant to other parts of the public sector with large office-based populations, such as the civil service.

Both organisations have their headquarters in the same city and have responsibility for geographically adjacent areas; as a result, their employees are drawn from the same local population, and this may mask regional effects within the results.

Additionally, respondents from both organisations are relatively old, with around half of all respondents aged over 45, and so may not accurately reflect responses that might be received from younger office workers.

Whether these characteristics do affect the results of this research cannot be determined within this research. However, with these reservations, the consistency of the findings of this research across the two organisations does suggest that the findings are revealing for energy demand

behaviours within city-based local government organisations, and further, that they may also be relevant to other office-based energy demand behaviours, particularly within the public sector.

Finally, the research was conducted at a time when budget cuts were having a major impact on the operations of local government and on the morale and motivation of local government employees. The extent of the influence of these circumstances on the findings of this research is not clear, nor whether this affects the generalisability of the results beyond other public sector organisations facing budget constraints.

Chapter 10: Conclusions

10.1 Introduction

This chapter draws together the findings of this research. Section 10.2 highlights the original contribution to knowledge that this research represents. Section 10.3 identifies how the research has addressed the research aim, objectives and the gaps in the literature. This includes recommendations for further avenues of research based on this work.

10.2 Original contribution to knowledge

The research presented in this thesis represents an original contribution to knowledge in five areas.

1. Much of the existing literature that examines energy demand in office buildings does so from a technical (building fabric and systems) perspective, or from the viewpoint of the organisation as a whole. Additionally, much of the current understanding of individual energy demand behaviours arises from studies within household settings. This research adds to a very small body of literature which examines energy demand behaviours in office buildings from the level of the individual building occupant in order to understand the influences on behaviour at the individual level. It identifies that there are different influences on individual-level energy demand behaviours in an office setting than in a household setting, with contextual influnces being particularly important.
2. The attitude-behaviour approach which underpins this research has more often been used to examine behaviours in households or travel mode choice. In this research, it is applied in a relatively new context. The application of both the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999), and the use of Structural Equation Modelling to analyse the relationships proposed by the theories, are also new in this context. These reveal that the construct Perceived Behavioural Control from the Theory of Planned Behaviour is particularly important in the office setting, and that the moral and value-led influences proposed by Values-Beliefs-Norms Theory, while supported by the models, only have a small influence on individual energy demand behaviours in the office setting.
3. The attitude-behaviour approach is extended through the use of mixed methods (questionnaire survey analysed using statistical techniques, and interviews analysed using

thematic analysis), which allows the research to also consider the influence of physical, social, organisational and other types of context on individual energy demand behaviours. This broadens the research beyond the psychological/attitudinal factors which are the main focus of more traditional attitude-behaviour research.

4. Little previous research has examined the effect of individual actors' actual and perceived control over the performance of energy demand behaviours. This research is novel in its examination of the effects that different types of context can have on the perceptions of such control.
5. There is also very little previous research that examines energy demand behaviours in different settings. This research examines the relationships between energy demand behaviours in office and home settings, and whether the behaviours and their antecedents in one setting influence the performance of behaviours in the other setting. The research identifies that there is no evidence for the spillover of behaviour from one setting to another, even where the behaviours themselves are physically similar.

10.3 Addressing the research objectives

This section identifies how the research met the aim and objectives identified in Section 1.3 and addressed the gaps identified in the literature in Section 2.6.1. Here, the findings under each research objective are described in turn.

Objective 1: To identify the contextual, organisational, social and psychological/attitudinal influences on individual energy use in office settings.

This objective examines the range of factors influencing individual energy demand behaviours in office settings. The gaps in the literature relating to this objective focus on relationships between the individual and the organisation, the importance of the expectations of the organisation for the performance of energy use behaviours by individual employees, and how these expectations relate to individual-level motivations. This situates the individual within the physical, organisational, social and cultural environment of a shared office. The objective was met using both quantitative analysis (statistical analysis of questionnaire survey reponses) and qualitative analysis (thematic analysis of interview transcripts).

Principal Components Analysis grouped the reported behaviours into factors according to the type of equipment used (lighting, computer monitors) and specific to the setting in which the

behaviour occurred (the office, the home). Performance of the behaviour is shaped by the environment in which it occurs. This can be seen in a negative correlation between the numbers sharing an office and the frequency of turning off office lights: the more people shared the office, the less frequently the behaviour was reported. Interviews also identified tensions around negotiating the use of energy in shared offices, including a different response to the need for negotiation between interviewees in the City Council's Loxley House and the County Council's Trent Bridge House. In Trent Bridge House, with higher levels of local control over energy use, negotiation was seen as a normal part of working in a shared environment. In Loxley House, with less local control, greater control over lighting was seen as potentially problematic, leading to conflict. This suggests that reducing control within a shared office can change how occupants relate to one another.

