

DRAWING ROOM

*In memory of my silly, clever, crude, sophisticated, serious, funny,
imperfect, beautiful friend; John.*

Acknowledgments

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Abstract

Despite widespread recognition of the need to decarbonise existing housing stocks, there remain limitations in the way this problem is theorised and addressed. Practice theory has sought to move away from the individualism and assumptions of rational-choice that have underpinned previous studies, but has still relied on comparisons of accounts of practices between individuals. Furthermore, these practice-based studies have encountered their own challenges with regards to adequately conceptualising 'large' phenomena such as retrofit, as well as addressing issues of variations in practitioner competence, and tractability.

Drawing on 31 in-depth interviews and walk-through tours with affluent owner-occupiers who were currently, or had recently undertaken home improvement projects, this thesis examines why, and how some of these projects incorporated low carbon retrofit measures, while others did not. The relationships between the components of practice, both within and between practices are examined to identify how they connect to the wider nexus of practices that extends beyond the home. Particular attention is given to understanding the connective power of teleological influences on home improvements (RQ1); the connections between these teleological influences, home improvement measures and competences (RQ2); and the implications of this enhanced understanding for encouraging higher rates of retrofit (RQ3). Furthermore, the thesis employs a methodology that facilitates adoption of the home improvement measure as the unit of analysis, rather than the individual. It is proposed that this is not only more appropriate to the ontological assumptions underpinning practice theory, but also to specialisations within the construction industry.

In conclusion, this thesis proposes a series of teleological constellations (i.e. structures of practices connected by shared goals) that provide a theoretical tool to further our empirical understanding of how low carbon home improvements fit within the wider nexus of practices. These connections, in turn, have implications for the way in which policy seeks to induce higher levels of low carbon retrofit in order to help meet national CO₂ reduction targets and contribute to addressing global climate change.

Schedule of abbreviations

ABC	Attitude – Behaviour - Choice
AEV	Adjusted Expectancy Value
ASHP	Air Source Heat Pump
BEN	Bristol Energy Network
BESN	Big Energy Saving Network
BGD	Bristol Green Doors
BRE	Building Research Establishment
CAQDAS	Computer Aided Qualitative Data Analysis Software
CCC	Committee on Climate Change
CERT	Carbon Emissions Reduction Target
CESP	Community Energy Savings Programme
CGTM	Constructivist Grounded Theory Method
CHP	Combined Heat and Power
CSE	Centre for Sustainable Energy
DEFRA	Department of Environment, Food and Rural Affairs
DRHI	Domestic Renewable Heat Incentive
DHW	Domestic Hot Water
ECO	Energy Company Obligation
EED	Energy Efficiency Directive
EPBD	Energy Performance in Buildings Directive
EPC	Energy Performance Certificate
EU	European Union
Fit	Feed-in Tariff
GDHIF	Green Deal Home Improvement Fund
GHG	Green House Gas
GSHP	Ground Source Heat Pump
GTM	Grounded Theory Method
HEED	Home Energy Efficiency Database
HER	Home Energy Report
HMSO	Her Majesty's Stationary Office
MTP	Market Transformation Programme
MVHR	Mechanical Ventilation with Heat Recovery
PAYS	Pay-as-you-save
POE	Post Occupancy Evaluation
PV	Photovoltaic
Qi	Quality of Life
RED	Renewable Energy Directive
RHI	Renewable Heat Incentive
SMEs	Small and Medium Enterprises
SPT	Social Practice Theory
SWI	Solid Wall Insulation
UKERC	United Kingdom Energy Research Centre

UNCED	United Nations Conference on Environment and Development
VERD	Value propositions for Energy Efficient Renovation Decisions
VOCs	Volatile Organic Compounds

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Definitions

More detailed explanations of the terms below are provided within the thesis. Below is a quick reference guide of definitions of terms:

Home Improvement	Umbrella term for changes to the home that include both retrofits and/or renovations.
Homeowner	Individuals who own a property that they may let to other occupants or occupy themselves.
Householder	Individual who occupies a house, which they may own or rent.
Owner-occupier	Individuals who own the home they currently occupy.
Renovation	Improvements made to the home for amenity purposes without the specific intent of improving energy efficiency. Examples include loft conversion or new kitchens.
Retrofit	Improvements made to the house with the specific intent of improving the energy efficiency of the property, This includes the installation of renewable energy technologies in addition to upgrading the building fabric.

Chapter 1 | Introduction

1.0 Introduction

Anthropogenic increases in greenhouse gas (GHG) concentrations have been strongly linked to a number of global environmental concerns including warming of the atmosphere, changes in the global water cycle and global mean sea level rise (EST 2011; IPCC 2013). Consequently, from the 1990s onwards, reduction of GHG emissions has become a significant international environmental issue. This has been reflected in international carbon dioxide emissions reduction targets such as the Paris Agreement (United Nations 2015) and its predecessor the Kyoto Protocol (United Nations 1998), as well as a legally binding target to reduce carbon dioxide emissions by 80% by the year 2050. In the broadest sense, this thesis aims to contribute to these efforts, by exploring owner-occupier low carbon retrofit with a view to understanding how the rate of retrofit could be increased, leading to a reduction in CO₂ emissions from the housing stock. This chapter outlines how this is to be achieved, beginning by outlining the potential of owner-occupier housing retrofit to make a significant contribution to international CO₂ emissions. Current knowledge regarding owner-occupier housing retrofit is then reviewed, and shortfalls in our understanding are identified, before outlining the contribution this thesis makes to address these gaps. A synopsis of the research questions, theoretical approach, and methods is then provided, before concluding with an outline of the thesis structure.

1.1 Contribution of retrofit to reducing CO₂ emissions

1.1.1 Buildings and CO₂ emissions

Between 1970 and 2010, the emission of greenhouse gases such as carbon dioxide from the building sector has more than doubled to reach 9.18 GtCO₂eq¹ in 2010 (IPCC 2014). This accounted for 19% of all global 2010 GHG emissions (International Energy Agency 2012), and

¹ GtCO₂eq = giga-tonnes CO₂ equivalent, where equivalent emissions are aggregated using global warming potentials (GWPs) over a 100-year time horizon (IPCC 2014)

36% of all GHG emissions in the EU (European Commission 2018). Therefore, as the source of a significant proportion of GHG emissions, buildings have the capacity to play an important role in mitigating climate change. Emissions from buildings include direct emissions given off during the manufacture of building products and the construction process, however, the majority are indirect emissions associated with energy consumption (e.g. heating, lighting) during the building's operation (IPCC 2014). For example, in the UK, these 'in operation' emissions account for 83% of the total CO₂ emissions over the lifecycle of a building ((HM Government 2010b) see Figure 1.1). Furthermore, whilst direct emissions have begun to level off, indirect emissions from buildings continue to increase (IPCC 2014). Therefore, while some research has investigated the embodied energy from which these direct emissions arise (see for example Hacker et al. 2008; Monahan and Powell 2011; Iddon and Firth 2013; Gaspar and Santos 2015), the 'in operation' phase of the building lifecycle emerges as the greatest opportunity to reduce CO₂ emissions from the building stock.

Lifecycle Phase	CO ₂ Emissions (MtCO ₂)	Percentage of Total (%)
Design	1.3	0.5
Manufacture	45.2	15
Distribution	2.8	1
Construction	2.6	1
Operation (in use)	246.4	83
Refurbishment/Demolition	1.3	0.4
Total	298.4	100

Figure 1.1: Amount of CO₂ emissions over a building's lifecycle (adapted from HM Government 2010b)

These indirect emissions result from energy being consumed in order to provide space heating, water heating, lighting and electricity to run appliances, making buildings one of the largest end-use sectors for energy consumption worldwide (IPCC 2014). Consequently, reduction in GHG emissions from the building stock will be influenced both by decarbonisation of the energy supply as well as increased energy efficiency in buildings themselves. However, as identified by Skea (2012); Calise et al. (2017); and Lechtenböhmer et al. (2017), decarbonisation strategies rely on a reduction in overall energy demand,

brought about by increased energy efficiency. This suggests that efficiency improvements to building fabric will play an important role in any strategy to reduce emissions from the 'operation' phase of buildings' lifecycles. Furthermore, in industrialised countries such as Germany, residential buildings consume almost one third of the total energy supply (Achtnicht and Madlener 2014). Globally, the residential sector accounts for 75% of energy consumption in buildings (IPCC 2014), making dwellings a key area of the building stock on which to focus in order to reduce indirect emissions from buildings.

1.1.2 Importance of retrofitting existing housing

Developed countries such as those in North America and Western Europe make a significant contribution to global emissions, for example, *"energy consumption for thermal uses in buildings in these countries accounts for most of the energy consumption in the world"* (IPCC 2014, p. 681). In rapidly developing countries economic growth and increasing urbanisation are driving significant construction activity (WBCSD 2007), allowing the development of an energy efficient housing stock through the provision of new housing. However, in developed countries, rendering the existing housing stock more energy efficient is essential to reducing GHG emissions from the building sector (Power 2008; Harvey 2013; IPCC 2014). Studies including those by Power (2008) and Srivastav et al. (2011) investigate the relative advantages of demolishing and replacing this housing stock, or retrofitting it to make it more energy efficient. These studies conclude that once embodied energy and costs are taken into consideration, *"...both the wider arguments and concrete evidence support a focus on renovation rather than large-scale demolition"* (Power 2008, p. 4497). Such renovations regularly achieve 30–70% savings in total energy use (Harvey 2013).

The terms 'renovation', 'refurbishment' and 'retrofit' are often used interchangeably. However, Karvonen (2013) argues that retrofits specifically describe work that goes beyond regular repair and maintenance and focuses on changes to improve energy efficiency (hereafter referred to as 'retrofit'). Galvin and Sunikka-Blank (2017) argue that beyond energy efficiency, 'sustainable' retrofit is also concerned with *"...increasing thermal comfort and health; keeping homes affordable; and retaining architectural heritage"* (p.378). In the absence of a universally accepted definition of low carbon retrofit, a number of independent standards have been established such as the EnerPhit² standard developed by the Passivhaus

²The EnerPhit Standard is a set of certification criteria for refurbished buildings developed by the Passivhaus Institute. (BRE 2011)

Institute (PHI)³, or projects have adopted their own bespoke standards. Fawcett (2013) observes that these typically consist of an end point definition such as a percentage energy reduction target or maximum energy consumption target. They do not describe the processes or measures employed to achieve these targets. The term retrofit is adopted in this research to refer to home improvements that deliver carbon savings “via energy efficiency (including in lights and appliances), use of household-level renewable energy and switching to lower carbon fuels” (Fawcett 2013, p. 3).

Measures contributing to energy efficiency are described in greater detail in the Value propositions for Energy Efficient Renovation Decisions (VERD)⁴ project as “*windows, doors, heating and hot water systems, or insulation*” (UKERC 2013, p. 2). Replacement of lights and appliances, which do not require significant investment or specialist skills Fawcett (2013), are not included in this research. The renewable and low carbon energy generated at a household level described above by Fawcett, fall under the category of ‘micro-generation’, defined in The Energy Act 2004 (HMSO 2004) as:

“...biomass; biofuels; fuel cells; photovoltaics; water (including waves and tides); wind; solar power; geothermal sources; combined heat and power systems; other sources of energy and technologies for the generation of electricity [up to 50 kilowatts] or the production of heat [up to 45 kilowatts], the use of which would, in the opinion of the Secretary of State, cut emissions of greenhouse gases in Great Britain.”

(Article 82, p.65. HMSO 2004)

A range of scales of retrofit will be considered in this thesis, from stand-alone upgrades to “*building fabric, systems or controls to improve the energy performance of the property*” as described by Brown et al. (2014, p.641), to the whole house retrofits defined by the government as “*installing as many energy efficiency improvement measures as possible and appropriate within a single home*” (HM Government 2009a, p.27) .

³The Passivhaus Institute (PHI) is an independent research institute responsible for the development of the Passive House concept; an approach to sustainable building design based on improved fabric performance and mechanical ventilation. (PHI 2013)

⁴VERD is a collaborative project between Norwich Business School and the Tyndall Centre, funded by the UK Energy Research Centre (UKERC).

1.1.3 Importance of owner-occupiers

In these developed countries, where retrofit of the existing housing stock will play a critical role in reducing GHG emissions from building stock, large proportions of the housing stock are owner-occupied (for example, 69.2% across the 28 countries of the EU ((eurostat 2018), 64.5% in the US (United States Census Bureau 2015), and 66.2% in Canada (Statistics Canada 2018)).

Regulations have been introduced to increase the energy efficiency and provision of renewable energy to new housing (for example, the Renewable Energies Heat Act (REHA) in Germany (Achtnicht 2011) or the Part L1A of the Building Regulations on Conservation of Fuel and Power in UK (HMSO 2010)) However, measures to improve the energy efficiency of existing housing have been limited to:

- Including energy efficiency measures during substantial refurbishments (see Energy Savings Ordinance (ESO/EnEV) in Germany (Achtnicht 2011) and Part L1B of Building Regulations in UK (HMSO 2010));
- Production of energy performance certificates (EPCs) or passes prior to sale or rental of the property (see Energy Performance of Buildings Directive (The European Parliament and The European Council 2010));
- Voluntary financial incentives to encourage adoption of retrofit measures (such as Property Assessed Clean Energy (PACE) in the US (Gillich 2013) or the Green Deal in the UK (Dowson et al. 2012)).

However, despite the significant spending power of many owner-occupiers (Helms 2003; Swan et al. 2013), these measures have had limited success in encouraging owner-occupier housing retrofit (Guertler et al. 2013; Achtnicht and Madlener 2014; Gooding and Gul 2016; Baumhof et al. 2018), as discussed in greater detail in Chapter 2.

Research investigating owner-occupier housing retrofit, has identified a number of challenges specific to owner-occupiers, that may explain why encouraging retrofit in this sector is proving difficult. Firstly, unlike social housing where a single organisation might be responsible for multiple houses, owner-occupiers have a high degree of independence and control over their property (Haines and Mitchell 2014; Baumhof et al. 2018), leading to highly bespoke home improvements addressing the desires expressed by individual owner-

occupiers (Horne et al. 2014). Furthermore, unlike social housing where a professional would be appointed to manage improvements to the housing stock, the majority of owner-occupiers are likely to have professional commitments in sectors unrelated to housing, leading to both conflicting demands on their time and financial resources (Haines and Mitchell 2014) as well as a lack of technical knowledge of home improvements (Gram-Hanssen 2014b). Finally, the *“...understanding that houses are owned, occupied and retrofitted by (the same) people implies a need to focus on the human dimensions of the retrofitting process”* (Gram-Hanssen 2014b, p. 393). In light of the prevalence of owner-occupied housing in developed countries and the limited success of existing attempts to encourage higher rates of housing retrofit in this sector, greater understanding of how and why retrofit takes place in households is imperative (Achtnicht 2011; Organ et al. 2013a; Gram-Hanssen 2014b; Haines and Mitchell 2014; Baumhof et al. 2018).

1.2 Understanding owner-occupier housing retrofit

1.2.1 State of current knowledge

Certain barriers to housing retrofit such as financial concerns (Davies and Osmani 2011; Pelenur and Cruickshank 2012; Tuominen et al. 2012; Brown et al. 2014), lack of information (Pelenur and Cruickshank 2012; Tuominen et al. 2012; Risholt and Berker 2013; Achtnicht and Madlener 2014); and a lack of appropriate legislation (Davies and Osmani 2011; Stieß and Dunkelberg 2012; Tuominen et al. 2012; Achtnicht and Madlener 2014) are well documented. However, following the limited success of many financial incentives (discussed in greater detail in Chapter 2) there is currently a growing consensus within industry and academia that overcoming these barriers is necessary, but not sufficient to encourage higher rates of retrofit (Stieß and Dunkelberg 2012; Bartiaux et al. 2014; Wilson et al. 2015). Therefore, more recent research by Stieß and Dunkelberg (2012); Haines and Mitchell (2014); and Wilson et al. (2015) avoids implicitly classifying those undertaking amenity home improvements as ‘non-adopters’ for example see Achtnicht and Madlener (2014) to examine how, having overcome many of the above barriers, these home improvements could be developed to include retrofit measures. However, in these cases the retrofit group is often older (see for example Roy et al. 2008a; Wilson et al. 2015) making it difficult to determine if any influences specifically associated with this group are associated with the retrofit measures adopted or the age of the owner-occupiers.

In addition to barriers, studies adopting Attitude-Behaviour-Choice (ABC) Theories drawn from psychology have also examined the influence of a wide range of psychological concepts on pro-environmental behaviour, including values (Jackson 2005; Organ 2015), norms (Barr 2003; Organ et al. 2013a), self-efficacy (Barr 2003; Organ et al. 2013a), and identity (Jackson 2005; Abrahamse and de Groot 2014). However, critics of this approach assert that it often assumes that actors follow a rational decision-making process as well as placing too much emphasis on conspicuous, rather than routine consumption of the home (Shove 2010; Gronow and Warde 2013). Furthermore, this approach considers individual decisions in isolation, rather than addressing them in relation to the conflicting demands for time and resources to which owner-occupiers are often subject.

Since the introduction of social practice theory to energy consumption studies by Warde (2005) and Shove et al. (2008), social practice theorists have begun to address some of these concerns, advocating that retrofit measures are understood within the context of the routine practices that take place in the home (see for example Maller et al. 2012; Karvonen 2013; Bartiaux et al. 2014). As described by Shove and Pantzar (2005), each of these practices is comprised of skills and competences, meanings and images, materials, and the connections that hold them together through repetition of the practice. However, this approach has raised concerns that too much focus on the routine does not allow social practice theory to sufficiently explain large phenomena such as retrofit. Alkemeyer and Buschmann (2017) and Hui et al. (2017) also express concern that this approach, in which meanings and competences are socially constructed, neglects the power of individuals and does not allow for the high degree of variation between owner-occupiers.

Furthermore, despite seeking to move away from the cognitive individualism of ABC approaches, many social practice based studies such as Gram-Hanssen (2010); Maller et al. (2012); and Judson et al. (2013), still rely on comparing practices between one individual and the next. An approach that instead adopted the home improvement measure as the unit of analysis, could reveal the agency of material objects, and the affordances (Gibson 1986) *they* offer to the actors who engage with them.

Recent work on a nexus approach to practice theory by Hui et al. (2017) has sought to address some of these criticisms by examining the relationships *within* and *between* practices and how they are constituted. However, so far the majority of this research has focused on how material objects and their spatial or temporal proximity link practices (see for example

(Schatzki 2011; Shove et al. 2012; Morley 2017), limiting these studies to primarily localised or consecutive practices. Therefore, further research is required to determine if this nexus approach to conceptualising retrofit practices has explanatory power to offer new insights into our understanding of owner-occupier retrofit. Similarly, a detailed examination of the relationships owner-occupiers describe between conflicting demands on their resources could identify relationships between practices that are independent of the spatial or temporal proximity of material home improvement measures. Finally, practice theory based research has offered valuable critiques of technical and behavioural policy approaches (Watson 2017). However, research including but not limited to practice theory based research, must now move beyond this, to examine the implications of a greater understanding of relationships between competing demands on owner-occupier resources for policies to encourage higher rates of owner-occupier retrofit.

1.2.2 A teleological approach

As described by Porta and Keating (2008), teleology is the study of ends. In the social sciences it provides a way of explaining events by their outcomes rather than their causes. The implicit role that these outcomes (or expected outcomes) play in psychological theories of behaviour is highlighted by Organ et al. (2013a), while Schatzki (1996) also introduced *teleo-affectivity* as one of the elements structuring practice theory understandings of social life. This *teleo-affectivity* (from the Greek 'telos' meaning end or goal, and the Latin 'affectus' meaning affection or mood (Galvin and Sunikka-Blank 2016)) "*implies that the practices are guided by a direction toward an objective that has a substantial meaning for someone*" (Gram-Hanssen 2009, p. 154). While subsequent iterations of practice theory have replaced this concept with the less complicated *engagements* (Warde 2005) or *meanings* (Shove and Pantzar 2005), researchers such as Bartiaux et al. (2011) and Gram-Hanssen (2009, 2010) have revisited the concept of teleo-affectivity in order to investigate home improvements.

Unlike the psychological concept of motives, teleological structures are not properties of actors or collectively willed ends but properties of actions (Schatzki 2002). They emerge through and mediate what actors do together (Schatzki 2002), making objective-driven activities intelligible without imposing an individualistic interpretation of these activities.

These teleological approaches have previously been criticized for being too techno-deterministic and paying insufficient attention to how and why changes come about (Lawhon

and Murphy 2011). Even advocates of teleology such as Schatzki (2002) acknowledge that *“...all that desires and ends can elucidate is that the easier, riskier, and longer path was taken because it was easier, riskier, or longer. They cannot explain why it, instead of the safer but more difficult and shorter route, was pursued”* (p.230). However, examining the relationships between teleological structures and how they relate to other elements of home improvement activities (such as home improvement measures) as well as concurrent and potentially conflicting activities, could provide alternative insights into why and how these home improvements unfold. Schatzki (2011) describes how the teleologies at work in a local practice *“...stretch out over time and space beyond such situations”* (p.4). Schatzki (2002) goes on to describe how in Shaker communities, teleological structures may even form teleological regimes that foreground the ‘general will’ of a socio-cultural group across multiple practices (Welch and Warde 2017). However, beyond this fleeting account, based on a community founded primarily on its shared beliefs and objectives, the precise role that teleological structures play in connecting practices has received limited attention.

1.2.3 A contribution to knowledge

Building on existing research described in sections 1.2.1-2, this thesis seeks to improve existing theoretical understanding of owner-occupier retrofit by conceptualising the relationships within and between home improvements as well as those linking these improvements to potentially conflicting activities. In particular, the research will investigate the explanatory power of a nexus approach to practice, and connections between teleological structures in particular, on the large and highly varied phenomenon of owner-occupier home improvements. Focussing on the relationships between home improvement measures, knowledge and teleological structures, will allow knowledge and teleological structures to be analysed using the home improvement measure as the unit of analysis in addition to the individual’s account of their practice. This methodological innovation is not only more appropriate if research is to adopt a practice-based approach, but may also produce findings that can more easily be disseminated to the construction industry, which is also organised around expertise in specific home improvements measures (for example, plumbers, electricians, plasterers).

These conceptual and methodological innovations, will make a significant contribution towards enhancing our understanding of influences on owner-occupier housing retrofit within the context of home improvements and competing demands on owner-occupiers

resources more broadly. Conceptualisation and understanding of the structures that link low carbon retrofit to these other activities could produce findings that acknowledge the complexity of influences on these home improvements, while being sufficiently tractable to inform policies that seek to encourage higher rates of low carbon retrofit.

1.3 Research Questions

This thesis will seek to answer the following research questions:

1. *What are the teleological influences stimulating owner-occupier home-improvements?*

This research will investigate influences stimulating owner-occupier low carbon retrofit, facilitating a comparative analysis between the influences acting on different household types, as well as different home improvement measures.

2. *What are the relationships between the teleological influences stimulating home improvements, the home improvement measures installed, and the competences acquired?*

Having identified the influences stimulating owner-occupier home improvements, this study will investigate the relationships between these influences, the home improvement measures adopted, and the places owner-occupiers turn to for knowledge and expertise regarding these measures. In addition, a comparative analysis of these relationships will be undertaken between different groups of owner-occupiers and different home improvement measures. Identification of such relationships could be used to identify how information stimulating such expertise could be appropriately distributed to different groups of owner-occupiers.

3. *What are the implications of an enhanced understanding of owner-occupier low home improvements as part of the wider nexus of practice for encouraging higher rates of owner-occupier low carbon retrofit?*

Finally, practices of acquiring appropriate skills and expertise will be examined and combined with a detailed understanding of teleological influences on home improvements from RQ1, and an understanding of the nature of the connections within and between practices from

RQ2. These findings will be examined to ascertain if conceptualising how home improvements are connected within the wider nexus of practice can offer further insights into how higher rates of owner-occupier retrofit could be encouraged.

1.4 Structure of Thesis

The rest of this thesis is divided into four parts, each comprised of a number of chapters. **Part I** presents a review of academic and grey literature relevant to the research questions posed by this thesis, beginning in *Chapter 2* with a review of existing policies and strategies to encourage adoption of retrofit measures. A review of these policies will identify the assumptions underpinning current understandings of owner-occupier retrofit and identify gaps in existing knowledge that inform the focus of the subsequent review of theoretical perspectives in *Chapter 3*.

Chapter 3 introduces the assumptions underpinning the two main theoretical approaches that have been applied to owner-occupier housing retrofit, namely Attitude-Behaviour-Choice theories and practice theories. The empirical insights these perspectives have given into owner-occupier retrofit are discussed, as well as the implications for encouraging higher rates of retrofit. *Chapter 3* concludes by proposing a theoretical and methodological framework for the investigation of the proposed research questions.

In **Part II**, *Chapter 4* describes the research methodology employed in this doctoral thesis including the underlying research philosophy as well the research methods, sampling strategy and measures taken to address any ethical concerns. The thesis employs a practice theory approach, focussing on the teleological structures of which practices of home improvement are partially comprised (see Schatzki 1996; Gram-Hanssen 2010; Bartiaux et al. 2014). More specifically, a relational approach is adopted to determine the explanatory power of a nexus of practices (as described by Shove et al. 2012; Schatzki 2016; Hui et al. 2017; Nicolini 2017) for understanding large and highly varied phenomena such as owner-occupier home improvements. This relational approach pays attention

“...not to single scene of action or a specific situation or instance of accomplishment of a practice, but rather a chain, sequence, or combination of

performances plus their relationships – what keeps them connected in space and time.”

(Nicolini 2017, p. 101)

In addition, the home improvement measures themselves were adopted as a unit of analysis in order to determine if this would offer additional insights into: a) how low carbon retrofit measures came to be incorporated into these home improvement projects; and b) how home improvements measures might offer points of connection between practices.

Part III presents the empirical finding of this research, beginning in *Chapter 5* with an overview of the profile of the research participants. This will be followed in *Chapter 6* with a detailed description of the 12 teleological influences on home improvements, identified in this thesis. The relative importance of these teleological influences from one household type to another and from one home improvement measure to another will be examined to try and understand the variations between how these influences manifest themselves differently in diverse situations.

Chapter 7 investigates the nature of the relationships between teleological influences identified in *Chapter 6*, home improvement measures, and sources of knowledge and expertise. These relationships will not only be analysed with regards to the adoption of single home improvement measures, but the relationships and connections between concurrent, but often apparently disparate activities, will also be examined, giving insight into how home improvement fit within the wider context of social life.

Part III concludes with *Chapter 8*, which examines in greater detail, the type of knowledge and expertise that owner-occupiers seek and how they go about acquiring it and assessing if sources are appropriate or trustworthy.

Part VI begins in *Chapter 9* with a discussion of the theoretical implications of the findings of this research, in which the value of teleological constellations for understanding the connections between spatially and temporally disparate practices, including home improvements, is argued.

The thesis concludes with *Chapter 10* summarising the findings of this thesis, and the contribution it makes to existing academic literature on low carbon, housing retrofit as well

as policies to encourage higher rates of retrofit, and help to address climate change in the UK.

PART I: LITERATURE REVIEW

2.0 Introduction

As discussed in Chapter 1, existing buildings, and housing in a particular, make a significant contribution to global Greenhouse Gas (GHG) emissions. This chapter seeks to review existing policies and strategies designed to encourage the adoption of retrofit measures, and the assumptions underlying them. By examining previous strategies to encourage retrofit and how successful they have been, this chapter identifies gaps in current knowledge of owner-occupier low carbon retrofit and situations in which existing assumptions regarding owner-occupier low carbon retrofit do not seem appropriate. The findings from this review will then inform the development of a theoretical framework that seeks to address these gaps in Chapter 3.