Respondents to both the questionnaire survey and the interviews reported that the organisation placed few expectations on them around energy use. However, interviewees characterised energy saving as part of being a 'good professional'. Being good at their job, they suggested, could also result in being energy efficient. Promoting energy efficiency as part of being a professional would be a useful approach for future interventions to change energy behaviours in these offices. Despite this, however, interviewees did not necessarily assign responsibility for energy saving in the office to themselves. For some, responsibility lay with those whose job specifically involved energy management; others felt that it was up to someone else to make energy saving easier for them. Employees in management roles reported that they turned off office lights significantly more frequently than non-managers, perhaps because their management role gave them responsibility in a shared environment where responsibility was otherwise diffuse.

The wider political and economic context was also influential, with local government budget cuts leading to redundancies in both organisations over the two years prior to the research. Financial issues were at the forefront of employees' minds, resulting in reports of low morale and demoralisation. However, this was not a motivator for energy saving. Assigning responsibility for saving energy to employees who felt they had little control over their energy use, and linking this to their fears about redundancy, was likely to provoke a backlash against energy saving.

Psychological/attitudinal influences on individual behaviour were primarily explored using constructs from the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999). Despite problems with some Structural Equation Models (see Section 8.2), findings support the importance of contextual rather than individual-level influences on behaviour. The partial results from analysis using the Theory of Planned Behaviour (Ajzen, 1991) revealed that the construct PBC: Perceived Behavioural Control was more influential than ATT:

Attitudes towards the behaviour or SN: Subjective Norm. Analysis using Values-Beliefs-Norms Theory (Stern et al., 1999) identified that, while values, beliefs and normative factors did influence energy demand behaviours, this influence was small.

A question remained in the literature as to whether the organisation could influence individual energy demand behaviours in office settings without changing individual attitudes or personal norms. This research suggests that it can, but not through organisational expectations alone. Instead, contextual factors shaping behaviour would need to be targeted, including the levels of control that individuals have over the behaviour, the appropriate assignment of responsibility to act to those who feel able to act, and the role of negotiation in shared environments. Additionally, organisational commitment to energy saving needs to be seen to be genuine throughout the organisation, including visible enactment by senior management. This can support the existing view that energy saving is desirable and part of being 'a good professional'.

Objective 2: To investigate the connections between similar individual energy use behaviours performed in different settings.

Stern (2000) categorised pro-environmental behaviours performed in organisational settings as different to 'private-sphere environmentalism' such as pro-environmental behaviours performed in household settings. In this research, behaviours performed in the office setting and in the home setting are superficially similar: turning off lights, computers and computer monitors. However, Principal Components Analysis (Section 7.2) identified that the behaviours group into factors at a level of specificity that includes the setting the behaviour occurs within, as Stern (2000) suggests. Objective 2 explores connections between behaviours performed in different settings to identify how important the setting is for understanding what leads to the performance of the behaviours. This links to the concept of 'spillover', which suggests that the performance of one behaviour can lead to the performance of other, related behaviours. The objective was met through statistical analysis of the responses to the questionnaire survey.

Significant differences were found between respondents in the City Council's Loxley House office building and the County Council's Trent Bridge House office building for the frequency of turning off meeting room lights and turning off computer monitors at the end of the day, and for three out of four attitude statements relating to the value of energy saving and the moral obligation to save energy. However, no significant differences were found for three statements measuring organisational factors, or for the performance of behaviours in the home setting, suggesting that differences in behaviour relate to differences in the office setting.

Correlations between behaviours performed in the home and office settings found a greater number of significant relationships between behaviours in the same setting than in different settings. Additionally, significant correlations were found between similar behaviours in different settings. The strongest correlation was found for turning computer monitors off when away from the desk for more than ten minutes; in each setting, the behaviour shared features of the equipment and the trigger for the performance of the behaviour.

Objective 2 asked whether behaviours in one setting influence the performance of behaviours in the other setting. Differences between the frequency of behaviours reported in Loxley House and Trent Bridge House in the office setting do not carry over as differences in the home setting. This suggests that an underlying pattern of behaviour performed by respondents from Trent Bridge House in both settings and by respondents from Loxley House in the home setting is disrupted when it comes to Loxley House respondents in the office setting. This research suggests that the level of control that individuals have over their energy use in the office setting is the major difference between the two buildings. The lower level of control in Loxley House, it seems, disrupts the pattern of behaviour, but this disruption does not cross between settings.

The results suggest that behaviours do not spill over across different settings. This further suggests that interventions designed to change behaviours in one setting are unlikely to also influence behaviours performed in another setting, even where the behaviours are superficially similar, unless this is a specific target of the intervention.