The remainder of this chapter is divided into three sections and is structured as follows. Section 2.1 begins by describing UK contributions to global CO₂ emissions, as well as placing UK policies to reduce these emissions in an international context. Section 2.2 is structured around three commonly used strategies to encourage low carbon retrofit, namely: legislation, financial incentives and information provision. The relative strengths and weaknesses of these approaches will be reviewed, illustrated with examples of strategies implemented at international, national, and local policy scale. This review will combine descriptive details drawn from policy literature with critical insights from both research and opinion of experts from practice. Finally, Section 2.3 will summarise the contribution that a study of housing retrofit in the UK can make to the broader issue of CO₂ emissions from buildings globally, as well as the gaps in current understanding of owner-occupier low carbon retrofit.

2.1 The UK in a Global context

Under the representation of the EU, the UK was one of 196 parties at COP21 (UNFCCC 2018), when the Paris Agreement, a successor to the Kyoto Protocol was made. The Paris Agreement included a limit to global warming of 1.5°C above pre-industrial levels, as well as a five year review process to ramp up intended nationally defined contributions (INDCs) to ensure this target is met (House of Commons Library 2015b; Vaughan 2015c). Experts say that in effect this means achieving “net zero emissions” between 2050 and 2100 (Vaughan 2015c). The role that buildings must play in achieving this was recognized, with one day of negotiations dedicated as ‘Buildings Day’ (UNEP 2015) and overhaul of the existing building stock deemed essential to cutting use of imported gas and meeting these cuts in GHG emissions (Climate Network News 2016).

As discussed in Chapter 1, as the largest contributors to global energy consumption in buildings, retrofitting the owner-occupied housing stock in North America and Western Europe will have a significant impact on global GHG emissions. The US and Canada in North America, and the UK and Germany in Europe, are amongst the top ten countries with highest GHG emissions globally (Nejat et al. 2015). Therefore, it is perhaps unsurprising that Germany, the US and UK are considered to be pioneering countries in terms of residential energy policies to reduce GHG emissions (Nejat et al. 2015). These policies have had some success with GHG emissions generated by Germany and UK decreasing by 30% and 16% respectively since the early 1990s (Nejat et al. 2015).

In the UK, the energy efficiency of the housing stock presents a particular challenge. The UK has one of the oldest housing stocks in Western Europe and North America, with 37.8% being constructed before 1945, compared with 18% across Europe overall (eurostat 2018) and only 10.3% in Canada (Statistics Canada 2018). The UK is also typical of other European Countries with older housing stocks such as Sweden, Italy, Denmark, Belgium, Germany, France and the Netherlands in that new construction represents less than 1.5% of the dwelling stock (Baek and Park 2012). Therefore, three quarters of housing stock that will exist in the UK in 2050 has already been built (HM Government 2010b). The Low Carbon Construction Report by the UK Government’s Innovation and Growth Team identified that approximately 25 million of these homes need to be retrofitted by the end of 2050 (HM Government 2010b). Working from a 2010 baseline, this rate is faster than one house being retrofitted every minute.

The UK presents similar challenges to many other countries in North America and Western Europe, which together have a significant impact on CO₂ emissions from buildings globally. These include a low rate of new construction, high rates of home ownership, and high levels of fossil fuel dependency. Therefore, a greater understanding of owner-occupier low carbon retrofit would also be relevant to reducing CO₂ emissions in these countries. However, in other respects, the UK presents an exceptional case. For example, with one of the oldest housing stocks in Europe, the UK presents certain material and heritage issues that may not be as prevalent elsewhere. However, studying an example where these issues are more common provides an opportunity to understand them and how they can be overcome that can subsequently be applied to countries with smaller proportions of older housing. Furthermore, as a country with a relatively long history of interventions addressing residential energy use, the UK offers an opportunity to understand the gaps in knowledge that have underpinned policy to date. Therefore, as an atypical case in these respects, the UK offers greater explanatory power (Clyde Mitchell 1983).

2.2 Strategies to stimulate domestic retrofit

In a seminal simulation-based study of the technical feasibility of reducing carbon dioxide (CO₂) emissions, Johnston et al. (2005) concluded that an 80% reduction by 2050 would be technically demanding but feasible, using those technologies which are currently available. However, this can only be achieved with the appropriate policy implementation (Johnston et al. 2005). In the UK, the dominant policy approach has been one of Market Transformation (Shove 1998; Foxon 2013), adopted by the UK Government in 1997, with the UK Market Transformation Programme (DEFRA 2014). Described by some analysts as an objective, and by others as a process, there is no widely agreed definition of Market Transformation (MT). However, many definitions share common elements such as strategic market interventions, assisting energy efficient technologies to penetrate a significant proportion of the available market or having an impact on the market that out-lasts the intervention itself (York 1999).

The MT approach is underpinned by several assumptions. Firstly, as a response to a free-market ideology, MT relies on market-logic (Foxon 2013), but recognises and seeks to correct what it perceives as 'market failures' (York 1999; Smallbone 2004). As described by Shove (1998), this notion of market failure is based on assumptions regarding the cost-effectiveness of energy efficiency and the rationality of consumers:

“If energy saving measures are indeed cost effective, and if individual consumers were to act in an appropriately rational fashion, the gap should not exist. But because there is a gap, something must be wrong.”

(Shove 1998, p. 1106)

In Market Transformation, the role of government is perceived to be one of facilitating efforts to correct these market failures, which are often attributed to barriers (Shove 1998; York 1999; Smallbone 2004). The most common barriers to retrofit identified in peer-reviewed articles are financial concerns (Davies and Osmani 2011; Pelenur and Cruickshank 2012; Tuominen et al. 2012; Achtnicht and Madlener 2014; Brown et al. 2014), lack of information (Pelenur and Cruickshank 2012; Tuominen et al. 2012; Risholt and Berker 2013; Achtnicht and Madlener 2014; Brown et al. 2014), and legislation (Davies and Osmani 2011; Stieß and Dunkelberg 2012; Tuominen et al. 2012; Achtnicht and Madlener 2014). Based on the assumption that once these barriers are removed, consumers will make rational economic decisions (Shove 1998), a mutually reinforcing combination of regulation, information provision, and financial incentives have been introduced in an attempt to ‘correct’ these market failures (Smallbone 2004).

However, some researchers in the field of low carbon retrofit have begun to see this problem framing as problematic. Gram-Hanssen (2014a); Sunikka-Blank and Galvin (2016); and Reid and Ellsworth-Krebs (2017) question the assumption of rationality underlying this approach, and consequently the effectiveness of the strategies implemented. Furthermore, government intervention in the form of funding for technical research implicitly adopts a technology-led approach, with secondary measures taken to ensure the incorporation of these technologies into everyday practice, without questioning the trajectory that technological development is taking (Shove 1998). Finally, this also assumes a ‘top down’ view of knowledge development (Shove 1998).

The policies outlined in this Section describe a combination of strategies implemented to achieve ‘Market Transformation’ (MT), namely legislation, financial incentives and information provision (International Energy Agency 2003). In order to determine the strengths and weaknesses of this approach and where further alternative, or complementary approaches are required, this section will review these following strategies, and the assumptions underpinning them.

2.2.1 Legislation

The Climate Change and Energy Agreements of 2009 exceeded those in the Kyoto Protocol (2005) and included: a) 20% reduction in emissions by 2020 (from 1990 baseline); b) 20% renewable share in total energy consumption by 2020; and c) 20% improvement in energy efficiency by 2020 (The European Commission 2014). This led to the issue of the EU Renewable Energy Directive (2009/28/EC (The European Commission 2014)) and Energy Efficiency Directive (EED [2012/27/EU]). Both of these directives operate through the establishment of a target (in the case of the UK, 15% of national energy consumption to come from renewables, and an 18% reduction in final energy consumption from increased efficiency) and an obligation on member states to devise a plan or strategy to meet this target (The European Parliament and The European Council 2009, 2012). The UK Renewable Energy Strategy (HM Government 2009c) is predicated on providing financial support for households, industry, businesses, and communities who adopt renewable energy technologies through Feed-in Tariffs (FiTs) and a Renewable Heat Incentive (RHI). This is discussed further in Section 2.2.2. Meanwhile, article 4 of the EED specifically focuses on the role that building retrofit can play in achieving greater energy efficiency (The European Parliament and The European Council 2012). The Directive demands that a strategy is put in place which includes the identification of the state of the existing building stock and cost-effective retrofit measures and policies to stimulate these retrofits (The European Parliament and The European Council 2012). However, as with the Renewable Energy Strategy, member states can choose the policy approach they deem most appropriate in order to meet these targets.

Other EU directives require more direct translation into national legislation. For example, the Energy Performance in Buildings Directive (2010/31/EU) *“promotes the improvement of the energy performance of buildings within the Union”* (The European Parliament and The European Council 2010, p. 17). The Energy Performance of Buildings Regulations have been introduced in the UK in order to implement the requirements of the Directive including establishing minimum requirements for a methodology to calculate the integrated energy performance of buildings, the application of minimum standards for energy performance of both new buildings and existing buildings subject to major renovations, and the energy certification and inspection of buildings (The European Parliament and The European Council 2010). The UK Energy Act 2011 (HMSO 2011) contains the provision to use the EPC to establish a minimum standard for the energy efficiency of properties in the private rented

sector.

The UK has introduced even more demanding CO₂ reduction targets than those set out by the EU through national legislation. The Climate Change Act (HMSO 2008a) commits the UK to an 80% reduction in carbon dioxide emissions by 2050 and establishes an independent Committee on Climate Change (CCC) (ibid). The UK Low Carbon Transition Plan (HM Government 2009b) outlines how the first three carbon budgets required by the CCC, equivalent to emission reductions of 35% by 2020⁵, could be achieved. The plan aims to reduce emissions from homes by 28% by 2020⁶(ibid).

Despite this, in the owner-occupied housing sector, energy efficiency improvements to existing buildings are still subject only to the requirements of the Building Regulations. The 2006 revision of Part L of the Building Regulations introduced Approved Document L1B⁷, setting out the standards to be met when undertaking works to existing dwellings including extensions, conversions and renovations (ODPM 2005). However, the obligation to upgrade existing fabric was only introduced in 2010 under the concept of 'consequential improvements' (HM Government 2010a). In England, significant consequential improvements apply only to a small number of dwellings over 1000m² (HM Government 2010a)⁸. However, in the 2014 revision to Approved Document L1B, the devolved administration in Wales imposed consequential improvements for all extensions and heating of previously unheated spaces (Welsh Government 2014a). These consequential improvements require installation of a range of insulation measures depending on the size of the increase in habitable floor area created by the works (Welsh Government 2014a).

These provisions for devolved administrations aside; UK policy regarding energy and the environment is largely centralized. Much of the influence of local authorities on policy, lies in the regulatory services they provide such as granting planning permission and building control approval (Roberts 2010). Through the planning process, the Planning and Energy Act

⁵Based on 1990 levels.

⁶Based on 2008 levels.

⁷Under the 1984 Building Act provision was made for future changes to technical specifications using a system of Approved Documents allowing for regular revision the design standards without the need for primary legislation to amend the Act (Mallaburn and Eyre 2014). Part L of the Building Regulations address requirements regarding Conservation of Fuel and Power with L1 and L2 addressing domestic and non-domestic buildings respectively. More specifically, Part L1A addresses new domestic buildings while Part L1B addresses existing domestic properties.

⁸ Some minor consequential improvements must be applied locally. For example if more than half the plaster finish on wall is removed then this wall must insulated.

(HMSO 2008b) gives UK local planning authorities the power to set higher energy efficiency and renewable generation standards than those mandated nationally. While, in England, local authorities have recently had to defend their right to exercise these powers in the face of a Deregulation Bill (RIBA 2014), in Wales, local authorities are still actively encouraged to exercise these powers. Once again this implies that the Welsh Government is willing to take a more legislative approach to retrofitting the existing building stock, whilst retrofit in England is more reliant on individual owner-occupiers.

The 'no' vote to Scottish independence in the September 2014 referendum increased interest in devolving powers to city region level, resulting in the passing of The Cities and Local Government Devolution Bill 2015-16 (House of Commons Library 2015a). This legislation allowed changes such as giving new powers in specific policy areas to local authorities and the transfer of additional budgets alongside those powers (House of Commons Library 2015a). For example, the Greater Manchester Agreement set out proposed new powers for the Greater Manchester Combined Authority (GMCA) including an additional £300m Housing Investment Fund and powers to develop a greater degree of integration between health and social care provision (House of Commons Library 2015a).

This is not the only example of political upheaval in the period 2014-2018 influencing legislation and policies related to low carbon housing retrofit, as outlined in Figure 2.1. The period following the 2015 General Election, and subsequent Conservative Party majority, saw a significant shift in policy direction on energy and environmental issues (Macalister 2015). Critics commented on the succession of environmental policies that were 'scrapped' (RIBA 2015b; Vaughan 2015a, b), however, it was the abandonment of one of the few pieces of direct regulation, the Zero Carbon Home Standard, that provoked most widespread concern. Announced in 2007, the regulations were due to come into force in 2016. This prompted 246 businesses from across the construction and renewable energy industries, many who had already committed resources in anticipation of the target, to challenge this decision as undermining construction industry investment plans (RIBA 2015a) as well as damaging the industry's ability to deliver energy efficient homes (RIBA 2015a), and confidence in government (Farah 2015). The latter point is of particular concern in light of the increased national control over energy and environmental legislation that is likely to arise out of the UK leaving the EU following the EU referendum on 23rd June 2016.

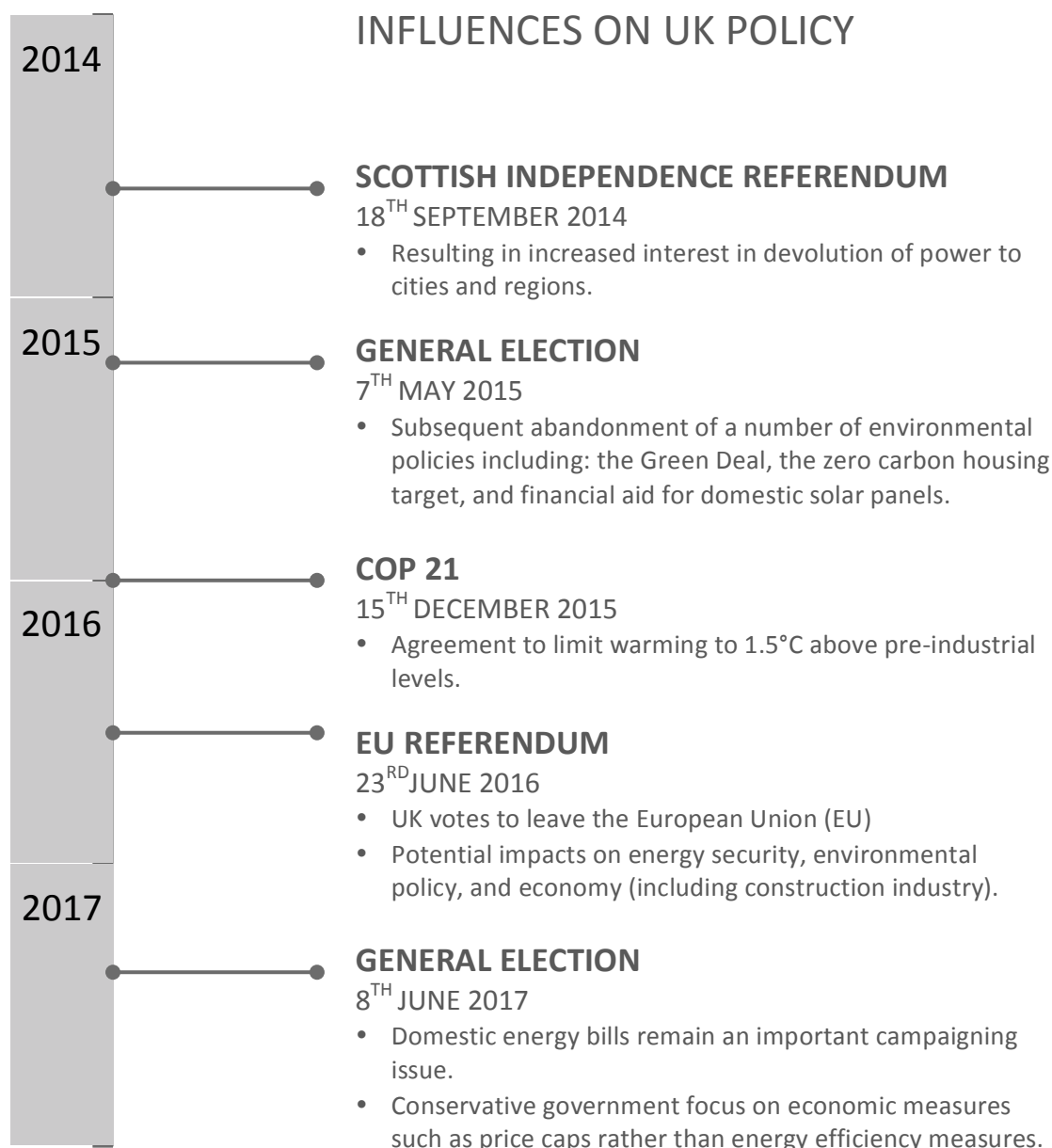


Figure 2.1: UK political timeline 2014-2018 and implications for low carbon retrofit

Lucas et al. (2008) argue that direct regulation has rarely been used to stimulate pro-environmental behaviour in the UK, due to the costs of implementation and enforcement. As case studies of homeowner refurbishment policy in Germany (Weiss et al. 2012; Galvin and Sunikka-Blank 2013), as well anecdotal studies on the implementation of changes to the Building Regulations indicate (Doran 2000; Grigg 2004), without these compliance checks, the effectiveness of regulatory tools is questionable. The introduction of a minimum retrofit standard in Germany is one example of an attempt to transfer of costs from the state onto private individuals. However, Galvin (2010) argues that using retrofit standards to encourage more ambitious retrofits makes measures unaffordable for many private homeowners

potentially leading to a reduction in the number of refurbishments. In addition to incurring costs associated with enforcement, direct legislation may be considered intrusive by voters (Lucas et al. 2008; Galvin and Sunikka-Blank 2013), thereby discouraging governments from adopting this approach. Despite seeking to replicate the principle of transferring the costs of low carbon retrofit from the state onto private households, the UK's Green Deal loan scheme, (discussed in greater detail in section 2.2.2) was initially to be complemented by increased 'consequential improvements' under Part L of the Building Regulations (Guertler et al. 2013). These consequential improvements required significant upgrades to energy efficiency in the course of other renovation works. However, these improvements were dubbed 'the conservatory tax' and were abandoned in the 2014 revision to the Building Regulations in England, in the face of public outcry (Guertler et al. 2013).

This section has shown how national and international legislation recognises the importance of retrofitting the building stock to achieve reductions in GHG emissions. However, while legislation is used to set national targets for GHG emissions reductions, legislation is seen as too intrusive and too expensive to enforce as a means to achieve these targets at national and local level. Furthermore, where legislation is not implemented consistently as part of a coherent strategy towards MT, it can undermine the confidence of the construction industry in government as well as industry investment in the necessary skills to meet the requirements of the legislation, as seen with the Zero Carbon Home standard. This places greater emphasis on homeowner led retrofit, and strategies such as financial incentives and information provisions that aim to encourage owner-occupiers to adopt retrofit measure voluntarily.

2.2.2 Financial incentives

The above EU and UK legislation has been complemented by a series of financial incentives to encourage low carbon retrofit. Christensen et al. (2014) observe that the impact of financial issues on owner-occupier retrofit is one of the areas that has received most attention in academic research. This is not surprising given that the high costs of energy efficient materials and micro-generation technologies are identified as a significant barrier by numerous studies (Davies and Osmani 2011). Financial incentives typically try to increase the demand for a product by influencing its economic attractiveness (Galvin and Sunikka-Blank 2013).

In the lead up to 2012, financial incentives were primarily delivered through obligations on energy suppliers and government-funded grant programmes (Dowson et al. 2012; Mallaburn and Eyre 2014). Grants and cash back schemes have proven effective at stimulating increased demand for housing retrofit measures (Hamilton et al. 2014), however, provision of grants is considered an expensive approach (Mallaburn and Eyre 2014). Consequently, Weiss et al. (2012) proposes that these schemes should be limited to financially disadvantaged homeowners, to minimize the ‘free-riding effect’⁹. The incentive schemes developed in the late 1990s and early 2000s such as the Decent Homes Programme (2000-2010) (Dowson et al. 2012); Warm Front Scheme (2000-2016) (Gilbertson et al. 2006; Dowson et al. 2012; DECC 2014g) and Community Energy Savings Programme (2009-2012) (Dowson et al. 2012) specifically targeted vulnerable and low-income households in addition to hard-to-treat homes¹⁰ across the social and private rented sector as well as owner-occupiers. The same can be said of the Arbed and Nest schemes, which have operated in Wales since 2009 (Welsh Government 2014b). The Carbon Emission Reduction Target (2008-2011), with only 40% of measures ring-fenced for vulnerable and low-income households, was the first scheme to address households outside this group (Dowson et al. 2012). In one of the first geographical analyses of the uptake of energy efficiency measures using the Home Energy Efficiency Database¹¹ (HEED), Hamilton et al. (2014) identified that the uptake rate of energy efficiency measures was higher in low-income areas, and so indicates that these schemes had been successful.

As Mallaburn and Eyre (2014) observe, this targeting of priority households raises the problematic issue of distribution, which is particularly salient where grants are funded through an obligation on energy suppliers. As Buchan (2010) identifies in his review of policy-making in the EU, with the power sector immune from international competition, energy suppliers pass their costs onto consumers, leading to cross-subsidization of those who receive grants from those who do not (Mallaburn and Eyre 2014). As outlined by the UK Government in its Renewable Energy Strategy (HM Government 2009c), the measures included in the UK Low Carbon Transition Plan (including both energy efficiency and

⁹The free-riding effect is when individuals are allocated subsidies in order to adopt measures they were already motivated and financially able to adopt without financial assistance (Weiss et al. 2012)

¹⁰“Hard-to-treat” homes are defined as dwellings, which possess solid walls, no loft space to insulate, no connection to the gas network, or are high-rise, (Dowson et al. 2012).

¹¹Compiled in compliance with the Energy Efficiency Directive and based on data from installers, industry accreditation bodies, energy suppliers, government- funded programs, local authorities and home surveys.

renewable energy measures) were predicted to add, on average, an additional 6% to consumer's household energy bills by 2020. In their analysis of the discourse surrounding the development of recent incentives, Guertler et al (2013) attribute the recent period of austerity to efforts to reduce the amount that can be levied on bill-payers by the energy companies to pay for these programmes. This in turn, has led to the development of schemes designed to shift the funding of low carbon retrofit measures from society and onto private individuals (ibid), thereby placing even greater emphasis on inducing individuals to invest their own funds into housing retrofit. In their literature based review of the condition of the housing stock, Ravetz (2008) identifies that by 2008 the average SAP rating of the social housing sector was 57¹², far exceeding the average SAP rating of private sector housing at 47. The 2012 UK Housing Energy Fact File¹³ confirms this as shown in Figure 2.2.

Financing schemes provide an alternative to grants that is a less-expensive method to overcome the barrier of capital costs and encourage investment of private funds through provision of loans. Launched in January 2013, the UK's Green Deal¹⁴ scheme (commonly referred to as 'the Green Deal') represents such a shift towards delivering energy efficiency measures for higher-income households through private sources of funding (Hamilton et al. 2014). Based on a 'pay-as-you-save' (PAYS) loan mechanism, homeowners applied for loans from registered Green Deal providers, who supply the capital investment for energy saving measures (Guertler et al. 2013). Repayments are collected by utility providers through energy bills and passed onto Green Deal providers (ibid). To be eligible for a Green Deal loan, the proposed measures must meet the 'golden rule', which stipulates that "bill savings in the first year must exceed the Green Deal repayment and that the repayment term must not exceed the expected lifetime of the measure" (DECC 2012b, p.20). Despite government emphasis on the policy's role in cutting fuel bills (DECC 2012c), demand for the scheme remained low, with just 12,479 properties receiving measures from the launch in January 2013 until the closure of the scheme in August 2015 (DECC 2016). The scheme has been criticised widely by academics (for example Hamilton et al. 2016) and the construction industry with many explanations proposed for an uptake described as 'disappointing' even by Energy Secretary Ed Davey (Pitt 2014). These include the removal of consequential improvements from the

¹² SAP (Standard Assessment Procedure) is the standardised calculation method used to assess the energy performance of housing in accordance with Part L1 of the Building Regulations. The calculation results in an energy performance rating for the property, based on a scale from 1-100, where 100 is the most energy efficient score possible.

¹³ The English Housing Survey (EHS) draws on a sample of over 16,000 homes.

¹⁴ The Green Deal scheme operates in England, Wales and Scotland but does not extend to Northern Ireland.

2014 update to the English Building Regulations (Guertler et al. 2013); the complex application process and 7% interest rate (Carrington 2014; Gooding and Gul 2016); the lack of clarity and transparency around the calculation procedure and loan mechanism (Simpson et al. 2015); the ‘Golden Rule’ often leading to higher cost measures being disqualified (Gooding and Gul 2016), and concerns about the impact of a Green Deal loan on the resaleability of a property (Dowson et al. 2012)¹⁵.

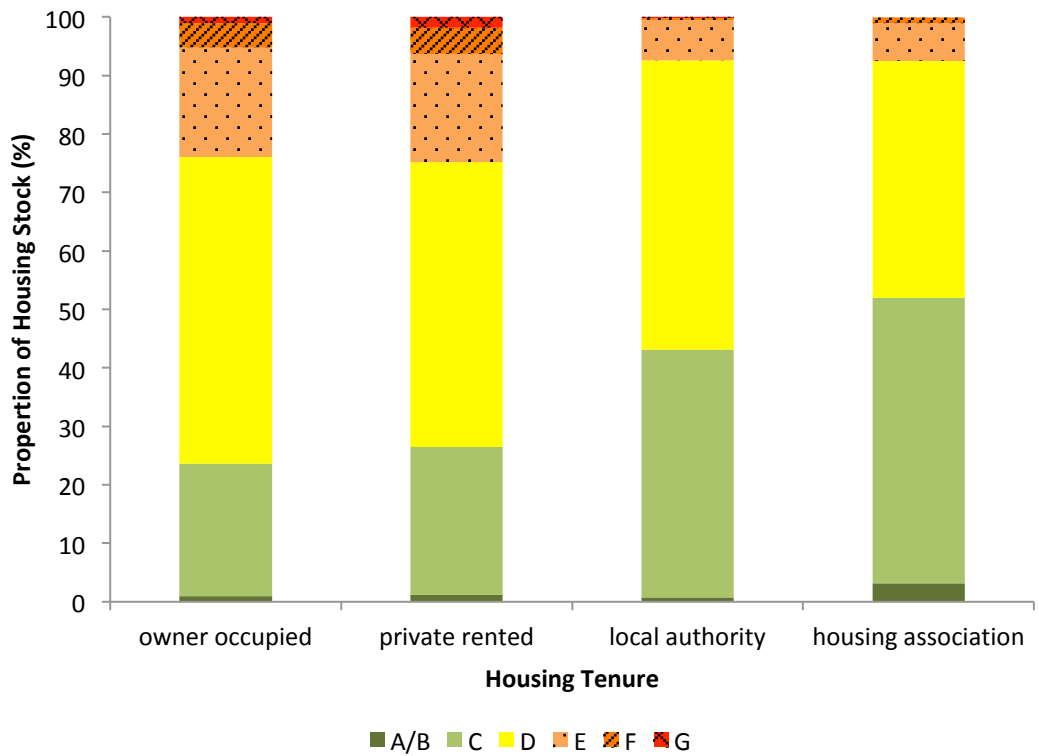


Figure 2.2: Energy Performance by tenure (A=Most Efficient; G=Least Efficient) based on data from the UK Housing Energy Fact file (DECC 2013)

The UK Government responded to low demand for Green Deal loans by making over £100million available through cash back and Green Deal Home Improvement Fund (GDHIF) grants (Mallaburn and Eyre 2014), which had to be closed with immediate effect in July 2014 following a rush of applications (Carrington 2014). A further £24 million of funds for Solid Wall Insulation (SWI) released under the scheme in December 2014 were exhausted after just one day (Shankleman 2014). The stop-start nature of these funds, alongside the delayed start and low-uptake of Green Deal have been blamed by the industry for destabilizing the insulation market (Vaughan 2012). Furthermore, in summer 2015, both the Green Deal and

¹⁵The loan is attached to the property, rather than the individual (Guertler et al. 2013).

the Green Deal Home Improvement Fund (Centre for Refurbishment Excellence 2015; Vaughan 2015d) were closed to new applications immediately, with no proposals made for a replacement (Vaughan 2015d; Woodman 2015). By the next General Election in 2017, a replacement scheme had still not been announced, leading to concerns that many installers would have gone out of business and much expertise would have been lost in the intervening years (Vaughan 2018).