Objective 3: To examine the roles of actual and perceived control over energy use in the performance of individual energy use behaviours.

The third objective focuses on control over individual energy use. This can be both actual control (whether someone objectively can perform a behaviour) and perceived control (whether they believe that they can). Results already discussed suggest that the perception of control is important: contextual constraints such as the shared nature of an office environment have a major influence on the performance of behaviours in office settings. This was identified as particularly important by analysis using the Theory of Planned Behaviour, which suggested that the construct Perceived Behavioural Control had the most influence on the behaviours examined here.

The centrality of control for this research is highlighted by it having already been discussed in relation to objectives 1 and 2. Objective 1 examined control as an aspect of the physical environment, but also identified that control relates to the social environment of an office setting. The need to share the space means that control over some behaviours is dependent on the needs

of others, or the ability to negotiate. However, taking control away from people in shared environments changes the way that those people relate to each other. For objective 2, individual control distinguished between the performance of behaviours in the office setting. In meeting objective 3, then, this research identified that a lack of control over the performance of a behaviour could disrupt the usual patterns of behaviour. This effect was limited, and did not cross into other contexts.

Objective 4. To apply social psychological models of individual behaviour and evaluate their ability to explain individual energy use behaviours in office settings.

This objective examines how well two social psychological models of individual behaviour describe relationships between influencing factors and how these factors influence the reported performance of individual energy demand behaviours. The two models used in the research, the Theory of Planned Behaviour (Ajzen, 1991) and Values-Beliefs-Norms Theory (Stern et al., 1999), have both been applied to individual behaviour in household settings, but have been less frequently applied in office settings. By testing how well the models fitted the data collected in this research using Structural Equation Modelling, an assessment of how well the models explain the factors that influence individual energy demand behaviour in office settings could be made.

While there were problems with the Structural Equation Models used to examine the Theory of Planned Behaviour (see Section 8.2), the results of this analysis did provide some support for the theory's proposal that Perceived Behavioural Control was a particularly important influence on individual energy demand. Furthermore, the Structural Equation Models examining Values-Beliefs-Norms Theory identified that, while the relationships between factors proposed by the theory were supported, they had very little influence on the reported performance of individual energy demand behaviour in the office setting. Overall, then, the analysis provided some limited support for the ability of the two models to explain elements of the influences on individual energy demand behaviour, but provided further evidence that understanding the context that a behaviour occurs within is central to understanding why that behaviour occurs.

Objective 5. To make recommendations for future policy and research.

Recommendations arising from this research fall into three categories: recommendations for practitioners seeking to reduce energy demand in office settings; recommendations for policy makers; and recommendations for future research.

Practitioners seeking to reduce energy demand in office settings have two main approaches to consider: changing the fabric or systems of the building, and changing the behaviour of the building's occupants. This research demonstrated that occupant behaviour is shaped by the physical building and its systems, but also by the social and organisational context of the office setting, and the level of control that occupants feel they have. Changes to building fabric or systems, then, need to be considered in the light of their effect on behaviour. Greater automation or centralisation of control of systems such as lighting can reduce the salience of other switching-off behaviours in that setting, and alter how people negotiate the use of the office space. The net energy saving benefits need to be considered before such systems are put into place.

Interventions need to target specific behaviours, including the setting that the behaviour occurs within. This suggests that general interventions about energy saving will be less successful than specific interventions, and that interventions for energy saving delivered in an office setting are unlikely to have an effect in the home setting (and vice versa). Interventions in office settings need to be framed differently to those in the home. In particular, pro-environmental or value-led messages are likely to only have a small influence on behaviour in the office, whereas promoting energy saving as part of being a 'good professional' will support existing beliefs about energy saving in the office context.

Additionally, in a time of budget cuts, messages about energy saving in the office need to be decoupled from the need to save money. In particular, assigning responsibility for energy saving to individual employees who feel demoralised about budget cuts, and who feel a lower level of control over energy use in the office than at home, is likely to produce a backlash against energy saving. Therefore, the behaviours targeted, the level of control that individual employees feel they have over the behaviour, and the assignment of responsibility for that behaviour need to be carefully considered in the design of any intervention.

Interventions aimed at the social aspects of the office environment rather than solely at individual behaviours would overcome some issues around perceptions of control over energy use. These could include 'team challenge' interventions, encouraging employees to meet group targets for energy saving, with feedback mechanisms reinforcing changes in behaviour. Employees need to feel that there is buy-in to energy saving from the organisation as a whole, including senior management. While some cynicism about motivations is likely, particularly during times of budget cuts, behaviour consistent with energy saving messages performed by the organisation as a whole (through policy commitments, public statements, the design of projects, etc.) and by members of senior management (visibly supporting or performing energy saving behaviours) would emphasise to employees the importance of energy saving.