Green Deal was complemented by the Energy Company Obligation (ECO)(DECC 2012b; Dowson et al. 2012) which is based on the more traditional funding approach of an obligation on energy suppliers providing subsidies to vulnerable households and hard-to-treat homes (Dowson et al. 2012; Hamilton et al. 2014). Measures that do not fulfil the Golden Rule (as discussed above) can be funded by ECO exclusively or bundled together with Green Deal funded measures as outlined by Rosenow et al. (2013). As with previous schemes funded by obligations on energy suppliers, the suppliers are expected to pass their costs onto bill-payers (Shrubsole et al. 2014). Therefore critics argue that as ECO focuses on high-cost measures and is paid for by all households, the scheme could potentially make fuel poverty in some households worse (Rosenow et al. 2013).

In addition, Feed-In-Tariffs (FiTs) and the Domestic Renewable Heat Incentive (DRHI) have been introduced to provide a financial incentive for homeowners to invest their own capital in micro-generation technologies. Both schemes operate on the principle of providing adopters of eligible micro-generation technologies with guaranteed payments (Shrubsole et al. 2014). FiTs were introduced to the UK in April 2010, with producers eligible for a payment for every kWh¹⁶ generated and an additional payment for every kWh exported to the national grid (Ofgem 2014). Due partly to increase in the price of electricity, uptake of the scheme was far higher than the government expected and the tariff had to be reduced to avoid breaching the spending envelope for the FiTs scheme (DECC 2011a), resulting in a significant reduction in new adopters (Balcombe et al. 2014). The cuts to environmental policy following the 2015 General Election also included a proposed 87% reduction in financial aid for domestic solar panels and closure to new projects altogether if capped funding runs out (Macalister 2015; RIBA 2015c). These cuts to renewables subsidies were blamed for the failure of two solar PV and energy firms, with forecasts that a further 20,000 jobs in solar sector were at risk (Macalister 2015; Woodman 2015).

¹⁶A kWh is a measure of energy equivalent to a power consumption of one thousand watts for one hour.

The domestic renewable heat incentive, introduced in April 2014, has suffered from many of the same criticisms from the media and experts in the industry as the Green Deal, including the negative impact on the industry of long delays in bringing the scheme into operation (Laughton 2014) and an initial low uptake blamed on a lack of publicity (Moulds 2014; Richards 2014). Other experts have more fundamental criticisms of the scheme. For example, practitioners argue that those households who would benefit most from the eligible technologies, such as those living off the gas grid, are unlikely to be able to afford the upfront investment in renewable heat technologies (Moulds 2014; Pritchard 2014).

Gillich (2013) concludes from a comparative evaluation of a grant based scheme versus a financing scheme, in Maine (USA), that the grant-based scheme was considered to be more successful, in terms of energy savings and cost effectiveness (Gillich 2013). However, much of the non-recuperated expenditures on the loan-based programme (PACE) were due to marketing and may diminish over time as the program becomes established (Gillich 2013). The potential of the slow, gradual impact of the loan-based programme to change the market was considered greater. Although, the grant-based program (HESP) had created almost 100 jobs, many contracting firms were unsure they would maintain the high demand for energy efficiency retrofit services (Gillich 2013). This rapid but tenuous job creation is symptomatic of the way in which grant programs create a temporary stimulus without lasting market changes (Gillich 2013). In State weatherization programs in the USA, organisations responsible for programme delivery have attributed poor standards of workmanship to these sudden expansions and contractions in the market, resulting in insufficient time to train contractors appropriately (Department of Energy 2010). However, whilst this explanation appears plausible, it should be noted that this has not so far been supported by independent research.

Gillich (2013) also asserts that there is a lack of consensus on how to define successful financial incentives. Using the most recent data available regarding the specification the Irish housing stock, Clinch and Healy (2000, 2003) undertook a simulation-based analysis of the cost-benefit ratio of improving energy efficiency. This simulation looked beyond energy saved to the economic benefits of improved health and comfort at national scale (Clinch and Healy 2000, 2003). The study concluded that taking these other factors into account, the cost-benefit ratio could be as high as 1:3 (Clinch and Healy 2003). In a detailed critical analysis of the assumptions used to calculate financial savings from housing retrofit in Germany, Galvin

(2014b) argues that looking beyond financial incentives is essential, as retrofitting to the national EnEV standard may not always be ‘economically viable’. Galvin (2014b) contends that due to a mixture of factors including assumptions about current fuel consumption, fuel prices, hidden costs and the shape and structure of the building, energy savings are often only 50–60% of those predicted by the EnEV methodology. However, in an earlier interview-based study with homeowners from across Germany, Galvin (2011) found that many of those who had retrofitted claimed not to have expected to break-even on their fuel savings. These findings indicate that:

“...people who can afford it, can be challenged to thermally retrofit their homes, just as they retrofit their bathrooms or kitchens – not because it pays back, but for other reasons: environmental concern; prestige; giving an old home a new lease of life; increased thermal comfort; and a degree of protection from swings in the price of heating fuel”

(Galvin 2014b, p.406)

These findings support research in the discipline of behavioural economics revealing that people do not act as rational economic players (Jolls et al. 1998). Empirical studies of owner-occupier motivations to retrofit (for example, see Christensen et al. 2014; Fawcett and Killip 2014), also indicate these motivations are often not the product of rational-economic decisions.

As outlined in this section, many different models of financial incentives to encourage low carbon retrofit have been trialled in the UK. While financial incentives are clearly successful in some cases, such as FiTs and GDHIF, the low uptake of other incentives such as the Green Deal and RHI suggest that merely removing market barriers is insufficient to encourage higher rates of retrofit. Furthermore, those financial incentives that are successful are not financially sustainable in the long-term, and as such can even have a negative impact on the stability of the industry providing these retrofit measures. This would suggest that there is currently a gap in terms of understanding the influences acting on owner-occupier low carbon retrofit, and in particular how financial concerns interact with other influences.

2.2.3 Information Provision

Another barrier to which 'market failures' are often attributed is a lack of sufficient information to make rational choices (Shove 1998). Education interventions based on this assertion adhere to the knowledge-deficit model of providing information. There are three primary assumptions underpinning this model. Firstly, that inaction on the part of the individual is caused by a lack of knowledge (Shove 1998; Barr 2003). Secondly, that this lack of knowledge can be remedied by a one-way flow of information from experts to the individual (Eden 1998), and finally that once in possession of all the relevant information the individual will make a rational decision (Shove 1998; Berry et al. 2014). This implies individual's decisions will be predictable, and in the absence of barriers, individuals provided with the same information will respond to it in the same way. Therefore, these interventions aim to provide actors with the necessary information to overcome the barrier of ignorance and consequently encourage action (Schultz 2002; Murphy 2014).

However, in his critique of traditional economic theory, Simon (1955) argues that 'perfect' market information is often impossible, as not all of the relevant information may be available to the decision maker. Simon describes how this lack of information may include uncertainty about the future consequences of actions, or regarding possible human behaviours, that are innate limitations of human beings and their physical and computational capacities (Cristofaro 2017). However, even where further market information would be available upon further investigation, Simon (1955) proposed that seeking out and processing information will 'cost' the individual time and effort. This leads individuals to often accept a satisfactory solution on the basis of incomplete information, rather than expend the effort to find sufficient information to determine the optimum solution (Simon 1955). It is clear that information plays an important role in Rational Choice Theory. Perhaps even more relevant to this thesis is Simon's proposal that individuals are often unwilling to expend further effort looking for an optimum solution once they have identified a solution that is satisfactory. In the context of housing retrofit, this could mean that information regarding energy efficient measures which addresses owner-occupier's motivations, must be disseminated so that it is received prior to the owner-occupiers settling on a less energy efficient solution and ceasing to look for alternatives.

Tversky and Kahneman (1973, 1974) went on to develop Bounded Rationality looking more specifically at how individuals deal with making decisions where the outcomes are uncertain.

In contrast to previous assertions, that a rational decision would be made based on an assessment of the odds of possible outcomes, Prospect Theory (Tversky and Kahneman 1973, 1974) proposed that assessments of alternative outcomes were based on mental shortcuts, called heuristics that enable fast decisions to be made in uncertain situations. In particular, Tversky and Kahneman (1973) identify an 'availability' heuristic, referring to the ease with which relevant events or outcomes are brought to mind. Tversky and Kahneman (1973) use the example of assessing the divorce rate in a community by recalling the number of divorces amongst one's acquaintances. De Bondt and Thaler (1985) went on to show how this availability bias could result the value of stock being underestimated through excessive weight being ascribed to the most recent financial news. This later work on heuristics implies that the 'availability' of news articles or examples of retrofit in which the individual perceives the outcomes positively, are likely to influence individuals' perception of retrofit being positive for them.

Many empirical and literature-based studies have identified the need for unbiased advice and information (see for example Roy et al. 2008b; Davies and Osmani 2011; Mallaburn and Eyre 2014). Based on the assumption that removing barriers will encourage adoption of these measures, information provision is arguably the most widely used intervention employed to encourage pro-environmental behaviours (Abrahamse and de Groot 2014). This approach is frequently advocated in order to highlight the cost-effectiveness of measures (Clinch and Healy 2003); encourage environmental concern (Brown et al. 2014); increase knowledge and understanding of individual technologies (Banfill et al. 2012) and improve awareness of available financial incentives (Watts et al. 2011).

However, despite much research advocating the use of information provision, studies such as those by Abrahamse et al. (2005) and Barr (2008) observe that information campaigns frequently do not result in behaviour change. Desmedt et al. (2009) conclude that mass-information campaigns do not always achieve their intended effect for two reasons: First, the information may not be technically relevant or compatible with the building, and second, because even motivated individuals are less likely to apply generalised recommendations to reduce their consumption. The Energy Performance Certificates (EPCs) introduced under the Energy Performance of Buildings Directive and associated Regulations, attempted to address these issues by providing a report on the energy performance of a building based on its

dimensions, construction and the installed building services¹⁷. In addition, the EPC provides information on recommended energy improvements and the energy rating and cost savings that could be achieved if these were undertaken. The 2008 White Paper on Existing Housing and Climate Change (Communities and Local Government Committee 2008) outlines that through increased awareness of retrofit measures, the government expected the provision of EPCs to overcome the market failure that saw householders pay higher-than-necessary fuel bills, in place of adopting measures with simple payback periods as short as three or four years. The EPC was also meant to provide a connection between the refurbishment market and property transactions market (Killip 2013b). This has been successful in some countries (Brounen and Kok (2011). However, in a geographically limited survey of 337 UK owner-occupiers in 2009, Watts et al. (2011) found that whilst awareness of EPCs was high (84%), none of the respondents identified energy efficiency as a priority in their selection of a house and 95% said it had little or no impact on the sale price. This research also concluded that the EPC had limited impact on the selection of retrofitting measures (Watts et al. 2011). Desmedt et al (2009) predicted that with the implementation of Energy Performance Certificates (EPCs) for buildings, energy audits providing information tailored to the situation of the households would become more common. This would “...reduce the uncertainty of expected cost savings and reinforce positive attitudes towards energy saving outcomes...” (Wilson et al. 2015, p. 15). However, in a survey of 5,516 households in the Netherlands, Murphy (2014) found that between 60% and 70% of recommendations provided by energy audits were ignored. These findings are also supported by Palmer et al. (2012) in a survey of almost 500 home energy auditors in the U.S.

Schultz (2002) argues that many of these information campaigns are ineffective because they do not address people’s motivations to act. This challenge is supported by Christensen et al. (2014), Murphy (2014) and Palmer et al. (2012) findings that removing the knowledge-deficit barrier did not result in the adoption of energy efficiency measures among many respondents. Although a lack of knowledge may act as a barrier to behaviour change, increased knowledge is not in itself a motive to act (Schultz 2002). Further criticisms of this linear model of information dissemination have come from the field of environmental geography. Blake (1999) identifies that whilst such linear models may be suitable for raising

¹⁷These ratings are calculated using a reduced data version of the UK Government’s Standard Assessment Procedure (SAP) for the energy performance of dwellings. For the purpose of producing EPCs, SAP rating are translated into the bands A–G, with A being the most energy efficient/environmentally friendly and G the least energy efficient/environmentally friendly (Watts et al. 2011)

awareness of environmental issues, addressing the knowledge-deficit is not sufficient to encourage pro-environmental behaviour. Meanwhile, Eden (1998, p. 426) criticises this linear model, as it assumes a “one-way flow of information - from science to policy and society”. In some situations, lay people will feel that they have expertise to contribute, however, the assumption that scientific knowledge is superior to public knowledge, excludes ‘lay people’ from participating in debates regarding environmental issues (Eden 1996). Consequently, “*identifying 'the expert'* is contextual upon the individual situation and form of knowledge under consideration” (Blake 1999, p. 271). For example, in the context of retrofit this may require the integration of the technical expertise of energy auditors or trusted construction professionals with the detailed knowledge owner-occupiers hold of the activities the property hosts.

Researchers argue that there is not only a role for the public in the production of knowledge, but also in the active consumption of knowledge (Irwin et al. 1996; Michael 1996; Shove 1998). Myers and Macnaghten (1998) assert that what they have termed the ‘rhetorical situation’ has a significant effect on how people interpret environmental information. This includes how people link this information to their everyday lives as well as how they relate to the organisations supplying the information (Macnaghten and Jacobs 1997). This means that different people will often interpret the same information in very different ways (Blake 1999). Therefore, as Eden (1998) observes policy must address how information will be interpreted by different social groups in diverse social contexts. These findings support the need for a greater understanding of where different groups of owner-occupiers access information, as well as how different individuals respond to the same information in very different ways.

The limited success of many information provision strategies suggests that simply removing the knowledge-deficit barrier is insufficient to encourage higher rates of retrofit. Researchers such as Schultz (2002) advocate a greater focus on the motivations of individuals. Again, this suggests the importance of addressing the gap in current understanding of how teleological influences act on owner-occupier, low carbon retrofit.

2.3 Conclusion

As one of the pioneer countries of residential energy policy, studying owner-occupier low carbon retrofit in the UK offers an opportunity to build on an existing body of knowledge

developed through previous attempts to understand this field. The housing stock in the UK shares many characteristics with countries in North America and Western Europe that are the biggest contributors to emissions from buildings. A greater understanding of owner-occupier retrofit in this context would be relevant to reducing GHG emissions from owner-occupier housing in many of these countries. Furthermore, the UK has particular characteristics regarding the age of the housing stock that offer the opportunity to gain a greater understanding of the issues this raises and how owner-occupier retrofit might proceed as a result of these.

This review of EU and UK Environmental and Energy policy has identified a series of binding targets to reduce carbon dioxide emissions, and increase renewable energy and energy efficiency. Targets are enforced by legislation at EU level, however, in most cases member states are free to choose the policy approach they deem appropriate in order to achieve these measures. Evaluation of MT strategies employed in the UK has identified a reticence to use legislation to directly enforce reductions in GHG emissions from existing housing, as this may prove both unpopular and expensive to enforce. Therefore, existing attempts to achieve reductions in GHG emissions from existing buildings is largely reliant on encouraging owner-occupier led retrofit using financial incentives and information provision.

Many previous grant and subsidy schemes designed to encourage housing retrofit have focussed on vulnerable or low-income households, and the rate of retrofit has so far been higher amongst social housing tenants and lower-income households, reflecting the success of these early grant-based schemes. Looking to shift the financing of retrofit from the state onto individuals, the UK government is now turning its attention to retrofit in more affluent households, which research indicates could be a source of higher carbon emissions savings. However, so far the financial incentives offered such as the Green Deal, have had limited success.

This calls into question the dominant assumption underpinning the UK government's MT strategy, that owner-occupier decisions to retrofit are rational, subject to the removal of barriers, and that interventions to remove these barriers will be sufficient to encourage owner-occupier to retrofit on a large scale. This raises more fundamental questions about the influences acting on low carbon retrofit and how agency in these home improvements is understood. In the next chapter (Chapter 3) alternative theoretical and empirical understandings of owner-occupier low carbon retrofit are examined.

Chapter 3 | Theoretical Perspectives on Owner-occupier Domestic Retrofit

3.0 Introduction

As previously discussed in Chapter 2, domestic retrofit policy in England has so far focussed on removing barriers to the adoption of retrofit measures. This is underpinned by the implicit assumption that combined with limited financial incentives and provision of information, this approach will be effective in encouraging owner-occupier housing retrofit. However, the lack of success achieved by this approach in encouraging more affluent owner-occupiers to adopt low carbon retrofit measures has called into question these assumptions of rationality (Pettifor et al. 2015; Sunikka-Blank and Galvin 2016), the linear transfer of knowledge from experts to lay people (Eden 1998; Watts et al. 2011) on which it is based, and consequently our fundamental understanding of owner-occupier low carbon retrofit. This thesis will build on these findings by further exploring how a greater understanding of owner-occupier low carbon retrofit could impact on the kinds of knowledge that might facilitate retrofit and how it can be disseminated.

This chapter is comprised of three sections that conclude with the development of a theoretical and methodological framework for investigating owner-occupier low carbon domestic retrofit. Sections 3.1 and 3.2 will review two of the main theoretical canons used to understand low carbon retrofit, namely: Attitude, Behaviour, Choice (ABC) models from the discipline of Psychology and Practice Theory from the social sciences. Each of these sections will review the theoretical assumptions of each of these theoretical perspectives, as well as the implication of these assumptions for the role of knowledge within low carbon retrofit, and the empirical insights into low carbon retrofit that these perspectives have offered to date. Section 3.3 will discuss the current gaps in our understanding of owner-occupier retrofit and the relative strengths and weakness of these two theoretical perspectives before proposing a theoretical framework that aims to address these gaps.

3.1 Attitude-Behaviour-Choice (ABC) theories of motivation

3.1.1 Introduction to ABC Theories of motivation

Current policies designed to encourage retrofit, such as the financial incentives and information campaigns identified in Chapter 2, implicitly assume a humanist ontology. This ontology considers the individual as the unit of analysis and focuses on individual actors' motivations and consequent behaviours (Shove 2010; Strengers 2014). Theories which adopt this ontology are commonly referred to as 'ABC approaches' (Shove 2010). According to these theories:

"...social change is thought to depend upon values and attitudes (the A), which are believed to drive the kinds of behaviour (the B) that individuals choose (the C) to adopt."

(Shove 2010, p. 1274).

In recent years, researchers have taken a renewed interest in the implications of these theories on motivation to increase the adoption of energy conservation and energy efficiency behaviours. Extensive reviews of these motivational and decision-making theories include Jackson (2005), Faiers et al. (2007) and Organ et al. (2013a). Rather than identifying specific needs or motivations, these reviews seek to identify factors that stimulate the development of a motivation. In the context of this research, an understanding of the antecedents to motivation is necessary in order to understand how the measures adopted stimulate these motivations. The following six antecedents to motivation are most commonly identified by ABC theories of motivation (as outlined in Figure 3.1): values, identity, norms, self-efficacy, external factors, and expected outcomes.

i) Values

The term value is often used to describe both the monetary worth of an object and things which are of significance of us, independent of their monetary evaluation (Miller 2008). Values can influence an individual's perception of the desirability of an end result (Abrahamse and de Groot 2014) and have their greatest impact in motivation theories based on the expectations of behavioural outcomes or consequences such as Simple Expectancy Value Attitude Theory and Means-End Chain Theory. These Adjusted Expectancy Value (AEV) Theories seek to incorporate the basic expected-value premise of Rational Choice Theory, which asserts that individuals act in order to increase their personal gains, whilst adopting an

understanding of the concept of value that moves beyond market worth (Jackson 2005). Meanwhile, Norm Activation Theory, proposed that altruistic values lead to the development of a personal or moral norm to act in a pro-social or pro-environmental manner (Schwartz 1977).

Theories of Motivation	Antecedents to Motivation					
	Values	Identity	Social Norms	Self-efficacy	External Factors	Expected outcomes
X = indicates theories of motivation that identify the relevant antecedent to motivation.						
Adjusted Expected-Value Theories						
Simple Expectancy Value Attitude Theory	X					X
Means-end Chain Theory	X					X
Theory of Reasoned Action	X		X			X
Theory of Planned Behaviour	X		X	X		X
Theory of Bounded Rationality					X	X
Norm Activation Theory	X			X		X
Self-Discrepancy Theory		X				
Cognitive Dissonance Theory		X				
Focus Theory of Normative behaviour			X		X	

Figure 3.1: Psychological antecedents of selected theories of motivation (Source: Researcher).

The multiple roles that *value* plays in motivation proposed by these theories, challenge some of the assumptions made by current policies and incentive schemes regarding how values influence the adoption of retrofit measures, indicating that there may be benefits in engaging in a wider range of ABC theories. Individuals acting out of self-interest may not be making rational economic decisions, but may be responding to a much broader definition of value including comfort or social status. However, as environmental geographers such as Blake (1999) observe, research shows that values are not always a good indicator of action. Even individuals with pro-environmental values do not always act in accordance with these values due to a large number of barriers, including social and institutional constraints. This phenomenon is commonly referred to as the ‘value - action gap’ (Blake 1999).

ii) Identity

The second psychological concept identified by Abrahamse and de Groot (2014) is identity. This component, which represents the individual's ideal or aspirational 'self', plays an important role in theories of motivation including Self-Discrepancy Theory (Higgins 1987) and Festinger's Cognitive Dissonance Theory (Organ et al. 2013a). Both theories propose that individuals are motivated to reduce the inconsistencies between their actual and ideal selves (Jackson 2005). When applied to pro-environmental behaviour, this theory implies that individuals who perceive their ideal self to be pro-environmental, are more likely to undertake retrofit (Organ et al. 2013a). Whether pro-environmental behaviour is seen as a positive attribute of the 'ideal self', it will depend on the social group the individual identifies with and the values that group holds. This antecedent is likely to have greater influence on highly visible measures such as solar panels, which offer greater opportunity for expression.

iii) Social Norms

The final influence on individual's behaviours identified by Abrahamse and de Groot (2014) are norms. These norms include descriptive social norms regarding beliefs about what would normally be done in a given situation and also injunctive social norms regarding beliefs about what others would approve or disapprove of (Abrahamse and de Groot 2014). Social norms play a prominent role in Cialdini et al's. (1991) Focus Theory of Normative Behaviour, which asserts that by following descriptive social norms, actors can avoid the effort of thinking through a decision for themselves. Organ et al. (2013a) observes that social norms are a product of factors both external and internal to the individual, influenced not only by cultural context, but also by the individual's perception of social norms and pressure to conform. As a result social norms can also be more influential, either positively or negatively, on highly visible activities (Barr 2003), such as the installation of solar panels or external wall insulation and are less likely to have an influence on hidden measures such as cavity wall insulation.

iv) Self-efficacy

A further theme that emerges from the psychology literature on theories of motivation is the concept of self-efficacy. This concept describes an individual's perception of their competence to perform the desirable behaviour (Organ et al. 2013a) and belief that this behaviour will have the desired effect (Barr 2003). Ajzen and Madden (1986) proposed the Theory of Planned Behaviour, which extends the Theory of Reasoned Action (Fishbein and Ajzen 1975) to incorporate the concept of self-efficacy as a determinant of the intention to act. As demonstrated theoretically by Eden (1993) and supported by the empirical findings of

Hinchliffe (1996), higher levels of self-efficacy lead to higher levels of action from citizens. Self-efficacy is an antecedent of motivation that existing policy interventions have sought to address through the provision of information such as the Energy Performance Certificates (EPC) that provide owner-occupiers with information on measures they could take to improve the energy efficiency of their property.

v) External factors

Many psychological theories on motivation also acknowledge the influence of external factors, otherwise referred to as situational factors. These include an individual's access to relevant services, resources and information, as those who have access to such services are more likely to adopt pro-environmental behaviours (Barr 2003). In one of the most famous critiques of Rational Choice Theory, Simon (1955) argues in his Theory of Bounded Rationality, that due not only to the cognitive limitations of the human mind, but also due to situational factors such as the costs incurred in obtaining information, humans were incapable of making completely rational choices. Furthermore, more recent developments in Bounded Rationality by Tversky and Kahneman (1973) and Kahneman (2011) suggest that external factors such as failure of the current building services or fabric, may force a shift from heuristic processes, to deliberative decision-making, making individuals less reliant on existing heuristics and biases (see pg. 43 for more detailed discussion). Extensive studies of the external barriers to retrofit have been undertaken elsewhere (see Dowson et al. 2012; Stieß and Dunkelberg 2012; and Brown et al. 2014), however, psychological models seldom look at decisions in the context of motivation to take multiple but competing actions.

vi) Expected outcomes

Finally, Organ et al. (2013a) have also identified the importance of individual beliefs regarding expected outcomes, which as shown in Figure 3.1, play a role in many of these theories. The role of expected outcomes is fairly explicit in Expectancy-Value Theories, the Theory of Bounded Rationality and Norm Activation Theory, as shown in Figure 3.2. In these theories beliefs about the outcome of an action are the point of departure of all behaviours. These beliefs regarding *expected outcomes* are then mediated by additional factors such as *values*, *norms* or *self-efficacy*, depending on the theory in question. The influence of *expected outcomes* is less explicit in the remaining theories of motivation summarised in Figure 3.1, however, many of them are underpinned by the assumption that individuals will be motivated by a desire to avoid the discomfort of cognitive dissonance or feeling that the

individual's actions are incompatible with those considered acceptable by their immediate and wider social group.