Wider recommendations for policy makers focus on similar issues to those identified for practitioners, although at a different level of implementation. Policies, and support to enable practitioners to enact policies, need to recognise different antecedents for energy demand behaviours in office settings, and support appropriate targeting of setting-specific behaviours. These require a different focus for behaviour change: energy demand behaviours in office settings are performed by situated individuals whose behaviours are shaped by physical, social and organisational context. Policy support for methods of behaviour change such as team challenges and feedback would help to disseminate this approach.

There are several recommendations for further research extending this research. Research based on the measurement of the actual performance of energy demand behaviours rather than self-reports of performance could confirm the findings of research conducted using a more traditional attitude-behaviour approach. Such measurements in a two-part study could identify the effects of changes in building fabric or systems, or of a behaviour change intervention, on the performance of energy demand behaviours. Quantification of the actual frequencies of performed behaviours, and the amount of energy used in or saved by these behaviours, would provide further evidence of the potential for saving energy in office settings through changes in occupant behaviour.

Further research could also focus on different contexts. This research examined energy demand behaviours in local government offices, but the behaviours examined were general office behaviours, not practices specific to local government. Further research could examine such behaviours in other public sector offices such as within the civil service, and in the offices of private sector organisations. It could also address such behaviours in other organisational settings such as factories, shops or leisure complexes. Additionally, buildings are not the only organisational users of energy: transport is another major user, for employee commuting and travel on behalf of the organisation. Addressing individual and organisational factors influencing travel mode choice would provide useful insights for interventions to reduce car use or encourage the use of alternative modes of transport.

An important finding of this research is that the setting of a behaviour is important for its definition, and that organisational and home settings are fundamentally different. However, many organisations are now encouraging office workers to work from home rather than in the office. Research examining how this shift from working in the office to working at home affects energy demand behaviours, and how such behaviours can be categorised, would be useful and timely.

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Appendix 1: Questionnaire survey

The questionnaire presented here is a text version of the questionnaire survey administered to the participants in the study. An image of the way the questionnaire survey looked when presented in the Bristol Online Surveys software can be seen in Figure 4.10.

Energy use by office workers

Screen 1

Thank you for taking the time to fill out this questionnaire.

This version of the questionnaire is for Nottingham City Council employees who are NOT based in the Loxley House building.

If you are a Nottingham City Council employee based in Loxley House, please follow this link to another version of the questionnaire designed specifically for Loxley House. *(Link given)*

If you are not an office-based employee, thank you for your interest in this survey but you do not need to fill out any questionnaires for this particular study.

The questionnaire is part of a study being carried out by researchers at Loughborough University, looking at how people use energy in different types of buildings. This study will identify some of the major influences on people's use of energy in office settings, including motivations and attitudes. Understanding these influences will help to reduce future energy use in office buildings.

The questionnaire should take around 20-30 minutes to complete. The answers you give will be completely confidential, and the Council will not have access to them. Any information reported in the final research will be anonymous and aggregated, and it will not be possible to trace answers back to individual respondents.

The research is being conducted by me, Clare Littleford, as part of the work towards a PhD in the Department of Civil and Building Engineering at Loughborough University. If you have any questions about the study at Nottingham City Council, or would like to be informed about the outcomes of the research, please contact me on the details below.

Many thanks for your contribution.
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Screen 2

About you and your workplace

1. Are you: Female/Male
2. How old are you?
3. Are you: Full Time/Part Time

4. For how many years have you worked for Nottingham City Council?
5. Have you previously worked for any other local authorities? Yes/No. If so, for how many years?
6. Have you previously worked in the private sector? Yes/No. If so, for how many years?

7. Are you in a managerial role? Yes/No
7a. If yes, how many Council employees do you manage (if any)?
7b. If yes, are you a member of the Corporate Leadership Team?

8. Which department do you work in?
9. Which building is your usual office base?
10. Including yourself, approximately how many people share the room that is your office? (If you are in an open-plan office, this means everyone in the whole of the large room that you sit in)

11. In a typical week, how much of your working time do you spend in the office? (Please mark the closest option)

Less than half the time	
About half the time	
More than half the time	
Most of the time	
All of the time	

Screen 3

About heating and cooling in the offices

12. On a typical winter day (excluding extremely cold spells), what is the temperature usually like in your office?
Very hot / a little too warm / about right / a little too cool / very cold

13. On a typical summer day (excluding heatwaves), what is the temperature usually like in your office?
Very hot / a little too warm / about right / a little too cool / very cold

14. Can your office heating be adjusted or controlled from within the office? Yes/No/Don't know
14a. If yes, what kind of controls are there? (e.g. a programmer with digital display, or a thermostat controlled by a dial, or Thermostatic Radiator Valves?)
14b. If yes, do you personally know how the heating controls work? Yes/No/Not sure
14c. If yes, do you personally ever adjust the heating controls? Yes/No

15. If your heating cannot be adjusted or controlled from within the office, what action are you able to take if you are too hot or too cold in your office?