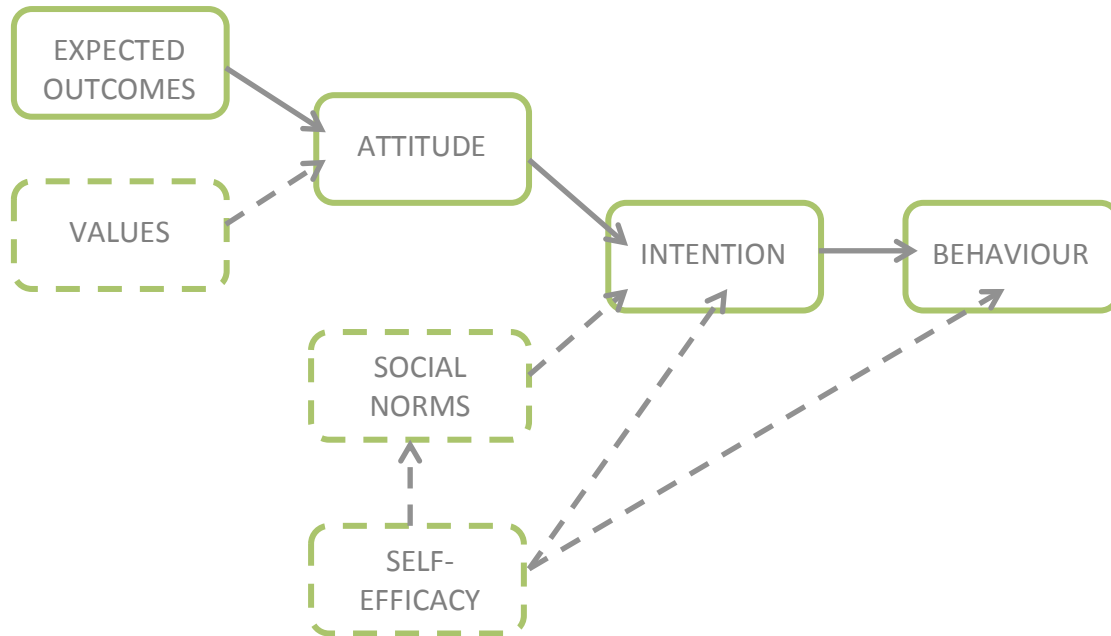


Figure 3.2: Adjusted Expectancy Value models of behaviour (adapted from Jackson (2005))

Critiques of the ABC approaches discussed above conclude that these theories place too much emphasis on conspicuous consumption rather than the routine consumption that shapes many everyday activities (Shove 2010). Shove (2009) argues that the points at which individual attitudes truly matter are limited, with the majority of our daily activities governed by social obligations or conventions - therefore focusing on these points is not effective. Applying these ideas to domestic energy consumption, Strengers (2014) argues that the only point at which the energy efficiency of housing can be addressed by ABC approaches is during the process of house purchases and renovations. However, they argue that even at this point, appeals to peoples' environmental, financial or technical motivations will have to compete against practices such as maintaining higher standards of cleanliness (Strengers 2014).

Kahneman (2011), based on his earlier collaboration on Prospect Theory (Tversky and Kahneman 1973, 1974), proposes a two-system functioning of the mind which goes some way to addressing such criticisms. In this dual system model, the deliberative decisions associated with ABC theories are dealt with by one system of processing information (System

2), which sits alongside more heuristic judgments associated with prospect theory (System 1). The switch from System 1 to System 2, may be stimulated by external forces (as discussed on p.42). This dual system approach has enjoyed significant popularity in the field of judgment and decision-making (as acknowledged by Kruglanski and Gigerenzer 2011), and is supported by a plethora of findings demonstrating simultaneous contradictory beliefs associated with this 2-system model (Kruglanski and Orehek 2007; Evans 2008). However, psychologists such as Gigerenzer and Regier (1996) argue that these contradictory beliefs support alternative explanations including linguistic ambiguity, competing lines of formal reasoning, or unclarified assumptions. Kruglanski et al. (2006) argues that in place of 2 systems, these contradictory beliefs are instead due to the nature of processing changing, depending on the goals of the individual at the time of using the information. Meanwhile, Keren and Schul (2009) develop this idea further, proposing that “...there need not be a fixed partition of parts to fixed subsystems. Rather, parts could interact in different combinations, depending on the goals” (p. 546). However, perhaps the greatest criticism of dual system models is Gigerenzer’s (2009) assertion that such dichotomies allow for a post-hoc categorization of actions, but due to a lack of focus on processes, these dichotomies have no predictive capability.

In these ABC theories, the concept of attitude is used to individuate beliefs or goal-directed actions according to the agent, and understand the mental state of the individual in terms of the input and output conditions on dispositions to act (Okrent 2000). Fundamental to these models is the assumption that the mental state of the agent is to desire a certain outcome and then to act in the belief that performing a certain behaviour will achieve that outcome (Okrent 2000). Therefore, if the beliefs or desirability of an expected outcome can be influenced, it follows that this will influence the behaviour of the individual. The following section will examine the opportunities to influence behaviour that the assumptions underlying these ABC theories present.

3.1.2: The role of knowledge in ABC theories

The review of ABC theories of behaviour in Section 3.1.1 has shown how expected outcomes are the common point of departure for many ABC models of behaviour. This assumption implies that to influence behaviour, the expected outcomes of an action, and perhaps even more fundamentally, people beliefs regarding these outcomes, must be changed. This supports interventions such as financial incentives, which may align the expected outcomes

of adopting retrofit measures with the outcomes evaluated positively by owner-occupiers. However, measures must also be taken to ensure that individual's beliefs regarding these outcomes are also updated, in accordance with the knowledge deficit model of information provision, on which many existing strategies have been based (see Chapter 2, Section 2.2.3). The difficulty of this task is two-fold. Firstly, as the review of ABC theories in Section 3.1.1 shows, there are many influences on behaviour (for example, values, norms and self-efficacy) that mediate the underlying assumption of rational economic choice. Therefore, identifying and communicating expected outcomes that will align with these influences is challenging. Secondly, this multitude of influences acting on individual behaviours also enable a high degree of variation between individuals, making it essential to target the appropriate individuals with the appropriate messages.

Whilst the knowledge-deficit model pays limited attention to the need to personalise information, it is logical in light of the theoretical assertions made by Expectancy Value Theories that our interpretation of the information will be influenced by the values that we hold, which will vary from one individual to the next (Fishbein and Ajzen 1975). Parnell (2003), Murphy (2014) and Desmedt et al. (2009) argue that the specific needs or concerns at the forefront of the minds of particular groups can be used to 'sell' the benefits of retrofit measures. However, as discussed by theories based on Bounded Rationality (Simon 1955; Tversky and Kahneman 1973), humans have the ability to process finite amounts of information (their cognitive capacity). While, the provision of information on wider outcomes of retrofitting may address the values of a wider range of individuals, providing too much information can result in confusion or helplessness and subsequent failure to act. Therefore, ABC theories of motivation imply that in order to change behaviours messages should not only address the values of individuals, but should be tailored to the values of these individuals.

Personalising messages to provide information that meets the needs of the individual, is an approach frequently used in health psychology to discourage unhealthy practices (Parnell 2003). This tailored approach has been applied to household energy conservation in a number of studies and has been shown to result in both increased knowledge of energy saving and significant energy savings through behavioural changes (Darby 1999; Abrahamse et al. 2007). However, in order to achieve this, the distribution of values amongst the population must be identified so that tailored messages can be targeted at appropriate individuals. In the case of larger low carbon retrofit programmes, market segmentation has

been used to address this variation in preferences and contexts (Hoicka et al. 2014; Gillich et al. 2017).

Segments are usually defined by socio-demographic variables such as age, gender, income and location (Haines and Mitchell 2014), although more sophisticated tools may group individuals according to psychological concepts (Hoicka et al. 2014). For example, Kahle and Kennedy (1989) develops a list of values (LOV) that research subjects are asked to rank by importance, allowing individuals to be grouped into market segments based on their top-ranked value (Kamakura and Mazzon 1991).

In contrast to this segmentation according to values and psychological concepts, in his Diffusion of Innovations theory, Rogers (1962) asserts that new ideas and practices spread between individuals through social networks. Furthermore, some individuals – known as *opinion leaders* or *change agents* - exert greater interpersonal influence than others within social networks (Rogers 1962). This supports the case for network analysis by asserting that those seeking to implement change should examine a) the connections that allow innovations to travel through populations; and b) how those individuals who exert greatest interpersonal influence over this network can be identified and targeted.

Despite hailing from rural and medical sociology, Rogers' Diffusion of Innovations (1962) shares many assumptions about the nature of information, and communication, with the psychological ABC theories that dominate this section of the thesis and the existing information provision strategies discussed in Chapter 2, Section 2.2.3. This includes the assumed one-way flow of information from science to policy and society critiqued by Eden (1998) and discussed more specifically in relation to Diffusion of Innovations by (Giesler 2012), who argues the need for a more participatory approach to information campaigns aimed at medical patients. Both ABC, and diffusion theories also focus on the individual as the unit of analysis, resulting in what Rogers himself referred to as an individual-blame bias (Rogers 1962; Greenhalgh et al. 2005). This individual blame bias is the tendency to ignore the role that systems play in the lives of individuals, choosing instead to hold the individual responsible for their problems (Caplan and Nelson 1973). Examples of this bias include studies which have sought to identify indicators of individual innovativeness such as formal education, income, and mass-media exposure, while seldom considering of the source of information or the innovation may be at fault (Rogers 1962).

This links to a second criticism of diffusion theories also acknowledged by Rogers and referred to as the pro-innovation bias (Rogers 1962; Greenhalgh et al. 2005). This bias assumes that innovations are always appropriate and *should* be adopted. However, following careful analysis, Rogers (1962) argues that some innovations were simply “not as appropriate for later adopters, perhaps because of their smaller sized operations and more limited resources” (p. 107). This reflects the assumptions underpinning many of the information provision strategies to encourage low carbon retrofit discussed in Chapter 2. Specifically, that the prospect of increased energy efficiency resulting in financial and environmental benefits should result in the adoption of retrofit technologies, without giving further consideration to how appropriate these technologies are to the specific needs or priorities of the individual.

More recent criticisms of diffusion theories have argued that even if an individual focus, pro-innovation bias are appropriate, humans and human networks are so complex that all relevant variables can never be accounted for, imbuing these theories limited predictive power (Damanpour 1996; Plsek and Greenhalgh 2001). Despite these limitations, research in communications studies has sought to investigate the impact of altering key variables such as the media, and nature of exposure, on the diffusion of information (Rogers 1962). This is mirrored in ABC-based studies by reviews of information provision strategies, including Fishbein and Ajzen (1975). Fishbein and Ajzen (1975) concluded that even where messages are successfully tailored to the target audience’s values, there are a number of the further factors that may mediate whether this information is able to change existing beliefs, or is discounted.

Firstly, Kaplan and Kaplan (1989); and Schahn and Holzer (1990) argue that messages need to contain concrete knowledge regarding specific behaviours to allow individuals to take action. This concrete knowledge is in contrast to the abstract knowledge included in much pro-environmental literature, which relates to environmental concerns in general (Myers and Macnaghten 1998). While this abstract knowledge may contribute to awareness of environmental issues, it does not mediate our ability to turn our intentions into actions (Schahn and Holzer 1990).

Secondly, the credibility of both the message and the messenger will have a significant impact on the effectiveness of the message (Syal et al. 2013; Horne et al. 2014; Klockner and Nayum 2016; Wu et al. 2016). This credibility can be conferred on information when individuals have direct experience that supports information contained within a message,

or when information is confirmed by people these individuals identify with, such as through social networks and community groups (Stern 1992; Bartiaux et al. 2011; Christensen et al. 2014; Mallaburn and Eyre 2014; Bartiaux et al. 2016). Social networks also have the advantage that information is often received indirectly. This can also increase the perceived trustworthiness of the source, as messages communicated directly are considered more likely to be in the self-interest of the source (Dennis 1990; Stieß and Dunkelberg 2012). Whilst messages from a 'highly credible source' result in a greater attitude change (Stern 1992; Darby 1999; Bator and Cialdini 2000), studies indicate that deciding which sources are credible can prove challenging (Klockner and Nayum 2016), as different groups in society may trust different sources (Macnaghten and Jacobs 1997; Mileti and Peek 2002). Research by Myers and Macnaghten (1998) found that individuals judged the credibility of sources by their actions rather than statements of trustworthiness made in the information itself, indicating that individuals need to be relatively familiar with the source of the message in order to make an assessment of its credibility.

Finally, studies by Stamm et al. (2000); Mileti and Peek (2002); and Valente and Schuster (2002) argue that the use of a wide range of media is important to the effectiveness of information provision strategies. These range from mass media advertising and telephone surveys through to written advice surgeries and home energy audits. Valente and Schuster (2002) propose that different media will influence different individuals. In the context of his Experiential Learning Model, Kolb (1974) observed that individuals with 'concrete learning skills' cited more people as relevant sources of information, and preferred to receive specific recommendations. Conversely, individuals with 'abstract learning skills' cited more written texts and preferred receiving data they could analyse themselves. In the Diffusion of Innovations Model as described by Rogers (1962), mass media has a greater impact on individuals who are amongst the first to adopt, also referred to as pioneers. However, as the innovation diffuses through society, later adopters are more influenced by interpersonal communication, although information campaigns may play a role in stimulating this interpersonal communication (Rogers 1962). Alternatively, Parnell (2003) argues that the use of mass media is appropriate only at the early stages of decision-making, with Valente and Schuster (2002) advocating that mass media be used to prime audiences before more interactive methods are used such as visits. The decision to renovate could be used as an opportunity to expose owner-occupiers to those specialist or more personalised sources of information.

Looking specifically at information provision strategies designed to encourage higher rates of low carbon retrofit, research by Fawcett and Killip (2014) supports the assertion that early adopters are likely to rely on information from mass media, with more than half of Superhome owners using mass media such as the Internet, books, and magazines. However, studies persistently identified a lack of procedural information (Risholt and Berker 2013; Fawcett and Killip 2014) and trustworthy advice (Pelenur and Cruickshank 2012; Tuominen et al. 2012; Syal et al. 2013) as having an on-going detrimental effect on rates of retrofit. This lack of procedural information is attributed by Risholt and Berker (2013) to the fact that some technologies such as ventilation systems are seldom marketed directly to end-users and highlights the difficulties that individuals without access to external expertise may encounter. This suggests that existing retrofits have relied on relevant professional experience of homeowners or construction professionals (Risholt and Berker 2013).

However, despite potentially being valuable mediators between the needs of the household and energy efficiency measures available, Risholt and Berker (2013) found that due to a lack of knowledge about retrofit, many contractors currently present a significant barrier to retrofit. A number of studies have examined the role that installers, advisors and boiler engineers could play in disseminating information about energy conservation or retrofit measures (Stieß and Dunkelberg 2012; Owen et al. 2014). Owen et al. (2014) observe that in addition to the 'expert' status, conferred by their technical capacity, energy advisers were also able to filter the suggestions they made for retrofit or energy conservation measures to the occupancy of the household (Owen et al. 2014). For example, houses without children and with modern appliances such as cold-fill washing machines were likely to have a lower Domestic Hot Water (DHW) demand and this could influence advice on whether to install solar thermal panels or photovoltaic (PV) solar panel. Conversely, Sunikka-Blank and Galvin (2016) observe that when work was subsidized, tradesmen were on strict time deadlines and only willing to carry out work in standardized ways, often resulting in difficult relationships with homeowners.

Contrary to the assumptions of the knowledge-deficit model, it also appears that while consumers are open to external advice, they do not trust experts and therefore, will also attempt to verify (Risholt and Berker 2013), evaluate and adapt this information to their own everyday lives (Bartiaux 2008; Desmedt et al. 2009). Therefore, as Owen et al. (2014) observes simply making the services of energy advisors available and expecting them to be able to stimulate wide-spread adoption of low carbon retrofit is not enough, as

demonstrated by the slow uptake of the Green Deal (DECC 2014b).

This section has identified a number of ways in which messages can be composed and delivered to maximise the possibility of changing individuals existing beliefs to align with new outcomes. The existing literature examining information provision for low carbon retrofit identifies a role for the small and medium sized enterprises (SMEs) undertaking regular repair and maintenance work in the absence of concrete knowledge aimed directly at owner-occupiers. However, this information will only be effective if these SMEs are trusted or owner-occupiers have means to verify the information they receive. However, central to increasing rates of retrofit according to ABC theories, is to correctly identify those outcomes that will be perceived positively by owner-occupiers and successfully target appropriate groups of the population in order to align their beliefs regarding retrofit measures with these desirable outcomes. The following section will examine existing attempts to achieve this.

3.1.3 ABC insights into home improvements

As discussed in Section 3.1.2, changing individuals' beliefs regarding the expected outcomes of adopting retrofit measures is central to ABC led approaches to encourage higher rates of low carbon retrofit. This requires that expected outcomes that would be perceived positively by owner-occupiers be identified. In addition, taking into consideration the critiques of the rational choice model discussed in Section 3.1.1 and the heterogeneity of values and attitudes towards retrofit measures this suggests, an understanding of how outcomes might be valued differently amongst the populations is also necessary. This section will review the expected outcomes that have driven retrofits and renovations, as identified by ABC-based studies. These reported stimuli are compared with a growing body of academic and policy literature that has examined the impacts of domestic retrofits, in order to identify those outcomes that are not captured by these ABC-based studies. This literature examining impacts comprises both post-occupancy evaluation (POE) studies, using a multidisciplinary approach incorporating both environmental monitoring and occupant feedback to assess existing buildings (Leaman et al. 2010), as well as larger scale reviews of the impacts of national grant programmes such as Warm Front (Gilbertson et al. 2006; Hong et al. 2006; Hong et al. 2009). This review of expected outcomes stimulating home improvements will be followed by a discussion of attempts to identify how these stimuli are distributed throughout the population.

As discussed in Chapter 2, Section 2.2.2, many evaluations of existing financial incentives call

for an understanding of influences on owner-occupier retrofit that moves beyond financial incentives. However, despite this, many ABC-based studies do acknowledge the importance of financial influences. Saving money on energy bills was found to be one of the drivers for installing energy saving measures by EST (2011); Fawcett and Killip (2014); and Haines and Mitchell (2014). Balcombe et al. (2014) also conclude that the Feed-in-Tariff (FiT) scheme has encouraged a new, more financially motivated consumer group to install micro-generation technologies. However, as shown by studies evaluating the outcomes of existing low carbon retrofits, the financial impacts of these retrofits can be hard to predict. Gilbertson et al. (2006) report in their evaluation of the Warm Front programme that only a quarter of the 50 grant recipients thought that they had saved money. However, it should be noted that a similar proportion of participants were having difficulty assessing if their bills had reduced or not, due to a change in supplier or payment method. These findings are also supported by a focus group based evaluation of social housing tenant's experiences of living with retrofit technologies undertaken by Brown et al. (2014). As previously discussed in Section 2.2.2, many of the financial incentives implemented in the UK to date have specifically targeted vulnerable and low-income households, with the Warm Front scheme explicitly aiming to reduce fuel poverty¹⁸(Gilbertson et al. 2006). These minimal or even negative impacts on household finances are attributed in part to the 'comfort takeback' effect that occurs most commonly in fuel poor households who choose to forgo some of the energy savings in favour of higher internal temperatures (Gilbertson et al. 2006; Davies and Oreszczyn 2012). Conversely, research indicates that financial savings in more affluent households are less likely to be compromised by the 'comfort takeback' effect.

Balcombe et al. (2014) observe that those who installed micro-generation technologies prior to FITs being introduced in 2010 were motivated more by demonstrating their environmental concern than financial incentives. Concern for the environment has been identified as a key motivation to adopting energy efficiency and micro-generation technologies by many studies (Galvin 2011; Stieß and Dunkelberg 2012; Balcombe et al. 2014; Fawcett and Killip 2014; Galvin 2014b). Again, as many previous communication strategies have provided information about the urgency of reducing carbon emissions and the measures owner-occupiers can take, it is likely that those owner-occupiers who are highly receptive to messages addressing environmental concern will have already taken action where they are able.

¹⁸A household is considered to be fuel poor if it would need to spend at least 10% of its income in order to heat the house to an acceptable level of warmth (recommended by the World Health Organisation to be 21°C for the main living area, and 18°C for other occupied rooms) (DECC 2011b).

However, the comfort ‘takeback’ effect discussed in relation to financial savings above, also has a negative impact on energy savings, resulting in the measured GHG emissions savings following retrofit not being as high as predicted (Hong et al. 2006; Davies and Oreszczyn 2012; Galvin 2014a). Low energy savings may also be attributable to inaccurate assumptions being made when calculating both current and predicted energy consumption. In a comparative study of the calculated Energy Performance Ratings (EPRs) with the actual measured energy consumption of 3,400 German homes Sunikka-Blank and Galvin (2012) identify that Energy Performance Ratings (EPRs) were on average 30% higher than measured energy consumption, leading to exaggerated predicted energy savings. They also observe that the same trends can be recognized in the UK (Sunikka-Blank and Galvin 2012). Hong et al. (2006) argue that predicted energy consumption calculations are inaccurate due to assumptions such as 100% insulation coverage, when in practice this is very hard to achieve with a retrofit.

Finally, studies which have drawn on ABC perspectives have also identified comfort (Fawcett and Killip 2014; Galvin 2014b), and an associated improved quality of life (Fawcett and Killip 2014), as key drivers for the installation of energy efficiency measures. This is unsurprising given that early retrofit programmes such as the Decent Homes standard and Warm Front did not focus on emissions savings but on thermal comfort (Dowson et al. 2012). However, these early retrofit programmes also expounded the benefits of retrofit measures for occupant health and safety (Gilbertson et al. 2006; Dowson et al. 2012) and state of repair (Dowson et al. 2012), which are seldom cited as influences stimulating the adoption of retrofit measures. The impacts of housing retrofit on health have been identified by a number of Post Occupancy Evaluation studies and programme evaluations including Schofield et al. (2012) and Gilbertson et al. (2006). These findings are also supported by clinical studies, such as the study of 1,350 households, investigating the impact of insulating houses on occupant health in New Zealand, undertaken by Howden-Chapman et al (2007).

Higher indoor temperatures, resulting from improvements to building fabric, lead to increased thermal comfort (see for example Munro and Leather 2000; Fawcett and Killip 2014; Gupta et al. 2014; Owen et al. 2014) as well as multiple health benefits including a decrease in common colds, easing of chronic conditions such as arthritis, high blood pressure, and asthma (Gilbertson et al. 2006; Heinrich 2011; Schofield et al. 2012; Colton et al. 2015). Increased temperatures may also result in a reduction in mould growth responsible for some

respiratory symptoms (Institute of Health of the National Academies 2004). Some fabric measures can also lead to improvements in indoor air quality such as a reduction in indoor pollutants following installation of a new heating system (Mills and Rosenfeld 1996; Gilbertson et al. 2006) or decreased penetration of outdoor pollutants due to increased airtightness (Davies and Oreszczyn 2012). Retrofit may also have wider impacts on physical health, with improvements in nutrition attributed to greater disposable income to spend on better quality food and more comfortable kitchens to cook in (Gilbertson et al. 2006).

However, for retrofit interventions in the UK, *“the magnitude and even direction of effects on health depend on how energy efficiency measures are implemented and maintained”* (Wilkinson et al. 2009, p.1917). An increase in insulation can increase the potential risk of summertime overheating and its associated impact on health (Davies and Oreszczyn 2012; Mavrogianni et al. 2012). When increasing airtightness, measures need to be put in place to maintain a healthy ventilation rate and avoid a build-up of indoor pollutants such as Volatile Organic Compounds (VOCs), radon, moisture, and environmental tobacco smoke (Davies and Oreszczyn 2012). Passive, through-wall ventilators are the most common method of maintaining adequate ventilation, however, occupants often perceive these as a source of unwanted cold air ingress and noise (Glad 2012; Kinnane et al. 2016). This can often lead to occupants blocking vents at the expense of Indoor Air Quality (Kinnane et al. 2016). Mechanical Ventilation with Heat Recovery (MVHR) is often proposed as an alternative solution to reducing heat losses through ventilation whilst maintaining indoor air quality. However, as observed by Davies and Oreszczyn (2012) and supported by experimental data (Banfill et al. 2012), MVHR is only effective when installed, maintained and used correctly.

Contrary to these mixed findings on the impact of retrofit on physical health, evidence of the effect of retrofit interventions on mental health and wellbeing is predominantly positive. Reported benefits include reduced stress resulting from increased financial control as identified by Gilbertson et al. (2012) in their questionnaire based study of 1897 households in receipt of Warm Front interventions. Perceived increases in security within the home also resulted in reductions in stress (Schofield et al. 2012). A national evaluation of the Warm Front programme, employing a General Health Questionnaire (GHQ-12) has also observed a lower proportion of respondents reporting adverse scores for common mental disorders (Wilkinson et al. 2005). Following retrofit some occupants reported simply feeling happier, more secure, more at home and more comfortable (Gilbertson et al. 2006; Howden-Chapman et al. 2007; Schofield et al. 2012), with around a quarter of respondents making an

explicit link between mood and temperature. The practical implications of warmer environments include greater room availability for activities such as homework and watching television, which was regarded positively by the majority of respondents (Gilbertson et al. 2006; Schofield et al. 2012). Low carbon retrofits were even reported to improve educational attainment, not only through the provision of space to undertake homework (Garrett et al. 2014), but also through reduced absences from school due to illness (Howden-Chapman et al. 2007; Thomson et al. 2013).

This review shows that the benefits of retrofits extend beyond reductions in carbon emissions, and in many cases it is the financial and energy efficiency outcomes of these retrofits that have proved disappointing. Despite the identification of these influences, attempts to determine the distribution of influences throughout the population associated with market segmentation strategies have been met with limited success. In his thesis, Pelenur (2013) focuses on householder attitudes towards retrofit, and attempts to identify demographic variables associated with influences on retrofit. Only household income, marital status, and dwelling type were found to be associated with teleological influences, allowing for the development of just two basic profiles: single occupants, renting apartments and earning below £40K per year, who are largely motivated by resource efficiency; and married, owner-occupiers, earning more than £40K a year who are largely motivated by financial savings (Pelenur 2013).

Haines and Mitchell (2014) have adopted an alternative to using demographics, embracing a User Centred Design (UCD) approach, which employs personas to *“provide insights into other motivations for householders which can perhaps be used as opportunities to encourage engagement with energy saving retrofit as a by-product”* (p. 472). Personas are not intended to be statistically representative, but characterise the needs and priorities of the users throughout the design process (Haines and Mitchell 2014). Haines and Mitchell (2014) argue that when supported by quantitative market segmentation, these personas could provide policy-makers with further insights into the market for low carbon retrofit. However, perhaps the most interesting findings to emerge from this research arises from the attention given to renovators and the similarities and differences between them and retrofitters, in contrast to research such as that undertaken by Achtnicht and Madlener (2014), which implicitly classifies renovators as ‘non-adopters’. These findings indicate there is limited evidence to suggest retrofit should be treated as a distinct type of home improvement from other renovations (Haines and Mitchell 2014). The Energy Saving Trust (EST 2011) goes further,

asserting that encouraging owners to integrate retrofit measures within their renovations, inherently overcomes many of the greatest barriers to retrofit, namely: information, inconvenience and cost. The ratio of investment in existing housing (as opposed to new-build housing) in the UK is one of the highest in Europe (Baek and Park 2012), amounting to £15 billion spent on renovation, maintenance and improvement (RMI) works in the UK every year (EST 2011). With studies indicating that half of all owner-occupiers are in the process of planning or undertaking a renovation (Office of National Statistics 2012), this market could offer a significant opportunity to increase the rate of retrofit.

The term renovation is often used interchangeably or to cover any activity that goes beyond mere maintenance, including: modernization, retrofit, restoration and rehabilitation (Meijer et al. 2009). In the context of this study, the term renovation is used to refer to works to the home that go beyond repair and maintenance but do not include energy efficiency measures. As with low carbon retrofits, some of the most commonly reported influences on renovation are financial concerns. However, studies report mixed findings on the nature of this influence. The Energy Saving Trust (2011) found that increasing property value was one of the main reasons cited by respondents for renovating their homes. However, Munro and Leather (2000) and UKERC (2013) observe that although finances might have dictated the pace of improvements, contrary to the assumption of rational decision-making underlying housing renovation policy, there was little consideration of whether the improvements were ‘worth it’ in financial terms. However, despite enhanced property value not acting as an influence on renovations, owners commonly expressed a sense of responsibility to preserve the existing value of the house (Munro and Leather 2000).

Owner-occupiers also cited comfort as an influence on renovations, however, along with convenience and functionality (Munro and Leather 2000), comfort was often subsumed within the concept of ‘modernisation’¹⁹(EST 2011). It is interesting that whilst comfort is also cited as a motivation to retrofit, it is seldom associated with modernisation when discussed low carbon measures. This provides one example of how this research could identify ways owner-occupier’s perceptions of retrofit could be realigned to address the same motivations as many other home improvements. A final influence on renovations cited by owner-occupiers was aesthetics (EST 2011; Galvin 2014b). This was often, but not always, associated with heritage features, in which case home improvements were seen as a threat to these

¹⁹The Oxford English Dictionary (Oxford University Press 2017) defines modernisation as “the act of modernising something”, whilst this in turn is defined as “adapting to modern needs or habits.”

heritage features (Davies and Osmani 2011; Crockford 2014).

Munro and Leather (2000) observe that households in apparently similar situations often make very different renovation choices and propose the complexity of motivations to renovate is due to the *“longevity and durability of housing as a commodity”* (p.512). This results in the home simultaneously serving as both a consumption good, providing immediate services, and an investment good, as first conceptualised by Henderson and Ioannides (1987).

Several studies have proposed methods to identify households that might be considering renovating and influencing the kinds of renovations they undertake. Baum & Hassan (1999) conclude that contextual factors such as higher available income, larger household size and older dwellings increase the likelihood of renovation, although, income was not found to be a significant variable in all cases. Baum and Hassan (1999, p. 26) argue that like the decision to move, the decision to renovate is an indication of *“a gap between the actual and desired level of residential environment attributes.”* EST (2011) identifies certain ‘trigger points’ at which such gaps are likely to occur, such as change of ownership, starting a family or preparing for retirement.

3.1.4 Summary – key insights and limitations

This section has shown that financial concerns, environmental concerns, and comfort are most commonly identified by ABC-based studies as influences stimulating retrofit. However, the financial and emissions savings associated with previous low carbon retrofit programmes have been lower than anticipated. This is often associated with the ‘comfort takeback’ effect that is most commonly observed in fuel poor households. However, POE literature also proposes alternative explanations for an increase in energy consumption following a low carbon retrofit, including inappropriate maintenance or installation that would not be confined to these fuel poor households. In light of these findings, Galvin (2014b) advocates that owner-occupiers be encouraged to retrofit for reasons other than financial savings.

The benefits of owner-occupier home improvement on comfort and quality of life are commonly cited as stimulating influences on low carbon retrofit by ABC-based studies. However the wider benefits for physical and mental health are seldom cited. Furthermore, while the concept of modernisation is cited only in relation to renovations and not retrofits, many of the benefits that are central to low carbon retrofit, such as comfort and quality of life are subsumed within this concept. This provides one example of how owner-occupier’s

expectations of retrofit could be realigned to address the same desirable outcomes as many other home improvements. With the predictable exception of environmental concern, many of the teleological influences on retrofit are similar to influences on renovation. Therefore, individuals that are considering renovation may be susceptible to many of the same influences that also stimulate retrofit, emphasising the importance of understanding retrofit within the context of home improvement more generally.

Studies such as those by Pelenur and Cruickshank (2014), which seek to use demographics to identify the distribution of influences on low carbon retrofit amongst the population have achieved limited success. However, factors such household size, household income and property age have been shown to influence the likelihood of undertaking home improvement broadly (Baum and Hassan 1999). Therefore, in the place of traditional market segmentation techniques, researchers such as Haines and Mitchell (2014) have begun working on alternative ways of categorising individuals undertaking home improvements such as personas.

The central role of expected outcomes to the majority of ABC theories provide a clear point of intervention for influencing behaviours, whilst the focus on conspicuous consumption also appears suited to capturing the influences acting on large and infrequent phenomena, such as home improvements. However, the lack of attention these approaches pay to daily routines such as ventilation or maintenance, can also result in adoption of these measures having unintended consequences as identified by POE literature. To avoid adverse unintended consequences, the measures installed need to be tailored to the activities and lifestyle of the particular household as well as to its physical fabric. More specifically, these theories examine the process of retrofit in isolation without examining the links between these 'larger' phenomena and the many smaller activities that support the daily use of the home.

3.2 Practice Theory

3.2.1 Introduction to Practice Theory

In recent years, research on owner-occupiers' decisions to retrofit has moved towards a more sociological approach embodied in Social Practice Theory (SPT), challenging the dominant role that psychological models have played in research and policy development to

date. Practice theory advocates that rather than abstract signs and symbols, ‘doings’ should be at the centre of analysing the social (Schatzki et al. 2001). In doing so, this also implies a shift away from conspicuous consumption towards more routine everyday consumption (Gram-Hanssen 2010), and from abstract ideas of energy demand to the everyday activities that energy facilitates (Reid and Ellsworth-Krebs 2017). This permits an understanding not only of the innovations and transitions that theories such as the MLP has been successful in conceptualising, but also the dynamics that sustain incumbent practices that may stand in the way of adopting more energy efficient alternatives (Shove et al. 2012).

Although practice theories share a common conviction that many of our everyday actions *“are not the result of carefully considered decisions or values, but are habits or embodied knowledge within techno-social systems.”* (Fyhn and Baron 2016, p. 4), there remains considerable variation amongst the theoretical approaches that ascribe to the nomenclature of practice theory (as outlined in Figure 3.2).

Schatzki (1996)	Gram-Hanssen (2009)	Warde (2005)	Shove-Pantzar (2005)	Reckwitz (2002b)
Practical understanding	Know-how and embodied habits	Understandings	Competences	Body
				Mind
				The agent
				Structure/ process
Rules	Institutionalised Knowledge	Procedures		Knowledge
Teleo-affective structures	Engagement	Engagement	Meanings	Discourse/ language
	Technologies	Items of consumption	Products	Things

Figure 3.3: Variations on the elements that comprise practices (adapted from (Gram-Hanssen 2009))

However, many of these variations on practice theory share common roots in the work of Bourdieu (1976) and Giddens (1984). Bourdieu’s *habitus* (1976) describes a process in which experiences are absorbed, creating an intuition formed during childhood, that influences one’s future habits and tastes (Sahakian and Wilhite 2013). This emphasis on childhood experiences, makes class position, gender, and ethnic group important determinants of how physical surroundings and experiences shape social structures (Gram-Hanssen 2009; Galvin

and Sunikka-Blank 2017). Bourdieu (1984) argues that choices regarding aesthetics and taste are one of the methods used by members of one social group to differentiate themselves from other social groups. Meanwhile, Giddens (1984) sought to overcome the actor – structure dualism prevalent in social theory by focusing on actions as processes in which actors and structure mutually constitute one another and reproduce the social structures of society. Giddens (1984) argues these actions are undertaken as they align with inter-subjective understandings that are held in the minds of individuals as rules.

It was through a critique of this inter-subjectivism, based on the Wittgensteinian (1953) insights that knowing rules is not the same as complying with them and that no amount of rules can ever fully describe an act, that Schatzki (1996) proposed his variation on practice theory. Schatzki (1996) argues that practices are comprised of, and held together not only by explicit rules, but also by practical understandings (borrowed from Bourdieu’s habitual action), and teleo-affective structures - both goal oriented (teleo), and holding meaning for the practitioner (affective). Teleology in this context moves away from the individualism and cognitive approach discussed in association with ABC theories in Section 3.2.1, to a teleology inspired by the philosophy of Heidegger that is premised on being-in-the-world (Okrent 2000). This approach prioritises action over self-understanding, and argues that agents can act to achieve goals even if they are not consciously aware of them (Okrent 2000). Furthermore, Okrent (2000) argues that teleological states can not only be individuated by the agent, but also the content of the state or the goal it is directed towards. For example:

“When Jane believes that there is a door knob on the door, or wants there to be a door knob on the door, or perceives that there is a door knob on the door, or acts in order that there is a door knob on the door, the content of each of these states is that there is a door knob on the door. Similarly, when Jane simply takes a door knob as a door knob by using it as such, what she does is a taking as, and as such it has the content that this thing is a door knob.”

(Okrent 2000, p. 195)

The priority given to action by this approach implies a relationship between this goal and the material environment. If we take Okrent’s (2000) example of making a cake, unless the agents does something in the material world – such as attempting to crack an egg – they could not be considered as acting in order to bring about a cake. Materials are given greater importance in Reckwitz’ (2002a) subsequent development of Schatzki’s ideas. Where Schatzki

(1996) considers material objects to be the outcome of practices, Reckwitz (2002a) describes ‘things’ as playing an important role as one of the elements that comprise practices and hold them together. In the context of research into low carbon retrofit, this would indicate that greater attention should be paid to the role that material objects, such as home improvement measures, play in facilitating certain practices.

More recent variations on social practice by Warde (2005) and Shove and Pantzar (2005), draw on the work of Schatzki (1996) and Reckwitz (2002b). Warde (2005) adapts Schatzki’s (1996) description of practice theory to consumer studies, by drawing on the work of Reckwitz (2002a) to add items of consumption. Practice theories have been adapted and applied to studies of sustainable consumption by Shove and Pantzar (2005) and Gram-Hanssen (2009). Shove and Pantzar (2005) propose a simplified version of practice theory in which implicit or practical understandings are combined with rules and procedures to form a single component of practices called competences (as shown in Figure 3.4).

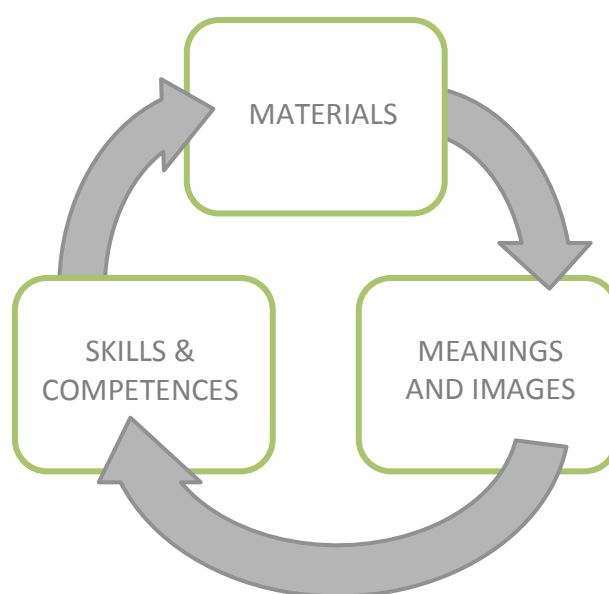


Figure 3.4: Social Practice Theory as described by Shove and Pantzar (2005)

Shove and Walker (2010) illustrate this simplified version of practice theory, comprising symbolic meanings and images; skills and competences; and materials (see Figure 3.3) using the practice of showering. In this example, individuals combine the ‘images’ of cleanliness and freshness, with the ‘skills and competences’ of conventions of propriety and the basic ‘materials’ of soap and water. Shove and Pantzar (2005) argue that it is through the regular performance of a practice, and consequent reinforcement or severing of links between these

components that the practice is maintained or changed. Meanwhile, Gram-Hanssen (2013) develops a consumer approach to practices of energy consumption and how they are influenced by communication initiatives and technologies. Following a critical analysis of previous variations on practice theory, Gram-Hanssen (2009) uses a variation comprised of know-how and embodied habits, institutionalised knowledge, engagement, and technologies to demonstrate the influence of technological and cultural influences whilst also acknowledging how individuals take on and employ new knowledge.

Practice theories may also be based on very different ontological assumptions. While human-centred approaches presuppose the centrality of practical or embodied understandings, Social Practice Theory moves away from a humanist perspective to a social ontology, in which practices themselves are the unit of analysis and individuals act as carriers of such practices (Strengers 2014). Meanwhile, a post-humanist or relational approach examines how all elements of a practice hang together (Gherardi 2017). This approach supposes that through these relationships, the social and the material co-constitute one another, and material objects acquire agency (Gherardi 2017). Whilst the term socio-materiality is not exclusive to this relational approach it can be employed to describe this perspective where the social and the technological do not have separate boundaries but relationally constitute each other through the performance of situated practices (Gherardi 2017). Therefore, in contrast to ABC models, the human is not viewed as a fixed identity, but is a state of becoming contingent on these relationships with material objects and the performance of practices (Gherardi 2017).

Reckwitz (2017) has sought to further develop this relational approach by exploring the potential for a practice theory of *affect*. The concept of *affect* describes emotions as the product of an interaction, rather than being cognitively generated by an individual (Hicky-Moody 2013), asking the question; “*who is affected by whom or what?*” (Reckwitz 2017, p. 121). Reckwitz (2017) argues that practices require the presence of affects in order to engage with meanings and the teleological structures that comprise an essential component of practice as described above. This engagement implies that in the context of practices affects must be seen as a process, a relation between two entities, rather than a quality (Reckwitz 2017). Similarly, material objects can only become generators of affects within the context of social practices, as Reckwitz (2017) asserts that associations between objects and reactions such as aversion or desire are acquired through practice. This implies that owner-occupiers’ relationships or feelings towards home improvement measures will vary depending on the measure in question and the owner-occupiers’ participation in previous practices.

The role that material objects can play in generating affect is often explored within architecture, in the form of relationships between material forms generating *atmospheres* that might invoke feeling of awe or joy (Reckwitz 2017). More specifically to low carbon retrofit, Sahakian and Wilhite (2013) argue that buildings have agency over how energy is used in the home. However, the role that affect might play in alterations to the material fabric of the home, such as in low carbon home improvements has received little attention.

Emerging from the field of Ecological Psychology, which eschews the cognitivist assumptions of mainstream psychology (Ingold 2000), the theory of affordances (Gibson 1986) also offers insights on social interactions with the material environment. Gibson (1986) defines the affordances of the environment as “...*what it offers the animal, what it provides or furnishes, either for good or for ill*” (p.119), emphasizing that these affordances will vary from one animal to another. Therefore affordances must be examined relative to the animal (Gibson 1986). Ingold (2000) observes that there are “...*clear parallels between the ecological critique, in the field of psychology, of cognitive science and the critique of practice theorists of cognitive anthropology...*” (p.167). Both practice theory and Ecological Psychology emphasize the importance of movement or on-going engagement with the material environment through the performance of routine activities, in cognition and perception (Ingold 2000). Therefore, objects take on meaning, or realize their affordances, through their incorporation into these activities (Ingold 2000). Building on these similarities between practice theory and the theory of affordances, alongside Heidegger’s (1971) rediscovery of dwelling as a process of cultivating the environment, Ingold (2000) develops his own dwelling perspective, with significant implications for the nature of home improvements. Ingold (2000) describes how dwelling is the on-going activity of construction rather than the occupation of an environment that is already built. This implies that home improvements such as those discussed in this thesis take place as part of dwellers’ on-going act of dwelling and practical engagement with their surroundings (Ingold 2000).

i) Application of Practice Theory to Home Improvements

Several authors have sought to apply these variations on practice theory to the study of home improvements. For example, Hand et al. (2007) examined the spatial constraints that the proliferation of appliances associated with daily practices places on homes, particularly with respect to bathrooms and kitchens. Looking more specifically at retrofit, Maller et al. (2012) argue that low carbon retrofits would be more successful if they addressed owner’s

aspirations and daily routines. Judson and Maller (2014) take this one step further by conceptualizing home renovations themselves as renovation practices and examining how these interact with daily practices. Their study revealed how the energy efficiency requirements of housing are negotiated in the context of other expectations of daily life at the household level (Judson and Maller 2014). Similarly, Reid and Ellsworth-Krebs (2017) use practice theory to study the adoption of micro-generation technologies.

However, Karvonen (2013) in his study of owner-occupier housing retrofit, acknowledges a number of limitations when applying the SPT perspective to the examination of activities such as renovation. Most fundamentally, Karvonen (2013) questions whether renovations can be considered as social practices given that such work is periodic and therefore the 'meanings' associated with such patterns are not maintained through regular repetition as advocated by Shove and Pantzar (2005). However, Bartiaux et al. (2011) argues that to be considered a practice, patterns do not need to be re-enacted by each individual but can be established through regular enactment at an aggregate level. In support of this assertion, Bartiaux et al. (2011) use the example of replacing domestic windows, which he proposes that as a common renovation activity, can be considered a renovation practice, even if only enacted by individuals a few times in their lifetime. Fyhn and Baron (2016) report that existing studies applying practice theory to housing renovation show that *"...even in activities not performed every day, it is possible to identify specific connections between meaning, competence, and materials that reach outside the individual performing the actions."* (p.4).

While Bartiaux et al. (2014) adopt this assumption that renovation can be considered as a practice, their study of renovation activities across four European countries (Belgium, Denmark, Latvia and Portugal), concludes that retrofits shouldn't be considered a practice in these countries due to a lack of common 'meaning' and 'competences' associated with this activity. More broadly, criticisms of practice theory include firstly, that its focus on everyday activities and the minutiae of social life renders it unsuitable for studying 'larger' social phenomena. As defined by Schatzki (2016):

"...a 'large' social phenomenon is one that is spatially extensive, consisting in a far-flung constellation of practices or arrangements... Size is not the same as either complexity or number and organization of elements... For example, a community might embrace more practices, arrangements, and bundles – and be denser – than the overall spatially larger but more spindly international financial system. Often,

however, the larger (or denser) the phenomenon the more complex it is."

(Schatzki 2016, pp. 6-7)

Schatzki (2016) also discusses how *"...some theorists say that practice theory applies best – or even only – to small social phenomena"* such as *"...coordinated activity, and face- to-face interaction in contiguous settings"* (p. 4), rather than the larger phenomena of markets or industries. These theorists argue that as these larger phenomena are beyond the discretion of any one individual, they should be conceptualised as 'external forces' that act on individual's daily activities (Nicolini 2017). Therefore, in contrast to the flat ontologies that many practice theories adopt, they constitute a different level of social reality, and require a different level of explanation than the mundane, concrete activities on which practice theories focus (Nicolini 2017).

A second criticism is that practice theory neglects the individual practitioner, treating them as empty vessels carrying out pre-determined practices (Hui et al. 2017), and ignoring the scope for practitioners to make transformative interventions (Alkemeyer and Buschmann 2017). Nicolini (2012) argues that this approach sees learning only as adaptation to the status quo in place of the constant acquisition and recreation of knowledge in practice. Similarly, Alkemeyer and Buschmann (2017) describe how practice theories *"...rarely reflect upon how the people involved in order-making come to be or, indeed, put themselves in the position to be able to participate as competent players"* (p.8). Furthermore, they argue this approach is the result of practices observed from the outside, rather than in the context of how they present themselves to participants (Alkemeyer and Buschmann 2017). Both of these weaknesses present significant challenges to understanding large and highly varied phenomena such as home improvements. The following sections will examine recent developments in practice theory that have sought to address these criticisms.

ii) Understanding practices within the wider nexus of social life

It is widely accepted that practices are connected to each other (Schatzki 2002; Kemmis et al. 2012; Maller et al. 2012) at various scales, from smaller bundles of practices, through more spatially extended and complex constellations of practice and finally to the nexus of bundles and constellations that make up the nexus of practice describing social life (Schatzki 2016). This approach to understanding the social world rejects the idea that there is a fundamental distinction between micro and macro phenomena (Schatzki 2011; Nicolini 2012). Nicolini

(2017) states that it is through these connections between practices that large phenomena such as home improvements can be understood. For example, Schatzki (2002) describes how practices within this nexus do not develop independently of one another, but are mutually determined. Connections between practices include what Schatzki (2011, 2016, 2017) refers to as causal chains. Therefore, changes in large phenomena such as retrofit arises from, and can be understood through, mapping these causal chains between 'smaller' or more 'localised' practices (Schatzki 2016). To facilitate a greater understanding of how changes in large phenomena arise, the remainder of this section will examine the bundles and constellations that form the nexus practices, followed by relations including these chains of action as well as material, jurisdictional and teleological connections.

At the smallest scale, practices are described as hanging together in bundles. However, the nature of these bundles is subject to different interpretations. Shove et al. (2012) introduces the concept of bundles of practices that *"...are loose-knit patterns based on the co-location and co-existence of practices..."* (p.81). Other theorists have argued that bundles can be held together through temporal sequences such as cycling as a means to get from home to work (Watson 2012) Meanwhile, Schatzki (2011), who does not include material objects as one of the implicit components of practices describes bundles as *"...a set of linked practices and (material) arrangements..."* (p.8), where arrangements are defined as *"...a layout of entities in which they relate and take up places with respect to one another..."* (Schatzki et al. 2001, p. 51), giving materials a privileged role in the formation of bundles.

Both Bartiaux et al. (2014) and Karvonen (2013) propose that rather than a practice of 'retrofit', low carbon home improvements can be conceptualized as bundles of practices comprised of different expertise and material objects. However, these bundles, like the practices which comprise them, are dynamic and unstable (Schatzki 2002), emerging, persisting and finally dissolving with the connections that hold them together (Schatzki 2011). The nature of the connections that hold these bundles together has received little attention. However, Shove et al. (2015) suggests that planned and deliberate infrastructural arrangements can serve to underpin these relationships, indicating the possibility of deliberately strengthening desired bundles while allowing less desirable bundles to dissolve.

These bundles connect to other bundles to form constellations of interconnected materials and practices (Schatzki 2011). Schatzki (2011) describes how, like the practices that comprise

them, links between bundles form between practices and arrangements, amongst practices or amongst arrangements. Therefore, Schatzki (2011, 2017) proposes that constellations are simply more complex and spatially extended linkage of practices and arrangements. These bundles and constellations link together to form the nexus of practices that make up social life, dubbed by Schatzki (2016) as the 'plenum of practice'. However, as Schatzki (2002) states, these bundles both cohere and conflict, and spatial-temporal form, density and complexity vary throughout the nexus' fabric. For example, greater density of relationships between practices in the nexus mark the existence of bundles and constellations. Whilst Karvonen (2013) proposes that low carbon retrofits can be conceptualized as bundles of practices, how these bundles might link together in constellations or connect with other practices to make up part of the wider social nexus, has not been explored. Doing this could develop greater understanding of the social context in which low carbon home improvements come about.

Like the bundles and practices that compose them, these constellations and the nexus they form are not static (Schatzki 2011), but are constantly being reconfigured. Shove et al. (2012) and Blue and Spurling (2017) argue that broader changes in the nexus can be understood as the result of the shifting relationships between the bundles and constellations that comprise it, rather than changes in the composition of individual practices. This proposition demands that to comprehend change, the relationships that hold multi-practice configurations such as bundles, constellations and nexuses together are first understood. Therefore, the following section will discuss the types of relationships between practices identified by practice theorists, namely chains of action, material relations, jurisdictional relations and teleological relations.

The formation, persistence, and dissolution of bundles and constellations of practice are supported by causal relationships that Schatzki (2016) refers to as chains of action. As observed by Shove et al. (2012), the position of practices within these chains of action arises not only from the practice itself but often from the scheduling and relations with parallel practices. Similarly, changes in these chains of action often result from multitudinous smaller changes in the surrounding practices (Schatzki 2016). Therefore, whilst Fawcett (2013) and Wilson et al. (2015) have begun to explore home improvements as a process that evolves over time, Schatzki's assertions would suggest that in order to fully understand these chains of action, it is essential to identify how they connect with the wider nexus of practice.

The material relations that mutually constitute relationships between practices such as bundles and constellations is relatively well developed, primarily by Schatzki (for example 2011, 2017). These relations could take the form of material objects playing roles in multiple practices, leading to conflict or competition for materials, or by the products of one practice forming the inputs for another practice as described by Shove et al. (2012). These material relations are used by Morley (2017) to conceptualise buildings. Shove et al. (2012) state that *“since buildings represent a site in which practices are contained, separated and combined, the history of domestic architecture provides a telling record of how daily life is organised and how this changes”* (p.84). More specifically to energy consumption practices in the home, Rinkinen et al. (2015) discusses how different heating systems such as central heating, or wood-fired heating produce very different rhythms of practice. Despite this, there is little research on how these material relations between practices could influence home improvements.

A third kind of relationship between practices that has received much less attention than chains of actions or material relations, are jurisdictional relations. The term jurisdiction is used here to describe *“...the categories of social problems around which expert tasks are organised”* (Blue and Spurling 2017, p. 29). Therefore, in this context the term refers to how the different competences or expertise of professionals may constitute connections between practices. Blue and Spurling (2017) apply this concept to the practices undertaken within hospital life, where patients must see a selected list of appropriate experts in a particular order. Blue and Spurling (2017) argue that patterns of interdependence between these expertise or jurisdictions, play a vital part in diagnosis and treatment. For example, a key organising feature of this process is determining who’s expertise is relevant to the patient and the order in which these experts must be seen (Blue and Spurling 2017). This bears comparison with the retrofit process where the contribution of various specialist expertise such as builders, plasterers and electricians must be identified and appropriately coordinated. Blue and Spurling (2017) also identify how new jurisdictions of expertise might develop around new technologies such as magnetic resonance imaging (MRI) or radiology, that resembles the emergence of new areas of expertise within the construction industry that developed alongside technologies such as solar panels and air source heat pumps. Therefore, practices are an *“outcome of jurisdictional qualities interconnecting with temporal and material-spatial qualities”* (Blue and Spurling 2017, p. 30). An example of these interdependencies within the home improvement process might include an electrician being recruited to chase cabling into walls, allowing plasterers to apply the plaster finish to walls,

subsequently allowing the electricians to complete a 'second fix' of sockets, switches and light-fittings. These jurisdictions have not yet been applied in the context of home improvements, however the organisation of the construction industry into these specialisms and the high level of material interdependencies in home improvements indicates this could provide additional insight into how practices connect to one another.

Finally, Schatzki (2011) acknowledges that practices may be linked when they share the same ends or teleological influences. Okrent (2000) argues that *"...an act having a goal is a holistic property in the sense that no event can have a goal unless it is appropriately related to other events that also have goals, in virtue of their relations"* (p.202). For example, returning to Okrent's (2000) example of making a cake, individual acts such as cracking an egg, taking out a bowl, or turning on the oven do not necessarily have the goal of making a cake. It is the relation of each of these actions with each other that gives the actions the goal of making a cake. Therefore, it is teleology, the goal of producing a cake that describes the relationship between the activity and its temporal and material environment. However, in the context of energy consumption practices, beyond findings by Gram-Hanssen (2009), that once a goal is established in a work environment it could also spread to domestic practices, the connective power of teleological influences has so far remained largely unexplored.

iii) Variation between practitioners

In a philosophical critique of Schatzkian practice theory, Galvin and Sunikka-Blank (2016) question the causal priority attributed to practices over individuals by defining practices as an ontologically robust identity rather than an heuristic device, as well as the lack of attention given to the variations in practice associated with different socio-economic and cultural contexts. These concerns resonate with the second weakness of much practice theory identified by Hui (2017), namely the neglect of individual practitioners and the variations between them. As stated by Hui (2017) variation is an implicit feature of practice. As a performance, no two performances of the practice will ever be exactly the same. It is this variation between different performances of the same practice, how it evolves and changes over time, that has been the focus of much existing research (Hui 2017). As a consequence our understanding of variations between different practices is underdeveloped. Hui (2017) argues that to address this deficit in understanding, practices must be considered within the wider social nexus, held together with diverse links that contribute to these variations. Furthermore, in order to understand such variations, in home improvement practices or

elsewhere, Hui (2017) argues that it is first essential to find referents to gauge similarity, against which differences or variations can then be measured. Therefore, it is unsurprising that many of the dimensions of practice identified by Hui (2017) as contributing to such variations, reflect the relationships that connect practices together, as discussed in Section iii.