16. Which of the following methods of cooling are available in your office? (Tick all that apply)

Full air conditioning	
Air circulation but not full air conditioning	
One of above but not sure which	
Electric desk fans	
Windows that can be opened	
Vents that can be opened	
Other (please specify)	

17. How effective is the control you have over the temperature in your office?
Not at all effective/ Not very effective/ Neutral / Quite effective/ Very effective

18. Would you like to have more control over the temperature in your office?
Yes/No/Not sure
If yes, how?

Screen 4

About lighting in your office

19. Do the meeting rooms in your building have switches to turn the lights off? Yes / No / Don't know
If Yes, when leaving a meeting room empty, how often do you turn the lights off?
Never / Rarely / Half the time / Frequently / Always

20. Do the toilets in your building have switches to turn the lights off? Yes / No / Don't know
If Yes, when leaving the toilets unoccupied, how often do you turn the lights off?
Never / Rarely / Half the time / Frequently / Always

21. What kind of lighting controls do you have in the room that is your office? (Tick all that apply)

Switches on the walls	
Dimmer switches on the walls	
Pull-switches hanging from the ceiling	
Automatic controls (e.g. timer or motion sensitive)	
Other (please specify)	

22. In the room that is your office, are you able to turn off the lights? Yes / No / Don't know

If you answered No or Don't know *to the last question, please move onto the next page by scrolling to the bottom of the screen and clicking 'Continue'.*
If you answered Yes *to the last question, please answer the following questions.*

23. Are you able to control the lights above your desk separately from the lights above most other people's desks? Yes / No / Don't know / I have an office to myself

24. How often do you do the following?
1 = Never, 2 = Rarely, 3 = Half the time, 4 = Frequently, 5 = Always

	1	2	3	4	5
When the lights in my office are not needed, I turn them off					

25. At work, turning off lights when they are not needed would be:
1 = Not at all, 2 = Not very, 3 = Neutral, 4 = A little, 5 = Very much

	1	2	3	4	5
Appropriate					
Worthwhile					
Convenient					
Satisfying					

26. How strongly do you agree or disagree with the following statements?
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

The people who are important to me would turn off their office lights when they are not needed	1	2	3	4	5
I would find it difficult to turn off the office lights when they are not needed					
The people I work with think that I should turn off the office lights when they are not needed					
Senior management turn off their office lights when they are not needed					
Turning off the office lights when they are not needed would help the Council to save energy					
The people I work with turn off the office lights when they are not needed					
My turning off the office lights when they are not needed is up to me					
The people who are important to me think that I should turn off the office lights when they are not needed					
Next time, I intend to turn off the office lights when they are not needed					
Senior management think that I should turn off the office lights when they are not needed					

Screen 5

Your computer use at work

27. Are you the only person who regularly uses the computer you usually use? Yes / No
If No, why not?

28. Please indicate how often you do the following at work:
1 = Never, 2 = Rarely, 3 = Half the time, 4 = Frequently, 5 = Always

	1	2	3	4	5
When I have finished using it for the day, I turn my computer off					
When I have finished using it for the day, I turn my monitor off					
When I am away from my desk for more than ten minutes, I turn my monitor off					

29. At work, turning off my monitor when I am away from my desk for more than ten minutes would be:
1 = Not at all, 2 = Not very, 3 = Neutral, 4 = A little, 5 = Very much

	1	2	3	4	5
Appropriate					
Worthwhile					
Convenient					
Satisfying					

30. Please indicate how strongly you agree or disagree with the following statements:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
The people who are important to me would turn off their monitor when they were away from their desk for more than ten minutes					
My turning off my monitor when I am away from my desk for more than ten minutes is up to me					
Senior management think that I should turn off my monitor when I am away from my desk for more than ten minutes					
Turning off my monitor when I am away from my desk for more than ten minutes would help the Council to save energy					
The people who are important to me think that I should turn off my monitor when I am away from my desk for more than ten minutes					
Next time, I intend to turn off my monitor when I am away from my desk for more than ten minutes					
The people I work with turn off their monitor when they are away from their desk for more than ten minutes					
I would find it difficult to turn off my monitor when I am away from my desk for more than ten minutes					
The people I work with think that I should turn off my monitor when I am away from my desk for more than ten minutes					
Senior management turn off their monitor when they are away from their desk for more than ten minutes					

Screen 6

About conserving energy at the Council

31. Please indicate how strongly you disagree or agree with the following statement:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
Reducing the Council's energy use would be a good thing					
It is important to reduce the Council's energy use					

32. When it comes to using energy at work:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
When it comes to using energy at work, I want to do what the people I work with think I should do					
When it comes to using energy at work, I want to do what is best for the environment					
When it comes to using energy at work, I want to do what the people who are important to me think I should do					
When it comes to using energy at work, I want to do whatever makes my job easiest					
When it comes to using energy at work, I want to do what senior management think I should do					

33. What do you think are the biggest influences over your energy use at work?

34. What do you think could be done to save energy in your building?

35. What do you think could be done to save energy across the whole of the Council?

36. Please indicate how strongly you disagree or agree with the following statements:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree,
4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
People who work for the Council are expected to care about the environment					
Over the next few weeks at work, most of my colleagues will try to conserve energy					
The Council is committed to environmental sustainability					
When I am at work, I rarely think about how much energy my activities are consuming					
I waste less energy than most of my colleagues					
Senior management see conserving energy as an important priority					
I am more aware of the need to conserve energy than most of my colleagues					
Over the next few weeks at work, I will try to conserve energy					
Senior management see environmental sustainability as an important priority					
People who work for the Council are expected to try to conserve energy					
The Council is committed to conserving energy					

Screen 7

About your energy consumption at home

The following section asks about your energy consumption at home.
It would be very helpful if you could complete this section, as it will give us some very useful insights into how being in a different situation (such as at work or at home) affects people's behaviour.
However, if you would prefer not to answer these questions, please do complete the rest of the questionnaire by scrolling to the bottom of the screen and clicking on 'Continue'.

37. Including yourself, how many adults (aged 18 and over) live in your home?
38. How many children (aged under 18) live in your home?

39. What best describes your living situation?

Owner-occupier	
Rented self-contained property	
Rented shared house/flat	
Other (please specify)	

40. Please indicate how strongly you agree with the following statements about your behaviour when you are at home:
NA = Not applicable, 1 = Strongly disagree, 2 = Tend to disagree,
3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

	NA	1	2	3	4	5
At home, when I leave a room empty I turn off the lights						
At home, when I consider turning on my heating, I think about how much it will cost						
When I am away from my home computer for more than ten minutes, I turn off the monitor						
Reducing my household's energy use would be a good thing						
When I have finished using my home computer, I turn it off						
At home, when lights in a room are not needed, I turn them off						
When I am not using my main television, I turn it off completely rather than leave it on standby						
At home, when I consider turning on my heating, I think about the effect on the environment						

Screen 8

About your energy consumption at home

The following section asks four more questions about your energy consumption at home.
It would be very helpful if you could complete this section, as it will give us some very useful insights into how being in a different situation (such as at work or at home) affects people's use of energy.
However, if you would prefer not to answer these questions, please do complete the rest of the questionnaire by scrolling to the bottom of the screen and clicking on 'Continue'.

41. At home, when lights are not needed, turning them off would be:
1 = Not at all, 2 = Not very, 3 = Neutral, 4 = A little, 5 = Very much

	1	2	3	4	5
Appropriate					
Worthwhile					
Convenient					
Satisfying					

42. Please indicate how strongly you disagree or agree with the following statements.
NA= Not applicable, 1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree,
4 = Tend to agree, 5 = Strongly agree

	NA	1	2	3	4	5
The people I live with think that I should turn off lights at home when they are not needed						
My turning the lights off at home when they are not needed is up to me						
The people who are important to me turn off the lights at home when they are not needed						
Turning the lights off when they are not needed will help my household to save energy						
The people who are important to me think that I should turn off lights at home when they are not needed						
Next time, I intend to turn the lights off at home when they are not needed						
The people I live with turn off the lights at home when they are not needed						
I would find it difficult to turn off the lights at home when they are not needed						

If you don't have a desktop computer at home, *or only have a laptop computer, please move on to the next page by scrolling to the bottom of the screen and clicking 'Continue'.*
If you have a desktop computer at home*, please answer the following questions.*

43. When you are away from your home computer for more than a few minutes, turning off the monitor would be:
1 = Not at all, 2 = Not very, 3 = Neutral, 4 = A little, 5 = Very much

	1	2	3	4	5
Appropriate					
Worthwhile					
Convenient					
Satisfying					

44. Please indicate how strongly you disagree or agree with the following statements:
NA = Not applicable, 1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree,
4 = Tend to agree, 5 = Strongly agree

	NA	1	2	3	4	5
The people I live with think that I should turn off the monitor when I am away from my home computer for more than ten minutes						
My turning the monitor when I am away from my home computer for more than ten minutes is up to me						
The people who are important to me turn off the monitor when they are away from their home computer for more than ten minutes						
Turning off the monitor when I am away from my home computer for more than ten minutes will help my household to save energy						
I would find it difficult to turn off the monitor when I am away from my home computer for more than ten minutes						
The people I live with turn off the monitor when they are away from their home computer for more than ten minutes						
Next time, I intend to turn off the monitor when I am away from my home computer for more than ten minutes						
The people who are important to me think that I should turn off the monitor when I am away from my home computer for more than ten minutes						