The material components that comprise a practice may contribute an element of variation as there may be several possibilities of material object that might suffice (Hui 2017). Furthermore, affective relationships with material objects will vary from one individual to the next, emerging through previous assemblages of human and non-human bodies (DeSilvey 2012; Hicky-Moody 2013). Similarly, the theory of affordances allows for objects to offer multiple affordances or even different affordances to different bodies (Gibson 1986), who through on-going engagement with the environment, are trained to notice and attend to relevant features of their material surroundings (Ingold 2000). Therefore, responses to material objects, such as home improvement measures, will vary depending on the ‘training’ the individual has had (as explored in further detail in Chapter 4).

Like the connections between practices, variations between practices may also emerge through their spatio-temporal characteristics (Hui 2017). For example, Hui (2017) argues that sequences where outputs of one practice become inputs of a subsequent practice, create opportunities for variation as the ability to develop competences or access certain materials may be constrained by participation, or lack of participation in previous practices. Variation in practices of household energy consumption between households, attributed to different practical understandings and technical competence, are identified in studies by Gram-Hanssen (2009, 2010).

iv) Implications for policy

Finally, as previously discussed in Chapter 2, current policy encouraging retrofit in the UK and England more specifically relies on the motivation and rational decision-making of individuals in light of new knowledge or economic incentives (Gram-Hanssen 2009). To apply findings from practice theory to policy implementation Shove (2010) argues that this would require a fundamental questioning of “the role of the state, the allocation of responsibility, and in very practical terms the meaning of manageability, within climate-change policy” (Shove 2010, p.1283). Shove and Walker (2010) identify that one of the most fundamental implications of practice theory for policy makers is that “...consumers, users and practitioners are, in any

event, actively involved in making and reproducing the systems and arrangements in question" (p.475). This does away with the supposition that those doing the governing are acting outside of the reproduction and transformation of practice and consequently the distinction between the governed and those doing the governing (Shove and Walker 2010). However, this does not mean that all practitioners are equal or that power is evenly distributed within practices (Shove and Walker 2010; Watson 2017). Policies can bring about significant changes in practices through introduction of regulations (Schatzki 2002); making available the material infrastructures that facilitate practices (Shove and Walker 2010); and circulating ideologies associated with desired practices (Shove and Walker 2010). However, even advocates of practice theories argue that in order to contribute to current environmental policy practice theories must move beyond critiques of technical and behavioural policy approaches (Watson 2017) to become more practicable (Shove 2010; Sahakian and Wilhite 2013).

3.2.2 Social practice perspective on acquiring knowledge

As shown in Figure 3.2, each of the variations on practice theory proposed by theorists from Schatzki (1996) to Gram-Hanssen (2009) comprise an element of knowledge, understanding, or competence. Despite this, as Alkemeyer and Buschmann (2017) observe, limited attention has been paid to how these competences or knowledges are acquired, with many practice theory-based studies assuming that practitioners are *"...‘play-able’ out of the box"* (p. 8). Alkemeyer and Buschmann (2017) argue that this arises from assuming that practices are pre-structured rather than contingent and subject to specific and competing demands requiring engagement from participants to overcome these uncertainties. Alkemeyer and Buschmann (2017) and Sahakian and Wilhite (2013) argue that such competences arise through engagement in practices themselves, in which the distributed agency of material objects and participants mutually enable one another. This is supported by the finding that introducing material objects such as recycling bins or shower timers can stimulate 'education' regarding pro-environmental behaviours (Hobson 2006). Similarly, participation in practices often involves being at an intersection of the practice nexus with other practitioners (Hui 2017). Therefore, practitioners also learn through shared practices with other practitioners (Alkemeyer and Buschmann 2017). Alkemeyer and Buschmann (2017) go on to argue that practice theories should be complemented with the concept of subjectivation, describing how *"...the ability to intelligently orient one's own actions towards practice-specific requirements is continually being formed..."* (p.9). This concept highlights the role that social

processes, such as practices, play in the formation of subjects (Alkemeyer and Buschmann 2017). Therefore, participants gain competences and become subjects through participation in previous practices, and through this process develop what Fyhn and Baron (2016) call a “readiness” for decision making. Therefore, this approach suggests a more experiential and participative method of acquiring knowledge than ABC theories.

In his Experiential Learning Model, Kolb (1974) proposes that concrete experiences serve as the basis for observations and reflections, which are in turn assimilated into a 'theory' or abstract concepts and generalisations. These concepts are then tested experimentally in new situations (ibid). Kolb (1974) acknowledges that this model demands a wide range of skills and abilities of the learner, and therefore, it is likely that different individuals will be more adept at different parts of this learning process. Clearly, this notion of learning through concrete experiences resonates with practice theory where competences or know-how and embodied habits (Bartiaux et al. 2011) are acquired through practice over time (Fyhn and Baron 2016).

Furthermore, different levels of enablement arise amongst practitioners as a result of previous opportunities to participate in relevant practices (Alkemeyer and Buschmann 2017). Watson (2017) observes how this allows for social difference between practitioners without resorting to individualism. These different levels of enablement also imply that power is not equally distributed in practice, an idea previously discussed by Shove and Walker (2010); Sahakian and Wilhite (2013); and Watson (2017). As Watson (2017) suggests that *“...inequality results from uneven distribution of the capacity to act...”* (p.173). This reflects Bourdieu’s (1984) earlier ideas regarding how unequal distributions are often systematically reproduced through the acquisition of a habitus based on parents’ practices and belongings during childhood.

This assertion of an unequal capacity to act is supported by findings of a wide range of home improvement expertise amongst homeowners (Syal et al. 2013). For example, Stieß and Dunkelberg (2012) and Vlasova and Gram-Hanssen (2014) assert how owner-occupiers may bring their own set of valuable expertise to the home improvement process. Meanwhile, Galvin and Sunikka-Blank (2014) and Sunikka-Blank and Galvin (2016) document how homeowners, through engagement with other retrofitters may develop more creative solutions or greater levels of appropriate technical knowledge regarding specialist measures than their tradesmen. However, Fyhn and Baron (2016) report that several of their

participants described themselves as DIY novices when they bought their home but developed skills through subsequent experience. These participants described how retrofit decisions had been taken incrementally, and only having undertaken certain retrofitting projects did they feel competent to embark on others. This highlights the importance of the process of creating a readiness for decision-making, as without readiness, incentives to influence the outcome of such a decision will never have the opportunity to take effect (Fyhn and Baron 2016). This implies that beyond information dissemination or circulating specific ideologies as suggested by Shove and Walker (2010), those interested in encouraging the adoption of low carbon retrofit measures should seek to provide opportunities for owner-occupiers to participate in practices that will allow them to develop the relevant competences.

Fyhn and Baron (2016) discuss how in the case of home improvements, developing these competences through practice is perhaps most evident in the case of Do-It-Yourself (DIY) skills. DIY activities have been shown to be part of the majority of home improvement projects (Bartiaux et al. 2011; Gram-Hanssen 2014a; Wilson et al. 2015) and there remains a strong tradition of DIY and the infrastructure, in the form of supply chains, to support this practice in the UK (Galvin and Sunikka-Blank 2014). Many people describe picking these skills up from their parents by helping out as children (Cox 2015). However, more recently studies have shown that DIY activities are now seen as competing with time spent raising children, leading increasing numbers of families, including those in the UK, to outsource home improvement projects to tradesmen (Gram-Hanssen 2010; Cox 2015). This loss of DIY skills could have significant implications for the adoption of low carbon retrofit measures. Fawcett and Killip (2014) study of Superhome²⁰ owners found that DIY provided households with a means to manage the cost and the quality of their low carbon retrofit. Meanwhile, Wilson et al. (2015) argues that skills and knowledge of homeowners, developed through previous DIY experiences, could make the relevance of low carbon retrofit measures to the household's aspirations for their home more explicit.

Previous attempts to develop competencies with regards to home improvements, in the absence of direct experience, have included open home events and demonstrations. The open-home events held by the Superhomes network offer one opportunity for experiential

²⁰Superhomes is a network of older homes, refurbished to be at least 60% less reliant on fossil fuels.

learning, allowing owner-occupiers to experience the impacts of energy efficiency measures on noise levels, aesthetics and comfort (Risholt and Berker 2013). However, in their evaluation of the impact of these events, Berry et al. (2014) observe that many visitors attending such events are already convinced of the need to retrofit and may be in the process of undertaking a retrofit project of their own. This indicates that whilst these events may be important sources of knowledge, they do not appear to play a significant role in stimulating retrofits.

Limited attention has previously been given to how the competences that comprise practices are acquired and how they might vary between practitioners. However, as described in this section, research by Sahakian and Wilhite (2013) and Fyhn and Baron (2016) has found that competences in sustainable consumption and home improvement projects more specifically have arisen through previous engagement with related practices. However, in the case of home improvements, reduction in the number of people employing practices of DIY indicates that competences associated with these improvements are shifting from manual skills to those associated with the sourcing and managing of construction professionals.

If these competences are acquired through previous practice, then to understand unequal distributions of the ability to engage with practices, one must understand the connections between practices. By understanding the connections with other practices that develop a 'readiness' for undertaking low-carbon retrofit, the interventions that could provide equal access to these 'enabling' practices can be identified, allowing practice theory to move beyond critiquing existing behavioural interventions and become more practicable to policy makers.

Hicky-Moody (2013) and Reckwitz (2017) identify that meaning and teleo-affective influences associated with material objects are also established through previous practices and therefore will vary from one practitioner to another. These teleo-affective influences and the variation between them will be explored in greater detail in the following section.

3.2.3 SPT insights into home improvements

As discussed in Section 3.2.1, practice theories seek to move from a focus on the individual and their conspicuous consumption, towards the practice itself and the consumption associated with routine practices. In addition to the competences discussed in Section 3.2.2,

these practices are also comprised of teleo-affective influences. However, other than that they arise through repeated performance, how these teleo-affective influences come to be associated with these practices and how practitioners that share these influences might be identified has been the subject of limited investigation. This has given rise to criticisms that the impact that practice theories can have on interventions to reduce emissions without becoming more practicable (Shove 2010; Sahakian and Wilhite 2013). This section will identify the teleo-affective influences associated with home improvement measures by practice-based studies, and compare these with the benefits of low carbon retrofit reported in POE literature. This will be followed by a review of attempts to determine who might share these teleo-affective influences, and hence render practice theory-based understandings of retrofit more tractable to policy-makers.

Like their ABC counterparts, practice theory-based studies also acknowledge the influence of financial concerns and issues of comfort and quality and quality of life on low carbon retrofit. However, studies which draw on practice theories such as UKERC (2013) and Gram-Hanssen (2014a), observe that economic gains are rarely cited as the initial motivation for retrofitting, but might inform final detailed decisions. Meanwhile, a number of practice-based studies have identified comfort (see for example Bartiaux et al. 2014; Christensen et al. 2014; Fawcett and Killip 2014; Galvin 2014b), and an associated improved quality of life (UKERC 2013; Fawcett and Killip 2014; Haines and Mitchell 2014), as influences on the installation of energy efficiency measures. Furthermore, in practice theory based studies, perceptions of comfort have been shown to vary from one household to another (Sunikka-Blank et al. 2012; Risholt and Berker 2013; Ellsworth-Krebs et al. 2015) and the role that homeowners' connections with their homes play in creating expectations of comfort (Ellsworth-Krebs et al. 2015; Wilson et al. 2015) has been presented as one explanation for this.

Practice theory based studies qualify that environmental concern will only result in a change in practice when accompanied by a technical understanding of how to reduce energy consumption, while also accommodating daily routines and aspirations of the ideal home (Gram-Hanssen 2010; Maller et al. 2012). Failure to take such practices into account may lead to an increase in energy demand due to increased window openings for cooling and ventilation (Hong et al. 2006) or inappropriate maintenance of technologies leading to unexpected energy consumption (Hong et al. 2006; Gupta et al. 2014).

In addition, practice-theory based studies also identify a number of influences that are not

discussed by ABC-based studies. These include convenience and functionality (Zundel and Stieß 2011; Stieß and Dunkelberg 2012; Bartiaux et al. 2014; Judson and Maller 2014) and social status (Zundel and Stieß 2011; Stieß and Dunkelberg 2012; Galvin 2014b; Judson and Maller 2014). Functionality is sometimes described as being part of a broader notion of comfort (Munro and Leather 2000; Bartiaux et al. 2011) or modernisation (Reid and Ellsworth-Krebs 2017). The majority of improvements in functionality described in the literature are typically associated with spatial redesign to create bigger rooms where the family can dine and socialise together. While, many retrofit measures do not directly contribute to increasing space within the home, a need for more space is cited in a number of studies as the initial motivation for embarking on retrofit project. Many retrofit measures can be incorporated into home improvements that will increase the available living space – for example, the incorporation of loft insulation in the course of a loft conversion. Finally, highly visible measures are often associated with social status and belonging Judson and Maller (2014) specifically associate this with measures such as “...*solar panels, solar hot water systems, water tanks; and items having some prestige, particularly double-glazing and central heating, energy or water-efficient appliances*” (p. 507). However, the visual impact of low carbon retrofit measures on the aesthetics and architectural heritage of traditional buildings has raised concerns (Galvin and Sunikka-Blank 2017), such as where heritage features are covered with external wall insulation. Attempts to introduce such energy efficiency measures without compromising architectural heritage, for example through introduction of internal wall insulation, have been shown to lead to a reduction in internal space and functionality (Chiu et al. 2014; Crockford 2014). However, in some cases these conflicts have shown to give rise to more innovative solutions for installing low carbon retrofit measures as documented by Galvin and Sunikka-Blank (2014), whilst for other occupants increasing the comfort and functionality of the property was an essential part of preserving heritage properties by making sure they remained in use (Crockford 2014; Martínez-Molina et al. 2016).

Based on the range of influences identified above, it is not surprising that several studies have identified that influences on retrofit are often multiple (Stieß and Dunkelberg 2012; Fawcett and Killip 2014), paradoxical (Sunikka-Blank and Galvin 2016), and likely to vary, both on the measure in question (Gram-Hanssen 2014a) and between individuals (Fawcett and Killip 2014; Gram-Hanssen 2014b; Haines and Mitchell 2014). In an attempt to understand how these influences are distributed amongst the population, Risholt and Berker (2013) developed a preliminary taxonomy of different types of renovators based on a number of

factors including owner-occupier's knowledge of renovation and retrofit. Meanwhile, research by UKERC (2013) adopted a similar approach, but instead of focussing on individuals, they developed 'household conditions' such as prioritising competing demands on space; embodying particular physical needs; or adapting the material surroundings of their homes, which may lead to renovations. These renovations evolve over time, and understanding how energy efficiency requirements relate to influences that stimulate home improvements more generally, may provide insights into how they may evolve to include retrofit measures UKERC (2013); Judson and Maller (2014). Therefore, the remainder of this section will examine the teleo-affective influences acting on renovations.

Firstly, space and 'modernisation'²¹ were often cited by owner-occupiers as motivations for undertaking renovation (EST 2011), with Bartiaux et al. (2011) concluding that the interior layout of homes were often reconfigured into bigger rooms that better suited modern standards and practices of dwelling. Meanwhile, in a practice-based study on the proliferation of household appliances and demand for space Hand et al. (2007, p.679) state that these *"things [appliances] are routinely acquired and accommodated in support of a broad vision of how life should be"*. For example, the idea that families should have place to eat and socialise together has practical consequences for the spatial organisation of the home (Hand et al. 2007).

Secondly, Practice theory based research such as that undertaken by Gram-Hanssen and Bech-Danielsen (2004) acknowledges that in addition to these practical uses, the house also has symbolic meaning. The relative importance of these symbolic and practical aspects of the house varies in each household, with status symbols or symbols of identity being very important to some families whilst the practical use of the home is more important to others (Gram-Hanssen and Bech-Danielsen 2004). Similar conclusions were also reached by Munro and Leather (2000) where excessive expenditure on home improvement was seen by some owners as a barrier to its functionality as a relaxed family location. Gram-Hanssen and Bech-Danielsen (2004) state that the style, size and location of the house are still integrated with perceptions of social status. As social status was also identified as being associated with highly visible retrofit measures, this implies that those owner-occupiers motivated to invest in a conservatory or a garage could also be persuaded to invest in solar panels. In addition to the social status inferred by the location and structure of the house, practice theory based

²¹The Oxford English Dictionary (Oxford University Press 2017) defines modernisation as "the act of modernising something", whilst this in turn is defined as "adapting to modern needs or habits."

studies such as Gram-Hanssen and Bech-Danielsen (2004, p.25) concluded that the decoration of the interior of the home has become *“a way to develop and express identity...”* This study goes on to conclude that renovating is also seen as a symbol of family building, allowing occupants to negotiate and develop their identity within the family as partners and parents (Gram-Hanssen and Bech-Danielsen 2004). These findings are confirmed more recently by Gram-Hanssen (2014a) who states that some individuals are intrinsically motivated to undertake renovations, enjoying the creative task itself rather than just the end result. The adoption of a highly visible retrofit measures such as solar panels or biomass stoves could also be encouraged as an expression of identity.

Finally, Bartiaux et al. (2014) identified that one of the main influences cited by homeowners for undertaking renovations was aesthetics. Aesthetic choices will vary from one household to another, supporting Bourdieu’s (1984) assertion that such distinctions are used to differentiate oneself in opposition to other social groups. Aesthetics were also often, but not always, associated with heritage features, although as identified by Judson et al. (2013); and Sunikka-Blank and Galvin (2016), this relationship was far from simple and often varied between homeowners. Such complexities were often based on different understanding of heritage itself. For example, Judson et al. (2013) discuss how homeowners often place greater value on the aesthetic of a heritage building rather the authenticity endorsed in conservation regulations or codes of practice. Where heritage is considered an aesthetic feature in this way, home improvements – including low carbon retrofit measures - can often be as a threat to these heritage features (Galvin and Sunikka-Blank 2014).

Both EST (2011) and UKERC (2013) identify certain ‘trigger points’ at which renovations are likely to take place, such as change of ownership, starting a family or preparing for retirement. The VERD project concludes that proxy indicators could be used to identify households experiencing conditions that could stimulate retrofit (UKERC 2013). For example, while household type does not directly stimulate renovation, larger households are more likely to experience competing demands for space.

3.2.4 Summary – key insights and limitations

This section has shown how like ABC-based studies, practice theory-based studies have also identified financial concerns and comfort as common influences on owner-occupier low carbon retrofit. However, practice theory based studies have also revealed how interpretation of these influences varied significantly between households. Meanwhile

environmental concerns, which are commonly identified as an influence by ABC-based studies, is reported by practice-based studies as only being effective when it does not conflict with practitioners' daily routines. This may account for the unintended consequences of retrofit reported in the POE literature and evaluations of existing retrofit programmes where financial and environmental savings are undermined by conflicts with daily routines associated with maintenance or by altered expectations of comfort.

In addition to those influences that were also identified by ABC studies, practice theory-based studies also identified increased functionality and an influence stimulating low carbon retrofit, and subsumed within the concept of modernisation. As with ABC studies, the concept of modernisation was reserved almost exclusively to discuss amenity renovations. Practice theory studies also identified social status and identity to be important for both retrofit and renovations, bringing particular attention to the impact of home improvements on the appearance of the property. This is something that has been identified in POE literature as of particular concern with regards to traditional or heritage dwellings.

Unlike the market segmentation approach adopted by ABC-based studies, practice theory studies have instead sought to understand the conditions out of which the need to undertake home improvements might arise. This approach has been more successful at identifying different types of home improvements with different properties than demographic approaches, as demonstrated by the work of Risholt and Berker (2013) and Wilson et al. (2013). However, identifying households experiencing these conditions remains challenging, leading to criticisms regarding the tractability of this approach for increasing rates of low carbon housing retrofit. Furthermore, despite seeking to move away from an individualist, cognitive perspective, towards a socio-material understanding, all practice-based studies that have examined home improvements have continued to do so through comparative analysis of accounts of practice presented by individuals.

3.3 Theoretical Framework

3.3.1 Current state of knowledge

As the review of ABC theories of motivation (Section 3.1) and practice theories (Section 3.2) reveal, there remain a number of gaps in our current understanding of owner-occupier retrofit. These can be summarised as issues of scale, variation between individuals, and tractability, and they are outlined in greater detail in the remainder of this section.

Firstly, as Henderson and Ioannides (1987) argue, behaviours regarding dwellings present particular challenges, as the home is both a long-term investment good as well as an object of daily consumption. While the cognitive, decision-making of ABC theories is appropriate for understanding the conspicuous and infrequent consumption associated with many aspects of major home improvements, the failure of financial incentives such as the Green Deal has called into question this underlying assumption of rational decision-making. Even where these incentives have resulted in the adoption of low carbon retrofit measures, the financial and energy savings have often been lower than predicted (Gilbertson et al. 2006; Davies and Oreszczyn 2012; Brown et al. 2014). This has been attributed to the adoption of low carbon technologies without taking into consideration how these fit into daily expectations of comfort and routines of maintenance (Hong et al. 2006; Gupta et al. 2014). This has given rise to calls for a greater understanding of retrofit measures within the context of the daily activities within the home (Gram-Hanssen 2010; Maller et al. 2012). This mantle has been taken up by practice theories, which in doing so have identified a wider range of influences on home improvements than ABC-based studies including functionality (Stieß and Dunkelberg 2012; Bartiaux et al. 2014; Judson and Maller 2014) and social status (Stieß and Dunkelberg 2012; Judson and Maller 2014). However, practice theories have been subject to criticism that they are only suited to studying the minutiae of social life and are unsuited to understanding long-term and spatially dispersed phenomena such as home improvements (Schatzki 2016). Previous incentives such as the FIT or the Warm Front scheme, have shown that financial incentives can be effective. However, there is a need to understand how these financial concerns interact with more routine influences on low carbon retrofit, that neither ABC nor practice-based studies have yet been able to satisfy.

Secondly, while practice theorists argue that the points at which the individual values and attitudes that are the focus of ABC theories can effect change are limited, practice theories have been criticised for denying the transformative intervention of the individual altogether (Alkemeyer and Buschmann 2017). Similarly, practice theories have traditionally not given much consideration to the variations between practitioners or how these variations came to be. Alkemeyer and Buschmann (2017) argue that this assumption of pre-existing and homogenous competences and desires arises out of observing practices from the outside rather than understanding how they present themselves to participants. Despite this attempt to move away from the individual as the unit of analysis, existing practice theory-based studies still compare narratives of practices provided by individuals, rather than

experimenting with other units of analysis such as the measures themselves. Given that teleological influences have been shown to vary both according to the individual and the measures in question (Stieß and Dunkelberg 2012; Fawcett and Killip 2014), this could provide additional insights into owner-occupier retrofit as well as being better suited to the socio-material assumptions of a practice theory approach. Home improvements are one of the few points at which individual competences and attitudes could have an impact on energy consumption within the home (Strengers 2014). However, this environment will also be employed in the routine activities that are largely governed by existing infrastructure and social convention. Therefore, the study of these home improvements requires a theoretical framework that is sensitive to these structural influences as well as recognising home improvements as an opportunity for variations in competences and desires between individuals to have a transformative impact that has not yet been adopted by existing research on low carbon retrofit.

Finally, while the strong teleological emphasis in ABC theories that manifests itself through expected outcomes provides a clear point of intervention for those seeking to influence behaviours, attempts to use market segmentation to identify those individuals who would value particular outcomes have had limited success (Pelenur and Cruickshank 2014). Meanwhile, studies adopting a practice theory perspective have identified household conditions out of which the need to undertake home improvements arises (Wilson et al. 2015). However, existing research has not addressed how households experiencing these conditions would be identified or what interventions could be made to encourage adoption of low carbon measures. Therefore, whilst both ABC and practice theory studies advocate understanding retrofit within the context of wider home improvements, neither approach has identified a practicable approach for influencing future outcomes of home improvements (Sahakian and Wilhite 2013).

3.3.2 Proposed Theoretical framework

This section will conclude the literature review by outlining a proposed theoretical framework that seeks to address the current gaps in knowledge regarding owner-occupier retrofit. As identified in Section 3.3.1, these gaps include issues of scale, variation between individuals, and tractability. A nexus approach to practices (Hui et al. 2017), that focuses on relationships between components of practice, combined with greater exploration of the connective power of teleological influences could address these gaps.

A nexus approach to practices allows for understanding of activities across a variety of scales from practices such as cooking and washing up that are temporally and spatially proximate, to larger practices such as sourcing expertise or planning home improvements that might unfold over a much longer time period, in different locations. A nexus approach to practice is able to conceptualise both large and small phenomena, it considers them to be made of the same basic components: competences, materials and teleo-affective influences. As these components connect together into practices, practices connect into bundles, and bundles connect into constellations, the connections between these components often become ever more complex. Furthermore, as identified by Okrent (2000), teleology plays a role describing the relationship between activities and their environment. As in Okrent's (2000) example of making a cake, the location and sequence of events are structured by the goal they seek to achieve.

Furthermore, Hicky-Moody (2013); Alkemeyer and Buschmann (2017) and Reckwitz (2017), competences and affective relationships with material objects come to be through previous practices. Therefore, understanding these sequences of practices could offer insights into how the competences that enable participants to undertake low carbon retrofit are acquired, and potentially seek to provide wider access to these practices.

Finally, this wider access to practices resulting in greater competences leads on to the issue of tractability. By understanding where these competences come from, this gives some indication of where an intervention could have the result of making the opportunity to develop such competences more widely available. Similarly, understanding commonly cited connections between retrofit measures and renovation measures provides a very specific point where there is an opportunity for a renovation to evolve to include retrofit measures. By also exploring the connective power of teleology, relationships between practices that share common goals, but have no material connection, can also be revealed, potentially providing additional points of intervention.

This thesis will investigate the explanatory power of this nexus approach to practices to answer the research questions outlined in Chapter 1 regarding the teleological influences on retrofit and renovation measures (RQ1), the nature of the relationships between these teleological influences, home improvement measures, and competences (RQ2), and finally the implications of this approach for encouraging higher rates of retrofit (RQ3). In order to

facilitate this approach the study will not only examine the components that comprise practice but also the relationships between these components. In addition to potentially addressing gaps in our current understanding of owner-occupier, low carbon retrofit, examining these relationships will also help to determine if the connections in the nexus of practices as described by Schatzki (2016) provide an accurate conceptualisation of the relationships as described by participants.