Screen 9

Energy consumption overall

45. When it comes to using energy at home:
NA = Not applicable, 1 = Strongly disagree, 2 = Tend to disagree,
3 = Neither agree nor disagree, 4 = Tend to agree, 5 = Strongly agree

	NA	1	2	3	4	5
When it comes to using energy at home, I want to do what the people who are important to me want me to do						
When it comes to using energy at home, I want to do what will cost me the least money						
When it comes to using energy at home, I want to do what is best for the environment						
When it comes to using energy at home, I want to do what is most convenient						
When it comes to using energy at home, I want to do what the people I live with want me to do						

About attitudes to energy consumption

46. Please indicate how strongly you disagree or agree with the following statements:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree,
4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
I feel morally obliged to save energy, regardless of what others do					
My household's energy consumption affects the environment					
The exhaustion of fossil fuels is a problem					
I feel jointly responsible for the exhaustion of energy sources					
Conserving energy at home is my responsibility					
Environmental quality will improve if we use less energy					
My contribution to the energy problem is negligible					
I should do what I can to save energy at home					
The Council's energy consumption affects the environment					
It's not just the government and industry that are responsible for high energy consumption levels, but I am too					
Conserving energy and natural resources is important to me					
When I'm at work, it's not my responsibility to conserve energy					
I would be a better person if I saved energy					
I should do what I can to help the Council save energy					

<u>Screen 10</u>

About your values

47. Please rate each item according to how important the statement is as a guiding principle for you.
1 = Not at all important, 2 = Tends not to be important, 3 = Neutral,
4 = Tends to be important, 5 = Extremely important

	1	2	3	4	5
Curious, interested in everything, exploring					
Influential, having an impact on people and events					
Honouring parents and elders, showing respect					
Protecting the environment, preserving nature					
Social justice, correcting injustice, care for the weak					
Respecting the earth, harmony with other species					
Wealth, material possessions, money					
Self-discipline, self-restraint, resistance to temptation					
A varied life, filled with challenge, novelty and change					
Family security, safety for loved ones					
A world at peace, free of war and conflict					

About the relationship between humans and the environment

48. Please indicate how strongly you disagree or agree with the following statements:
1 = Strongly disagree, 2 = Tend to disagree, 3 = Neither agree nor disagree,
4 = Tend to agree, 5 = Strongly agree

	1	2	3	4	5
We are approaching the limit of the number of people the earth can support					
Humans have the right to modify the natural environment to suit their needs					
When humans interfere with nature it often produces disastrous consequences					
Human ingenuity will ensure that we do NOT make the earth unliveable					
Humans are severely abusing the environment					
The earth is like a spaceship with limited room and resources					
Plants and animals have as much right as humans to exist					
The balance of nature is strong enough to cope with the impacts of modern industrial nations					
Despite our special abilities humans are still subject to the laws of nature					
The so-called 'ecological crisis' facing humankind has been greatly exaggerated					
If things continue on their present course, we will soon experience a major ecological catastrophe					

Screen 11

Thank you for filling in this questionnaire

Thank you for taking the time to fill out this questionnaire. The answers you have given will be very useful for this research. If you have any questions or concerns regarding this questionnaire, or any other aspect of this research, please do get in touch by emailing c.littleford@lboro.ac.uk

The next stage in this research is to carry out interviews with a small number of people who work in the Council offices. These interviews will explore energy use in office buildings in more detail than can be done in a questionnaire. Interviews will last a maximum of 45 minutes, will be carried out in work's time, and will be completely confidential. They will take place in a few weeks' time, at a time that suits the interviewee.

If you would be willing to be interviewed, please add your email address below. (Your email address will not be stored with the rest of your questionnaire answers.)

49. Email address:
50. How did you hear about this survey?
Weekly news email / Personal recommendation / All staff email / Other (specify)

Appendix 2: Interview schedule

General questions

Questions for all buildings except Loxley House:

1. Confirm which building they are based in
2. How long have you been based there?
3. How long have you been working for the Council?
4. Can you describe your office to me, e.g. how modern is it, how many people are there?
5. Can you control things like heating and lighting from within the office?

Questions for Loxley House:

1. How long have you been based in Loxley House?
2. Where were you based before then?
3. How does the office you were in before compare to Loxley House?
4. How long have you been working for the Council?

Importance of energy conservation at the Council

6. How important do you think it is that the Council as a whole organisation tries to conserve energy?
7. How important do you think energy saving actually is for the Council as a whole organisation?
8. How important do you think senior managers think energy saving is?
9. How important do you think Councillors think energy saving is (if you deal with them)?
10. How important do you think energy saving is for most employees on the ground?

Energy saving actions

11. What do you think can be done to save energy across the Council?
12. What energy saving initiatives do you already know about at the Council?
13. Is there anything that stops you carrying out energy saving at work?
14. What (if anything) would encourage or help you to save energy at work?

Expectations on behaviour

15. Thinking about energy use in the offices, how do you think the Council as a whole organisation expects individual employees to behave?
16. Is that the same as how senior management expect individual employees to behave?
17. How do you think individual employees react to the ways the organisation and senior management expect them to behave around energy use?
18. How do you think people in your team expect you to behave around energy use?

Social environment of shared offices

19. How influential do you think the behaviour of other people in your team is on your own use of energy at work?

20. Do you know how switching off shared equipment such as printers and photocopiers at the end of the day is managed in your area?

21. How are things like temperature or whether lights or desk fans decided on within your office?

22. How is it handled if people disagree?

23. How do you think people in your building would react to being asked to change their behaviour in order to save energy?

Condition of buildings

Question for all buildings except Loxley House:

24. How do you think the design or condition of your building affects individual energy use?

Question for Loxley House only:

24. Regarding energy use, how do you think Loxley House compares to the building you were previously based in?

Budget cuts

25. There have been some big changes in local government over the last couple of years because of budget cuts. How do you think that has affected employees' attitudes and behaviour around energy use at work?

Office and home location

26. What do you think are the similarities and differences between your energy use at work and at home? (Prompt for similarity/difference not discussed)

27. Do you think the way you use energy in one location influences the way you use energy in another location, for example at work or home?

Appendix 3: Conference presentations from this research

Oral papers based on the research presented in this thesis have been presented, or accepted for presentation, by the author at the following international academic conferences:

22-25 September 2013 (Accepted for presentation)
Title of paper: *Organisational settings and individual energy use: How context affects behaviour in shared offices.*
Tenth Biennial Conference on Environmental Psychology,
Otto-Von-Guericke University, Magdeburg, Germany.

20-21 September 2012
Title of paper: *Saving energy in shared offices: the effect of setting on individual energy demand.*
Second European Conference on Energy Efficiency and Behaviour (BEhavE),
Helsinki, Finland.

24-29 June 2012
Title of paper: *Saving energy in shared offices: the impact of individual attitudes and behaviour on lighting and heating.*
22nd Conference of the International Association of People-Environment Studies (IAPS),
University of Strathclyde, Glasgow.

26-28 September 2011
Title of paper: *The energy consumption behaviour of individual office workers: Influences of context, control and norms.*
Ninth Biennial Conference on Environmental Psychology,
Eindhoden University of Technology, Eindhoven, The Netherlands.

Appendix 4: Training attended during PhD

Loughborough University training courses

Half-day training courses (unless otherwise stated), organised by Staff Development/ Loughborough University Graduate School.

General training:

- Postgraduate research students' induction (3 November 2009)
- Keeping your research up to date (19 November 2009)
- Getting the most out of supervision (14 December 2009)
- Designing and producing conference posters (20 January 2010)
- Reflective activities for research (20 January 2010)
- Conference presentation skills (2 parts, 3 & 17 February 2010)
- Managing your PhD as a project (22 February 2010)
- The effective researcher (2 days, 16 & 17 March 2010)
- Introduction to the job of lecturer (25 March 2010)
- Networking skills – attending conferences (15 April 2010)
- Getting articles published (27 April 2010)
- Real creativity (2 days, 19 & 20 October 2010)
- Career planning and management (7 March 2012)
- Viva – what happens? (3 April 2012)
- Writing up your PhD thesis (30 May 2012)

Research methods training:

- Introduction to linear regression and correlation (25 November 2009)
- Qualitative analysis (2 parts, 22 February, 3 March 2010)
- Cluster analysis (2 March 2010)
- SPSS – Cluster and Factor analysis (16 March 2010)
- Discriminant analysis (27 April 2010)
- Overview of regression (11 May 2010)
- SPSS – regression (18 May 2010)
- Questionnaire design (13 October 2010)
- Introduction to statistical methodology (27 October 2010)
- Paired and unpaired t-tests (3 November 2010)
- Chi-squared tests (10 November 2010)

- Non-parametric statistics (17 November 2010)
- Introduction to linear regression and correlation (24 November 2010)
- Introduction to ANOVA (1 December 2010)
- Design of multifactor experiments (8 December 2010)

External training courses

- Understanding energy and pathways to low-carbon living and resilient systems (Summer School), UK Energy Research Centre (UKERC), Warwick University (26 June – 1 July 2011)
- Structural Equation Modeling, Southampton University (16 & 17 January 2012)