In designing a theoretical framework that operationalizes a nexus approach, the research has been mindful that despite the significant ontological differences between ABC and practice theories, even these otherwise antithetical approaches share some basic 'components'. Firstly, both approaches recognise the importance of a teleological structure underpinning an action. These expected outcomes are in part informed by knowledge of the action, which is the second feature common to both ABC and practice theories. However, while ABC theories see this knowledge as coming from information, which when mediated by beliefs and values, informs motivations, practice theories see it as acquired through previous practice and mutually constituted through interactions with teleological structures and material objects. Finally, it is this material aspect, which in the case of home improvements, is common to both approaches. While ABC approaches see adaptations to the material environment as the outcome of this process of home improvement, practice theorists conceive the materiality of the home to be in on-going dialogue with the practitioner, enabling the practitioner by increasing competences and informing teleological structures. Therefore, the fundamental, ontological differences between these two approaches manifest themselves not through different features, but through the differences in how these features relate to each other as shown in Figure 5.1 and 5.2. Therefore, by structuring a theoretical and methodological framework around these three features, while leaving the participant to infer the relationships between these features, the researcher is also able to gain insight into the explanatory power of a nexus approach to practice for understanding owner-occupier low carbon retrofit.

The implementation of this theoretical framework through appropriate research philosophy, design, methods, and subsequent analysis using both individual and home improvement measure as the unit of analysis, will be the subject of more detailed explanation in the following Chapter.

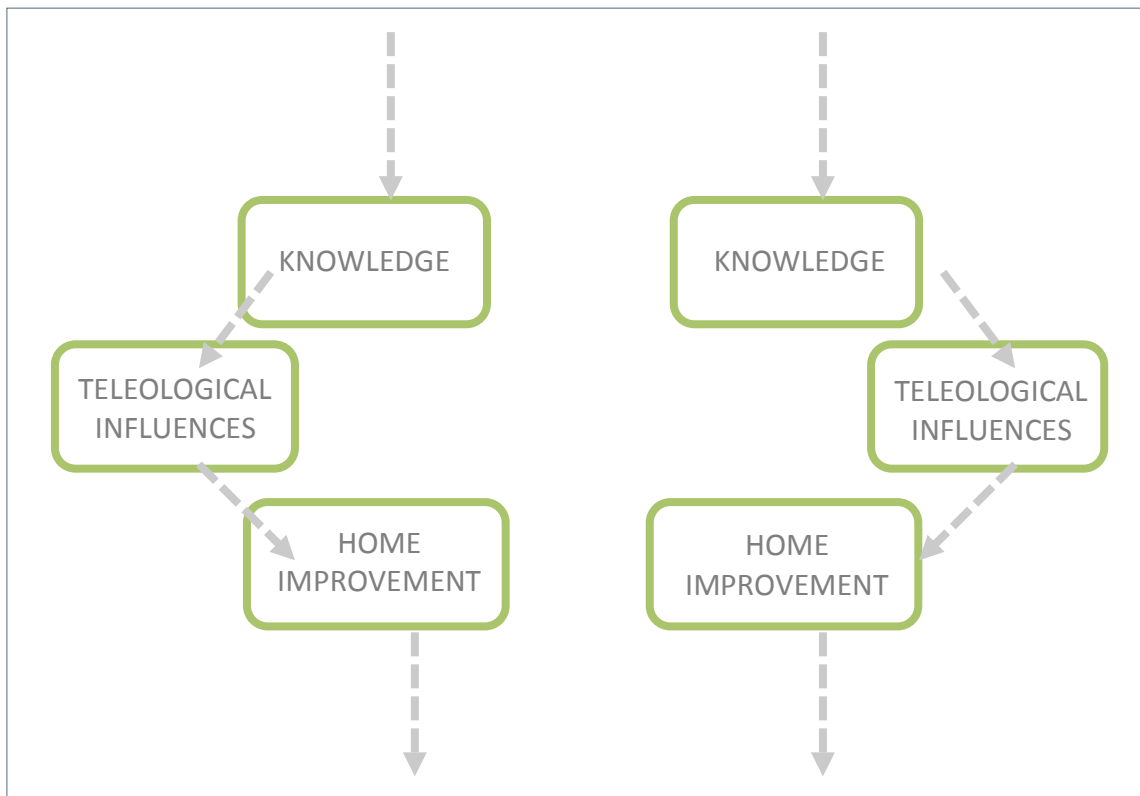


Figure 3.5: Linear relations between elements as described by ABC theories of motivation

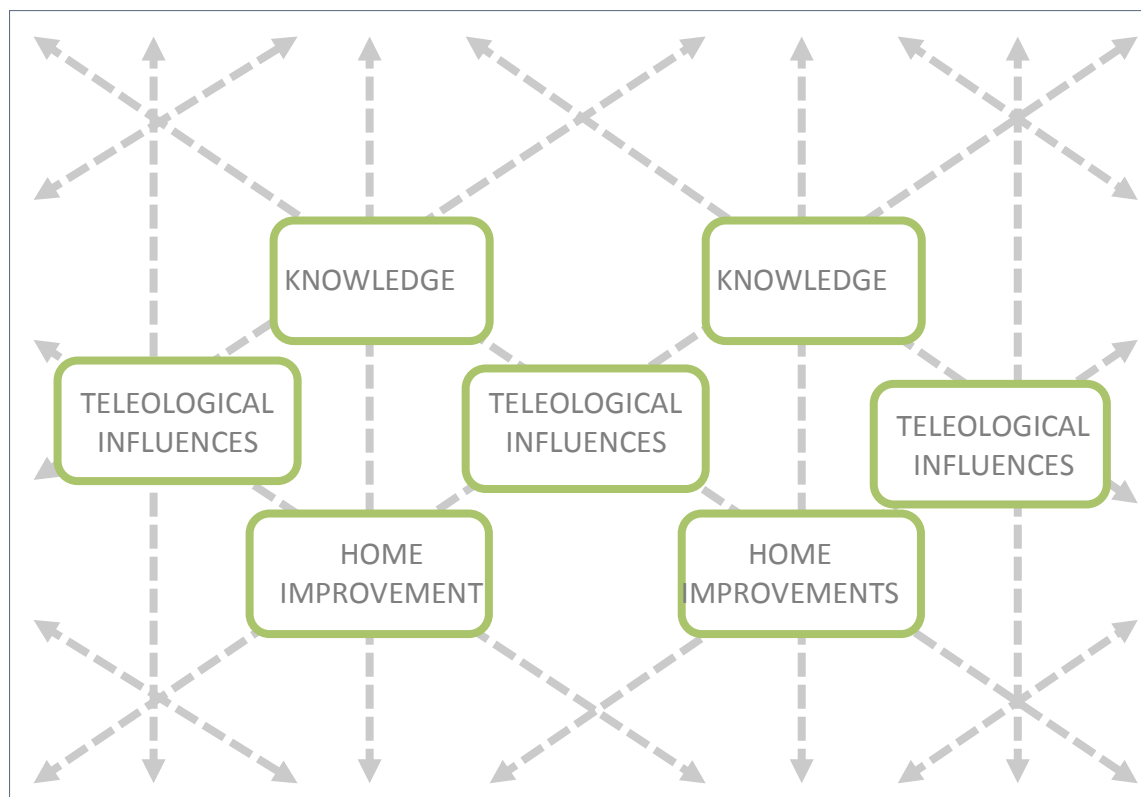


Figure 3.6: Non-linear relations between elements as described by practice theory

PART II: METHODOLOGY

4.0 Introduction

Chapter 3 describes a theoretical framework for investigating the explanatory power of a ‘nexus of practices’ approach to understanding owner-occupier home improvements. Through greater focus on the connective power of teleology, and investigation of how practices present themselves to participants, this approach seeks to overcome gaps in existing knowledge regarding unequal distributions of the ability to act between practitioners and the tractability of large phenomena such as retrofit. However, it is important to identify appropriate research methods and methodological approaches that will allow the researcher to apply this framework to investigate: the teleological influences on home improvements (RQ1); the connections between these teleological influences, competences, and home improvement measures (RQ2); and the implications of these findings for increasing the rate of housing retrofit (RQ3). This chapter will describe in detail the methodological approach adopted in this thesis. It will begin with the overarching research philosophy (Section 4.1) and then the research design (Section 4.2). This is followed by a description of the geographical context for the research (Section 4.3) and the sampling approach (Section 4.4). Subsequently, Sections 4.5 and 4.6 will discuss in greater detail, the research methods and approach to analysis. The final Section (4.7) will consider the ethical dimensions of this methodological approach.

4.1 Research Philosophy

As discussed in Chapter 3, previous attempts to identify individuals or households sharing desires or experiencing constraints that would make them more likely to adopt low carbon retrofit measures have been dominated by large-scale quantitative approaches, commonly associated with market segmentation. This includes studies such as those undertaken by Wilson et al. (2013), which sought to find ways that the highly descriptive and contextual data generated by practice based approaches can be gathered and analysed quantitatively.

This reflects the traditional association between the documentation and explanation of large-scale behavioural trends with quantitative research. The purpose of identifying such trends would be to identify market segments and target these segments with the appropriate information. Conversely, this thesis aims to gain a richer, primarily qualitative understanding not only of the teleological influences on owner-occupier home-improvements (RQ1), but also of the relationship between these influences, the measures installed and the competences acquired (RQ2). Additionally, this thesis aims to examine the implications of an enhanced understanding of owner-occupier retrofit, brought about through investigation of these relationships, for attempts to increase the rate of owner-occupier retrofit (RQ3). To achieve this, this thesis adopts a primarily qualitative research approach that facilitates the generation of deep, rich data, which can be probed in greater detail (Bryman 2008).

As discussed in Chapter 3, Alkemeyer and Buschmann (2017) argue that the lack of consideration given to variations in practitioners' competences is the product of viewing practices from the outside, rather than how they present themselves to practitioners. The flexibility of an inductive research approach, typically associated with qualitative research allows for the participant's perspective on the research topic to emerge and structure the investigation (Bryman 2008). The ability to frame the owner-occupier as 'the expert', with regards to the use of *their* home, *their* home improvements, and the knowledge *they* deem important has been previously identified as being of importance to this doctoral research (see Chapter 3). However, Charmaz (2006) contests the argument that an inductive approach is facilitated by delaying engagement with previous research until after data collection:

"If you have the luxury of entering the field without a literature review you may enter it with a fresh mind - or not. You might enter the field with unexamined pre-conceptions about the topic that you have long held."

(Charmaz 2006, p. 59)

Certainly, in this instance, where the author been engaged in the design and construction industry for over a decade, most recently, in the field of sustainable building and housing retrofit, it would not be practicable to assume that prior knowledge and experience had not influenced the research design. Indeed, in their review of journal articles examining non-technical aspects of 'energy' and 'buildings', Schweber and Leiringer (2012, p. 490) identify a role for researchers with "*an inside appreciation*" of the construction industry. The methodology used in this thesis aims to make the most appropriate use of the researcher's

previous engagement with this topic, whilst adopting an inductive research approach to explore influences on retrofit from the owner-occupier's perspective.

Chapter 3, identified a number of influences on retrofit. The majority of influences identified, such as quality of life (Fawcett and Killip 2014; Haines and Mitchell 2014) or social status (Zundel and Stieß 2011; Judson and Maller 2014) could be said to only exist within the organisations and cultures that sustain them. This broad concept is referred to as constructivism and encompasses many social science cognate disciplines (Bryman 2008). Constructivism acknowledges that whilst the formal aspects of organisations and cultures may restrain individuals, these individuals also play an active part in their creation (Bryman 2008). However, as previously discussed in Chapter 3, the nature of the appropriate ontological approach to examining and understanding environmental behaviour is a matter of some debate. Those advocating the humanist ontology underpinning many ABC theories on motivation propose that individuals construct social reality cognitively, using beliefs, values and norms (Abrahamse and de Groot 2014). Conversely, social ontologies argue that social reality is constructed and maintained through agreed patterns of actions between individuals that are constantly being negotiated, maintained or forgotten (Shove and Pantzar 2005; Strengers 2014). Finally, relational ontologies assume that both social and material elements co-constitute one another through their interactions. As previously discussed in Chapter 3, this research is structured around common elements between these approaches, namely: teleological influences, home improvement measures, and knowledge acquired. This thesis focuses on the relationships between these elements, the aim of which is twofold: Firstly, to determine if this approach can offer additional insights into understandings of owner-occupier retrofit, as specified by the research questions. Secondly, to investigate if a the relationships and connections that comprise a nexus of practices as described by Schatzki (2016) are an appropriate way of conceptualising the relationship reported by participants.

The emphasis this thesis places on understanding these relationships, as participants perceive them, also has very specific epistemological connotations. Such an approach implies that in contrast to research in the natural sciences, researchers of social reality should look beyond those phenomena that can be directly observed by the senses, towards an interpretivist epistemology. This epistemology acknowledges the distinctiveness of humans as conscious research participants who ascribe meaning to their actions (Schutz 1962), and therefore seeks to interpret participants' actions from *their* point of view. This moves away from the positivist pre-occupation with the *explanation* of human behaviour towards a

greater focus on the *understanding* of human behaviour (Bryman 2008). In their review of 153 journal articles on non-technical aspects of 'energy' and 'buildings', Schweber and Leiringer (2012) identify only 19 that adopted interpretivist approaches, and argue for more interpretivist research in this field.

In summary, this thesis aims to gather rich, deep, qualitative data regarding influences on owner-occupier home improvements and the relationships between these influences, the measures installed and the knowledge acquired. The research questions have inevitably been informed by existing literature and also the researcher's previous professional exposure to this field of study. In particular, the development of the research philosophy in the context of an understanding of dominant theoretical debates in this field has informed the decision to focus on the relationships between practices, particularly the connective power of teleology. Furthermore, the inductive research approach, combined with an interpretivist epistemology should allow the researcher to develop an understanding of the home improvement process, as it is perceived by the research participants, overcoming the existing tendency within practice theory to observe these practices from the outside.

4.2 Research Design

As a framework for the collection and analysis of data, the research design gives preference to examining certain dimensions of the research (Bryman 2008) and helps address the criteria for evaluating qualitative research. This research primarily uses a comparative research design, allowing for the development of greater understanding of the similarities and differences between retrofit and renovation projects as discussed previously (Chapter 3). Therefore, this comparative study uses the same research methods to collect data from one group of owner-occupiers who have incorporated retrofit measures into their home improvements, in parallel with one group of owner-occupiers who have undertaken amenity-only renovations. As Bryman (2008) describes, comparative studies can give greater insight into the conditions under which theories will hold. However, caution must be taken in interpreting the research findings, as not all differences between the two groups may be attributable to the variables used to define each group.

All owner-occupiers who are invited to take part in the study will be drawn from the same UK geographical location (see Section 4.3), limiting the variance in contextual factors such as availability of support from local organisations, housing typologies and local climate, which

could also account for differences between the two groups of owner-occupiers. Given the emphasis in this study on gathering rich, deep and contextual data regarding owner-occupiers' retrofit decisions it is also more practical to recruit owner-occupier's from a single location in order to allow the researcher to develop a more detailed understanding of that context.

The research design (see Figure 4.1) seeks to develop a more detailed understanding of the adoption of specific home improvement measures from the perspective of research participants (RQ1 & 2), using a combination of postal questionnaires, semi-structured interviews and a 'walk-through' tour of the home. This data is then analysed using not only the owner-occupiers who have undertaken recent home-improvements as the unit of analysis, as is typical with ABC based studies, but also the measures they have adopted as advocated by practice theory based studies. Finally, to consider the implications of these findings for encouraging higher rates of retrofit (RQ3), both of these units of analysis should be considered, alongside analysis of how knowledge of these home improvements was acquired.

This section has described the overall research design employed in this thesis and also provided an overview of the research methods and units of analysis selected to address the research questions. These research methods will be described in greater detail in Section 4.5. However, as identified in Figure 4.1, before collection of research data can begin the researcher must first identify an appropriate geographical location for the research as described in the following section (4.3).

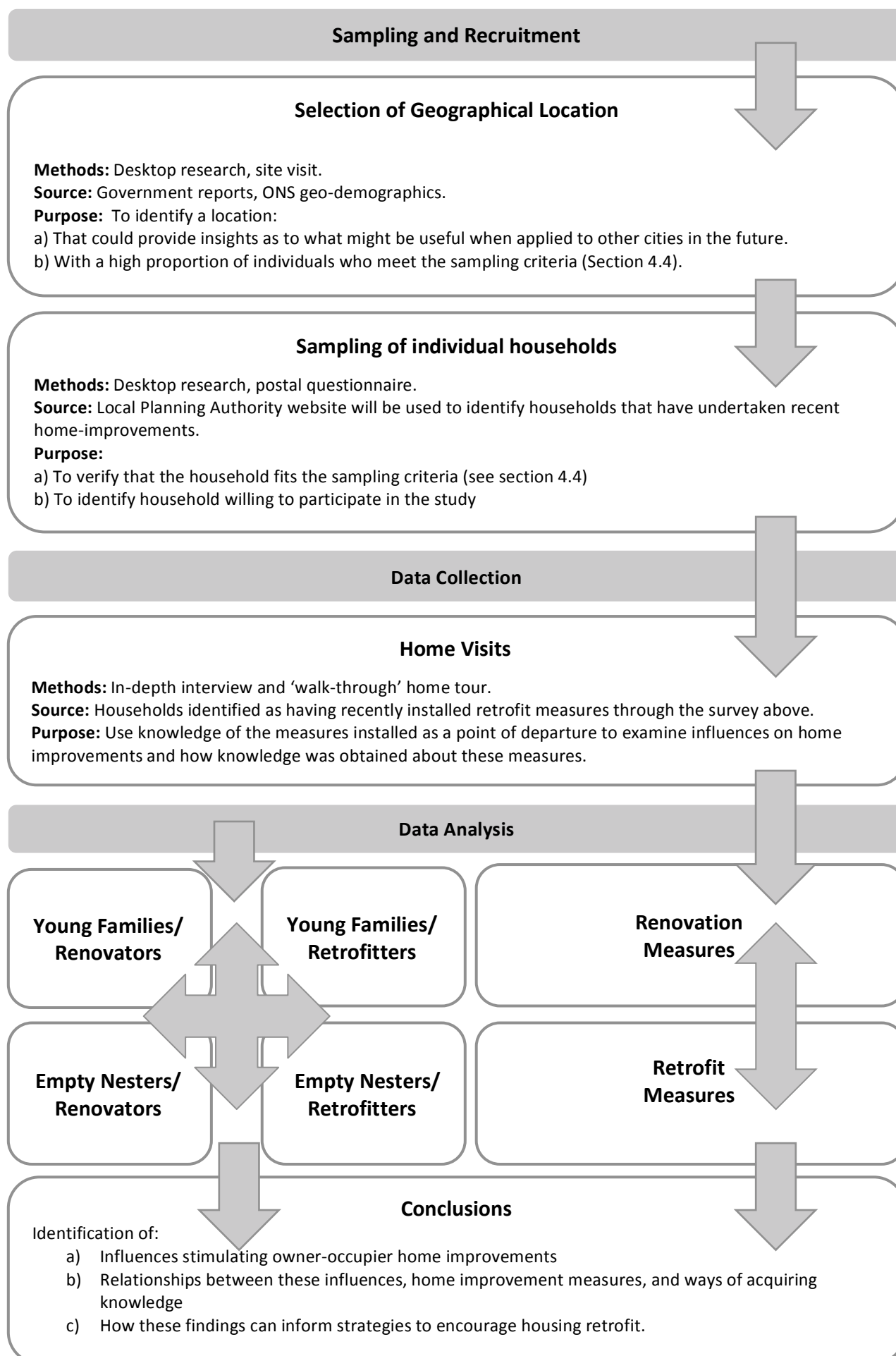


Figure: 4.1: Research Design

4.3 Geographic Location

Research by Helms (2003) and Baum and Hassan (1999) has shown that location influences home improvement decisions. Helms states that this can be due to positive attributes of the area such as good connection to public transport, meaning owner-occupiers would prefer to adapt their existing home than move to another location. However, location can also be an indicator of property age and other housing characteristics that have been shown to influence renovation and retrofit decisions. As previously discussed in Section 4.2, this research recruited participants from a single location, in order to minimise the variation in external factors that may account for the adoption of different home improvement types. This allowed the comparative analysis to focus on the differences between renovators and retrofitters (see Section 4.4 on purposive sampling), as well as allowing the researcher to gain a greater understanding of one context and how this has influenced these home improvement projects. The geographical location selected for this study was Bristol, the seventh largest city in England outside of London, accommodating approximately 437,500 inhabitants (Bristol City Council 2014). The following section provides a description of the policy and research context, the city's local context and its inhabitants.

4.3.1 Policy and research context

In light of the greater emphasis placed on owner-occupier instigated retrofit by incentive schemes and building regulations, and the researcher's experience of practising within this regulatory framework, an English city was selected as the context for this research. More specifically, the eight Core Cities that had received funding from UK government in 2012 to pilot the Green Deal scheme offering loans for retrofit measures, namely: Birmingham, Bristol, Leeds, Liverpool, Manchester, Newcastle, Nottingham and Sheffield were considered. The additional funding received by these cities and additional exposure to current incentives such as the Green Deal have allowed these cities to develop local supply chains (DECC 2014c), providing a snapshot of what the industry may look like in other cities in several years' time.

As Bryman (2008, p. 27) states *"all social research is a coming together of the ideal and the feasible"*. Therefore, Bristol was selected for further consideration, due to the amount of contact time required with research participants and their relative proximity to the researcher's city of residence. Further investigation revealed that Bristol had successfully applied for a further grant of £7,292,200 through the Green Deal Communities Fund in April

2014 (DECC 2014f). However, there is a wider culture of sustainability in Bristol that goes beyond awareness of government incentives such as the Green Deal as discussed below.

4.3.2 Local Context

In 2015, Bristol took over from Copenhagen as European Green Capital (Green Building 2014; Birch 2015) with £2m funding created for local sustainability projects. Whilst, Bristol might not be as sustainable as its predecessor, in terms of issues such as sustainable transport, Bristol is considered to be far in advance of the UK's other Core Cities (Birch 2015). The city has also been at the forefront of innovation with regards to Low Carbon Technologies, including the exemplar Zero Carbon Homes development by Barratt at Hanham Hall (HM Government 2010b), and one of only 130 large scale Combined Heat and Power (CHP) plants in the UK at the University of Bristol (DECC 2014a).

Bristol City Council also has a strong record on acting to mitigate climate change as identified by Mann et al. (2013) in their GIS-based evaluation of local government engagement with this issue. In 2014, Bristol City Council (BCC) collaborated with Climate Energy (an independent energy efficiency company) to run a program called 'Warm Up Bristol'. The program aimed to offer every home a Green Deal assessment and to pull together funding from the Green Deal, the Energy Company Obligation (ECO), the Green Deal Home Improvement Fund (GDHIF) and Green Deal Communities Funding to encourage homeowners to adopt retrofit measures. Bristol City Council has assessed the city's housing stock and identified 64,321 homes requiring solid wall insulation and 64,317 still requiring loft insulation, despite years of offers of very low cost or free insulation (Green Building 2014). In addition, they identified 20,806 homes with cavity walls to be insulated and 8,290 boilers requiring upgrading to more energy efficient models (Green Building 2014). Organisers sought to harness the power of local energy groups to promote 'Warm Up' Bristol, in order to make a significant impact on the number of houses in the city that require new boilers and cavity wall insulation. However, one of the main outcomes of the programme is considered to be an increase in the number of skilled installers and tradespeople in the local area (Green Building 2014). This improved infrastructure and a greater understanding of influences on owner-occupier retrofit are likely to be important given the large number of loft and Solid Wall Insulation (SWI) installations the 'Warm Up' Bristol scheme did not address. Similarly, the multiple methods of acquiring knowledge available to owner-occupiers in the city should provide useful insights into which of those methods owner-occupiers make

use of.

4.3.3 Geo-demographics

The City of Bristol is home to 437,500 residents (Bristol City Council 2014) accommodated in 182,747 dwellings (Office of National Statistics 2015a), 54% of which are owner-occupied. This rate of home-ownership is considerably lower than the national average of 66% (DECC 2012d) and may be attributable to the young population profile of Bristol, where 20-39 year olds make up 36% of the population compared to 27% nationally (Bristol City Council 2014). The city is comprised of 35 wards and as in many UK cities; young residents (under 35 years) are located in the centre of Bristol, resulting in the lowest levels of home-ownership in the central Electoral Wards of Clifton East, Cabot and Lawrence Hill. Due to these low levels of home-ownership, the researcher has eliminated these wards as potential locations for this research.

Owner-occupiers are largely located in peripheral wards such as Bedminster and Hengrove to the South; Brislington East, St. George East and Hillfields to the East; and Bishopston, Henleaze and Westbury-on-Trym to the North. These three northern wards are also amongst the most affluent areas in Bristol, where alongside Clifton, Clifton East, Cotham, Redland and Stoke Bishop average weekly household income is at least £100 greater than the average weekly earnings for the city. However, as shown in Figure 4.2 these wards are primarily home to older residents, with very few young families accommodated in this area. Wards such as Hengrove to the South and Brislington East and Hillfields to the East are home to younger families, and whilst they are less affluent, household incomes are broadly equal to or greater than average weekly earnings and levels of home-ownership remain relatively high.

Based on the geo-demographics described above, the search for appropriate participants through the Planning Portal began in the wards of Bishopston, Henleaze, Westbury-on-Trym and Hengrove. However, this was subsequently narrowed down to Henleaze and Bishopston based the higher response rates and greater suitability of the housing stock in these areas.

In light of the characteristics of Bristol as described in this section, it is clear that it could not be said to be representative of English cities. However, this study is concerned less with external validity and the statistical generalisation of results to other locations, than with ecological validity and an analytical understanding of the home improvement processes, that can be generalised to other cases through the logic of the analysis and subsequent

theoretical interpretation (Clyde Mitchell 1983). Bristol can be considered as a ‘unique case’ due to the more advanced stage of engagement with current policy as a Green Deal Pioneer city and an unusually prevalent concern with sustainability. This facilitated a focus on influences stimulating home-improvements rather than a discussion of the barriers that underdeveloped infrastructure can present. Therefore, as a case with particular characteristics, Bristol offers greater explanatory power (Clyde Mitchell 1983).

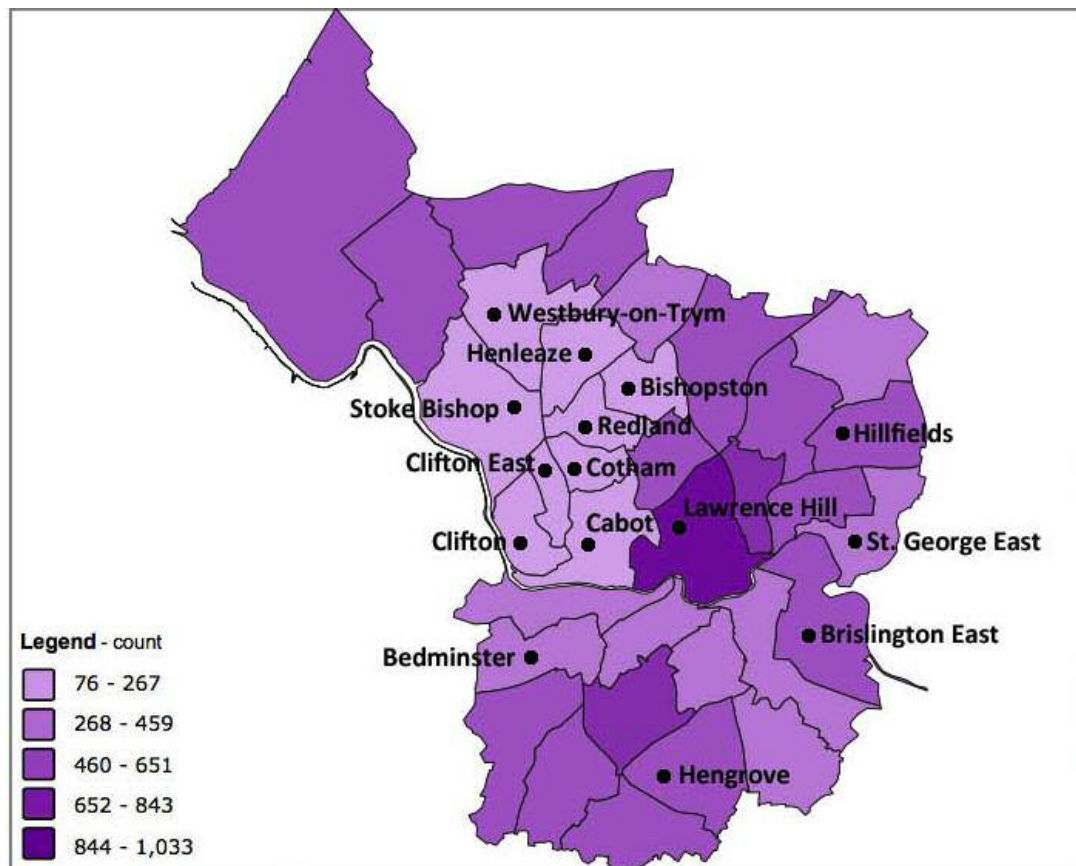


Figure 4.2: Ward map of the City of Bristol showing the distribution of households where Household Reference Person (HRP) is under 35, with dependent children (Count, Households, Mar11) (Office of National Statistics 2015a)

This Section has described the rationale behind the selection of Bristol as the geographical location within which to undertake this work. The following Section (4.4) will explain how potential research participants within this location were identified.

4.4 Sampling

This section will begin by describing the sampling strategy adopted by this research as well as reviewing important factors considered when developing sampling criteria for research

examining owner-occupier retrofit and renovation (Section 4.4.1). Subsequently, the sampling process employed to implement this sampling strategy and the size of the sample will be described in greater detail in Section 4.4.2.

4.3.4 Sampling Strategy

This research adopts a purposive sampling strategy, used commonly by qualitative researchers (Bryman 2008). Purposive sampling uses a strategic process to select units of analysis with a suitable combination of homogenous and heterogeneous characteristics to allow specific comparisons to be made that answer the research questions (Bryman 2008). As Bryman (2008) observes is also commonly the case, purposive sampling has been undertaken at multiple levels; through the selection of an appropriate geographical location (see Section 4.4) as well as the selection of units of analysis within that location as outlined below.

The overall aim of this thesis is to address several of the gaps in our understanding of owner-occupier low carbon retrofit, which could inform attempts to increase the rate of owner-occupier retrofit. As discussed in Chapter 3, many influences stimulating amenity only renovations cited by owner-occupiers are similar to influences stimulating retrofit. A review of studies of influences on retrofit has shown that previous ABC-based studies have adopted a general population sample, in which amenity only renovators are implicitly classified as 'non-adopters' (see for example Achtnicht and Madlener 2014). Conversely, this research aims to facilitate a comparative analysis of renovation and retrofit measures; and the knowledge and teleological influences associated with their adoption. While it is often impossible to create controlled conditions in fieldwork such as this, to allow specific comparisons to be made between amenity renovations and retrofits, individuals were selected who are otherwise relatively homogeneous with regards to further characteristics that have been shown to influence retrofit and renovation activity as discussed below.

i) Dwelling Characteristics

Owner-occupiers were all selected from a small number of wards within Bristol as outlined in Section 4.3. This served to recruit owner-occupiers living in dwellings of roughly the same age. Whilst age itself has been identified as influencing renovations (Baum and Hassan 1999), it is also indicative of many other dwelling characteristics, such as construction materials, construction techniques (for example cavity wall or solid wall), and housing typologies (for example terraced or detached). These characteristics can influence the viability of certain renovation and retrofit measures. For example, cavity wall insulation (CWI) is not viable in solid wall properties and many householders may also feel that external wall insulation (EWI)

would have a negative aesthetic impact on the streetscape of terraced properties. Therefore, whilst no two houses are exactly the same due to subsequent alterations, by selecting properties of a similar age and construction, the researcher will attempt to recruit owner-occupiers of properties with relatively homogenous characteristics.

ii) Household Income

The impacts of household income on decisions to retrofit is matter of some debate, with researchers such as Barr et al. (2005) arguing that adoption of energy efficiency technologies was limited to those households with capital to invest, while research by Pelenur and Cruickshank (2012) found that household income could not be correlated with any barriers to retrofit, including cost. This is also reflected in decisions to undertake amenity renovations, where Baum and Hassan (1999) and Plaut and Plaut (2010) argue that households with higher incomes are more likely to renovate, while research by UKERC (2013) indicates that lower incomes do not deter renovation, but merely slow the process down. In light of this uncertainty regarding the impact of income on retrofit and renovation decisions, this research recruited individuals with relatively homogenous levels of household income. As discussed in Chapter 2, current retrofit policy is moving towards encouraging more affluent owner-occupiers to invest their own funds in retrofit, therefore this research focused on owner-occupiers with average to above average household income.

iii) Household Lifecycle

A further factor that has been shown to influence home improvements is household size (Plaut and Plaut 2010). UKERC (2013) argue that greater household size places greater pressure on the available housing resources, making renovation more likely. However, many studies argue that, more accurately, it is changes in household size, associated with the lifecycle of the household that lead to home improvements (Baum and Hassan 1999). For example, a growing family may result in increased competition for use of spaces for different purposes resulting in renovations or extensions to the dwelling (Baum and Hassan 1999; UKERC 2013). Furthermore, in their study of home improvements, UKERC (2013) identified that household lifecycle was also likely to influence the type of home improvements undertaken, with retrofitters more likely to have lived in their home for over 10 years, but were likely to have smaller households with fewer dependent children. This research recruited owner-occupiers from stages in the household lifecycle at which changes in household size are commonly observed (UKERC 2013): young families whose household size is growing; and 'empty nesters' whose household size is decreasing. These two groups will

provide a further point of comparison to determine if any differences between the decisions undertaken with regards to amenity renovations and retrofit are endemic to the stage of the lifecycle at which these renovations typically occur.

Using the above sampling criteria, participants were selected that offer greatest explanatory insight into processes of home improvement (Clyde Mitchell 1983). In particular this research seeks to identify how these relationships vary between the low carbon retrofit process and the much more prevalent amenity renovation process and recruiting a relatively homogenous sample allows the research to focus on these differences. As older householders have been shown to be more likely to undertake low carbon retrofit (UKERC 2013), two different household types are also included in the sample to provide some indication of whether this additional variable will influence these relationships.

4.3.5 Selection Process

Firstly, as described in Section 4.4.3, the Office of National Statistics (ONS) mapping facility²² has been used to identify areas within the geographic location with a high proportion of inhabitants who meet the following sampling criteria:

- Average or above average income
- Homogenous dwelling typology
- Household type aligns with those shown in Figure 6.3

Subsequently, potential owner-occupier participants in these Wards were identified by searching the Bristol City Council planning website²³ for residential planning applications submitted between July 2012 and December 2014. Taking into account addresses for which multiple applications had been submitted or applications pertaining to unsuitable improvements such as minor landscaping works, a total of 233 potential participants were identified (from 272 submitted applications). Using the planning system to identify potential participants, rather than networks such as Bristol Green Doors or Superhomes as previously studied by Fawcett and Killip (2014) and Berry et al. (2014), avoids the bias towards individuals with an explicitly strong environmental agenda that often characterize these groups (see for example Fawcett and Killip 2014). However, with only one of the homes located in a conservation area, identification of participants through the planning system will exclude many smaller home improvement projects that fall under the category of permitted

²² <http://neighbourhood.statistics.gov.uk/dissemination/>

²³ <http://planningonline.bristol.gov.uk/online-applications/search.do?action=simple>

development as set out in the General Permitted Development Order (HMSO 2015). For example, smaller extensions and loft conversions that are not highly visible from the street can be undertaken without submitting a Planning Application. Therefore, identification of participants through the planning process is likely to bias the sample towards larger home improvements. However, as discussed in Chapter 3, (Section 3.1.3), renovations are of particular interest to those looking to encourage increased rates of retrofit as they offer an opportunity to adopt low carbon retrofit measures with minimal additional effort, inconvenience and cost. In these larger home improvements, it is more likely that these commonly cited barriers to adoption of retrofit measures will have already been overcome. This facilitates a conversation that moves beyond barriers, to the teleological influences on home improvement measures and the relationships between low carbon retrofit measures and other home improvements. However, many low carbon retrofit measures such as domestic scale Solar Panels, Air and Ground Source Heat Pumps and External Wall Insulation, are almost always allowable under permitted development outside conservation areas, therefore, in order to identify households that were also adopting these measures, the review of planning applications also had to be complemented by researcher observations in the field. Invitations to participate in the study, were hand-delivered, as this was not only a more cost effective method of delivery than post, but also allowed the researcher to spend time in the selected wards, and through external observation of properties, identifying further households that were currently or recently undertaking home improvements that might not be subject to planning applications. This method was used to identify a further 92 potential research participants, resulting in a total of 325 invitations to participate being sent out between July 2015 and June 2016. These invitations included an information leaflet explaining the nature of research being undertaken and inviting them to take part (see Appendix A) as well as a postal survey (as described in Section 4.5.3), asking owner-occupiers for 'face sheet' information in order to confirm they meet the above criteria and to identify their home improvement type and household type. As shown in Figure 4.3, overall 27% of questionnaires were returned and 16% respondents volunteered to take part in an interview.

There is little agreement in qualitative research regarding how many interviewees are required to support researcher's conclusions (Bryman 2008). In his study of African women's perceptions of sex, Guest (2006) found that data saturation - the point at which no new data is emerging and the cases are well developed in terms of variations (Bryman 2008) - was achieved at around twelve transcripts. Guest (2006) observes that this may be partly the result of the relative homogeneity of the sample (as discussed in Section 4.4.1) and the

narrow focus of the research questions. In light of Guest's findings, the measures taken to recruit a relatively homogenous group of research participants and the specific focus of the research questions, the researcher proposed conducting 12-16 interviews with participants from both the amenity renovation and energy efficient retrofit group, also seeking to achieve a balance between the two household types. The final sample reflected this sampling strategy with 31 interviews undertaken, with a balance of participants across these four groups as shown in Figure 4.4.

Electoral Ward	Sent: Invitations & Questionnaires	Returned Questionnaires	Volunteered Interviews	Completed Interviews
Bishopston	112	22 (20%)	11 (10%)	11 (10%)
Henleaze	213	67 (31%)	40 (19%) ²⁴	20 (9%)
Total	325	89 (27%)	51 (16%)	31 (10%)

Figure 4.3: Participant response rate by ward

Overall Total: 31 Participants			Household Type	
Home Improvement Type	Young Family (15 participants)		Empty-nesters (16 participants)	
Renovation (16No. participants)	Group 1: Young Family undertaking amenity renovation work only. (8 participants)		Group 2: Empty nesters undertaking amenity renovation work only. (8 participants)	
Retrofit (15No. participants)	Group 3: Young family undertaking renovation work including low carbon retrofit. (7 participants)		Group 4: Empty nesters undertaking renovation work including low carbon retrofit. (8 participants)	

Figure 4.4: Interview Participants

In order to identify any unintended biases in the purposive sampling, each participant was asked at the close of each interview, why they had volunteered to take part. By far the most common reason for being willing to take part in an interview, cited by over two thirds of participants, was a degree of empathy with the researcher. This was often through their

²⁴ Interviews were not undertaken with all volunteers in order to maintain a balanced sample across home improvement type (renovation or retrofit) and household type (young family or empty nester) as outlined in Figure 4.4.

professional or academic experiences, but was also sometimes based on the experiences of their children, siblings or partners:

“Well because I was a student for many years. I had a nightmare with my MSc....It was a two year thing where you spent one year swotting up converting from Geography to Planning and then one year where you did a big long thing, which I found very difficult. And my son is doing a PhD in London.”

(Retrofitter, Empty nester)

This empathy, and an association with Cardiff were cited most often by participants who had not incorporated low carbon retrofit measures into their home improvements. Meanwhile, a belief in the importance of research generally and more specifically on this topic was cited by eight participants who had incorporated retrofit measures into their home improvements, and only three participants that had not incorporated them. This implies that whilst those who had not incorporated retrofit measures into their home improvements had volunteered due to a relatively emotional association between my situation and those close to them, those who had incorporated retrofit measures had volunteered following consideration of the value of the research and topic. This marked difference in reasons to take part in the research is intriguing in that it may reflect different priorities influencing home improvements and potentially different value placed on research, information and advice arising from research by these two groups. However, it is clear that both groups share a familiarity with university-based study and research, either through their personal or professional lives, which is associated with more affluent individuals. However, as outlined in Section 4.4.1, it is the intention of this research to focus on those individuals who can afford to invest in home improvements, therefore, this bias in the sample is intentional and not a cause for concern.

4.5 Research Methods

4.5.1 *Considerations when selecting research methods*

Within this research design, the selection of appropriate research methods will be influenced by a number of factors including the research questions and research philosophy.

i) Research Questions

Perhaps the most apparent influence on the selection of appropriate research methods are the research questions. For example, unlike the home improvement itself, teleological influences on home improvements are not directly observable, making their identification (RQ1) largely reliant on participant's accounts. However, as stated by Christensen et al. (2014), in response to direct questions regarding their preferences, participants often under-represent the effect of normative influences, requiring careful selection of research methods used to generate these accounts. The research methods employed also need to facilitate sufficiently detailed accounts to investigate the relationship between these influences, the home improvement measures that were installed and the sources of advice and expertise that were accessed (RQ2). To establish what the implications of these findings are for encouraging retrofit (RQ3), an understanding of how and why this knowledge was accessed is also required.

ii) Research Philosophy

Research philosophies which emphasise qualitative research often seek to use methods that allow the researcher closer involvement with research participants, so they can understand the world through the participant's eyes (Bryman 2008). For example, research methods such as participant observation and ethnography that support a highly naturalistic stance are often perceived to be stronger in terms of ecological validity than methods such as surveys. Equally, to ensure credibility, multiple research methods may be employed wherever possible, so that the results can be triangulated.

Schweber and Leiringer (2012), report that the research in the field of 'energy and buildings' is currently dominated by quantitative methods and large samples (see Section 4.0 - 4.1) that are also typical of studies adopting ABC perspectives. Conversely as discussed by Browne et al. (2013), studies adopting the practice perspective privilege qualitative data. These studies explore the relationships between the different components of a practice (described in section 3.2) rather than looking for correlations between variables and generally employ

much smaller samples. Both ABC and practice theory based studies primarily use data generated from interviews, however, while ABC approaches have complemented this through the use of questionnaires, practice based studies have begun to incorporate building surveys, ranging from full structural surveys to more informal 'walk-throughs' of the property to contextualise occupant's answers. The research methods adopted by this thesis seek to build upon the strengths of both of these approaches. The research primarily used a specialised interview technique to collect rich, qualitative data, describing influences stimulating owner-occupier home improvements (see section 4.5.3). These interviews will be complemented by a walk-through tour of the home to contextualise the interview data through observations of the home and the changes made, and also by survey data to contextualise the relationships identified using this qualitative analysis within a larger sample of owner-occupiers.

4.5.2 Detailed description and justification of selected methods

As discussed previously this research seeks understand the influences stimulating home-improvements from the perspective of the owner-occupier, as well as the relationships between these influences, the measures they choose to adopt, and how knowledge regarding these home improvements is acquired. The findings can be used to suggest how strategies encouraging retrofit could be made more effective. The research methods employed are described in greater detail below.

i) Postal Survey

Following the identification of potential research participants as outlined in section 4.4, these households were sent a postal questionnaire. These surveys included 'facesheet' information relating to the sampling criteria such as household income and household size as well as confirming the measures that have been installed. The questionnaire was deliberately designed to be quick and easy to complete. The following participant response to why they decided to take part the research suggests this may have been successful:

"...and also the fact that it was quite short - your questionnaire. Had it been pages and pages long I'd have thought 'Oh, I will do that sometime' and I never would. But because it was quite short I could do it straight away."

(Retrofitter, Young Family)

Furthermore, a conscious decision was taken to provide return envelopes with address labels and stamps, rather than printing freepost envelopes, as research has shown that this can increase response rates (Edwards et al. 2002). The following quote from a participant regarding why he agreed to be interviewed indicates this strategy was also successful:

“So first of all I think it was just the fact that you spent time going through and actually put the stamps on and stuff. It wasn’t just like a mail shot, like a computerised one.”

(Renovator, Young Family)

As shown in Figure 4.3, 27% of questionnaires were returned correctly completed resulting in one of the following outcomes:

- a) The owner-occupier is not willing to participate further in the research
- b) The owner-occupier is willing to participate further in research but does not meet sampling criteria
- c) The owner-occupier is willing to participate further in research and meets sampling criteria.

In the case of a) and b), although the owner-occupier did not participate further in the study, with a response rate of 27% the data provided in the returned questionnaire can be used to place the detailed qualitative relationships identified through the interviews within the context of the larger population of 325 owner-occupiers in the geographical sampling frame who had undertaken home improvements. However, it should be taken into consideration that with such a small population there is a larger margin for error and that these statistics cannot be generalised to groups in other areas, time periods or households, which have not undertaken home improvements. In the case of c) the information provided was used to assign the participant to one of the four groups of interview participants described in Figure 4.4.

ii) Semi-structured interview and ‘walk-through tour’ of participant’s home

Much of the data necessary to identify teleological influences stimulating home improvements (RQ1) and establish their relationship with the competences acquired and the measures subsequently adopted (RQ2), was gathered through a single visit to the participant’s home. During this visit a semi-structured interview was undertaken with at least

one owner-occupier responsible for the recent home-improvement and this data was complemented where possible by a walk-through tour of the home. As described by Organ et al. (2013b) in addition to facilitating the walk-through tour, conducting the interview at the participant's home also allows:

"...a more complete understanding of the immediate context, enabling the interviewer to observe participants in their own environment. It also aims to reduce the interviewer's influences on participant's responses and temper the effects of 'power' on the dialogue".

Organ et al. (2013b, p. 493)

a) Semi-structured interviews

Semi-structured interviews were undertaken with the aim of assisting owner-occupiers to 'unpack' their own home improvement project. Interviews were considered particularly appropriate as the primary means of collecting data in this case due to the nature of the research questions. As these questions concern events that are episodic and require the reconstruction of previous actions, they are not amenable to participant observation. Semi-structured interviews, as conducted in this research, also provide the flexibility for the researcher to adapt to participant responses as appropriate (Walliman 2006), whilst facilitating a focus around more specific research questions (Bryman 2008). However, interviews are still reliant on self-reporting and as observed by Nolan et al. (2008) and Christensen et al. (2014), when asked specifically about their motivations, participants often underestimate the effect of some influences on their actions. Therefore, considerable time was spent developing an interview approach that would meet the following criteria:

- a) An ability to generate deep, rich, qualitative, empirical data, in which participants' responses can be probed in greater detail.
- b) Capacity to allow the participant's perspective on the research topic to emerge and structure the investigation, in place of the theoretical pre-conceptions of the researcher.
- c) An ability to frame the owner-occupier as 'the expert', with regards to the use of *their* home, home improvements, and the sources of knowledge they accessed.
- d) An ability to facilitate analysis of data using both the owner-occupier and measure as the unit of analysis.
- e) An ability to facilitate critical reflection and introspection on the part of the research participants with regard to the influences on their home improvements.

To develop a suitable interview approach that met the above criteria, this research drew on a *laddering* interview technique developed by Gutman (1982) for use in association with *Means-end Chain Theory* and later applied to housing preferences by Coolen and Hoekstra (2001). In this laddering technique, interviews begin by identifying the key attributes of the house that have been changed, before investigating what the expected outcomes or consequences of these changes were. Finally, this insight into the expected outcomes of the changes can elucidate what value or meaning these changes have for the owner and why they were important (Coolen and Hoekstra 2001). This approach addresses several of the criteria described above. By taking home improvement measures themselves as the point of departure, the laddering technique facilitates the analysis of data using these measures as the unit of analysis in addition to the owner-occupiers themselves. However, perhaps most evident is the focus the laddering technique places on encouraging research participants to critically reflect upon their motivations. However, in order to achieve this, Reynolds and Gutman (1988) stress the importance of creating a non-threatening interview environment and of making it explicit that that purpose of the interviews is to understand the perspective of the research participant. Therefore, the participant is positioned as the 'expert', while the interviewer is "*merely [a] trained facilitator of this discovery process*" (p. 13). The researcher sought to create a non-threatening interview environment by undertaking the interview in the home of the participant as advocated by Coolen and Hoekstra (2001). Further considerations with regards to creating a non-threatening interview environment included the researcher's own appearance and demeanour during the interviews. Wishing to position the participant as the expert in these interviews the researcher sought to play down their own qualifications and experience. This was done partly through attire, by eschewing the formal clothes worn in professional practice. Furthermore, although the researcher freely answered any questions regarding their academic or professional background, their registration as a chartered architect was not advertised unnecessarily, through concern this would worry potential participants that their home would be 'judged' for architectural merit. Furthermore, these interviews presented the researcher with the need to suppress the instinctive inclination, acquired in practice, to demonstrate professional competency, as discussed in Charmaz (2006, p. 156), thus creating space for the interviewee to demonstrate their own understanding. Despite this, the researcher's professional background and understanding of building physics and construction contracts provided some advantages, such as assisting with the recognition of owner-occupiers with an advanced technical understanding of the measures adopted or recognition of contractual processes. Examples

include the following quotes from participants describing a passive heating strategy employed by architects known as a thermal storage wall and the process of issuing payments under a standardised building contract:

“...the brickwork, exposed brickwork on that side, which gets all the sun as it comes around, and it gets really quite warm to the touch, so that really helps to keep the conservatory...”

(Retrofitter, Empty Nester)

M: “Because they just say, ‘ok, we repaired that ceiling and that’s two hours’ and then the architect says, ‘no, that’s one hour.’ Even if the architect wasn’t here to check how many minutes. So, I think he just started being upset about that.”

R: “So it sounds like the architect was doing architect’s certificates in terms of staging the payments?”

M: “Yes. It was a normal contract.”

(Retrofitter, Young Family)

However, whilst the laddering approach seeks to address “*the linkages between the product and the personally relevant role it has in the life of the consumer*” (Reynolds and Gutman 1988, p. 12) that is arguably more typical of Practice Theory based approaches, the technique is explicitly underpinned by *Means-End Chain theory*. This ABC approach is reflected in the linear causality that is assumed in the chains depicted in Figure 4.5. In contrast, the researcher conceptualised interrelated webs of data that also allowed for the identification of non-linear relationships as described by research participants.

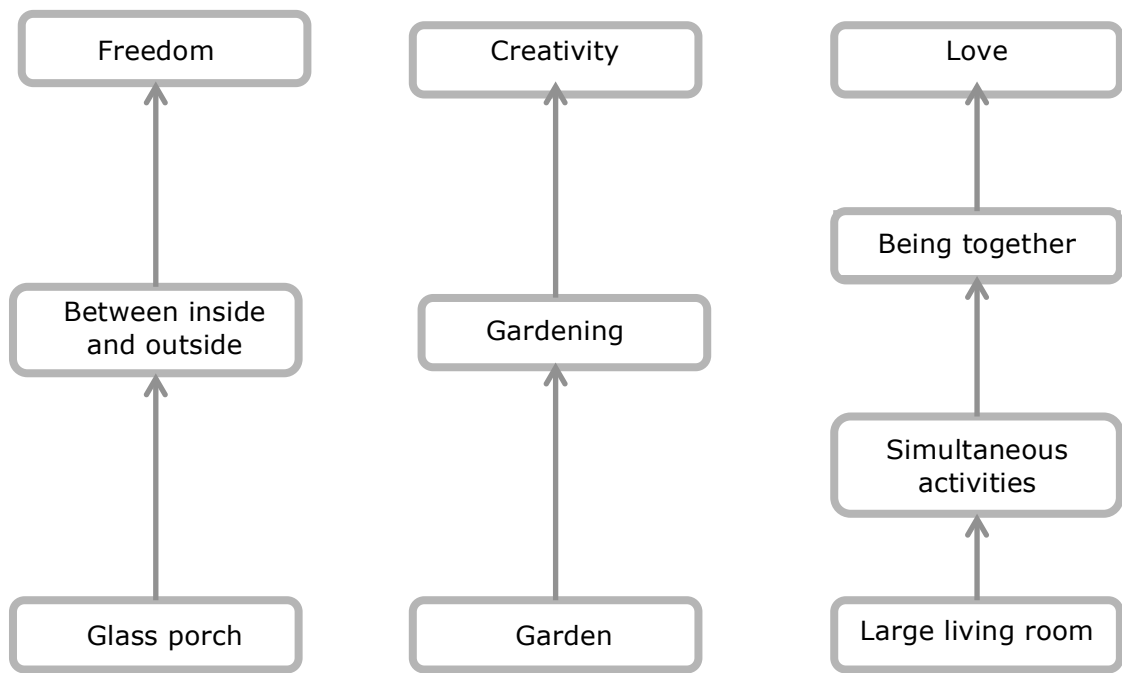


Figure 4.5: Means End Chains identified by Coolen and Hoekstra (2001)

Interview Structure

The interviews were structured into three sets of questions (as outlined in the interview guide in Appendix B): 1) initial open-ended questions, 2) intermediate questions, and 3) ending questions, with opening and closing comments to keep the participants informed about their rights and how the research will be conducted. The initial open-ended questions asked the participants to expand upon the information provided in the questionnaire and helped the researcher and the participant to develop a rapport. During the course of this conversation, the participant often began to expand on the benefits of certain measures or their reasons for adopting them. The intermediate questions were used to tease out individual measures for closer examination, mapping out the connections described by participants between these measures, influences on their home improvement and how they acquired appropriate knowledge. With the permission of the research participants, the interviews were recorded and subsequently transcribed rather than relying on writing extensive interview notes, as this can cause the researcher to move too quickly to abstract concepts, losing valuable details (Charmaz 2006), and can be difficult to undertake while taking part in the interview. Therefore, the researcher used diagrams to initially record any connections implied by research participants, and to act as a visual cue to ask questions aimed at exploring these connections further, as shown in Figure 4.6.

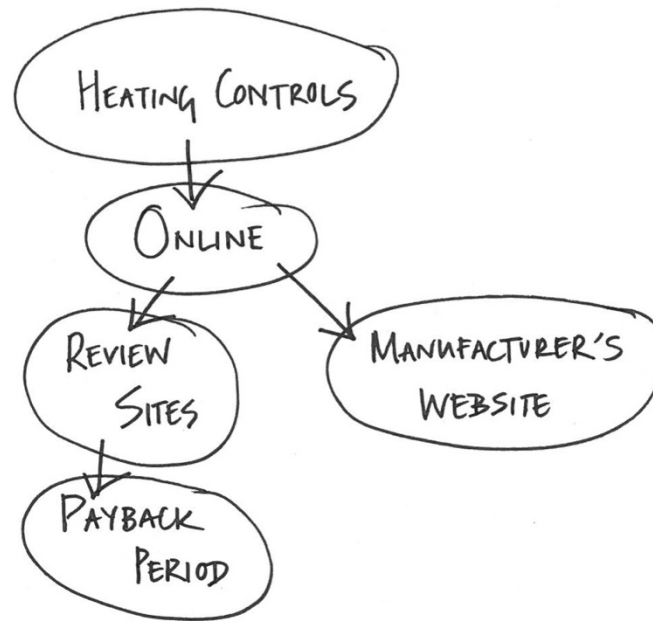


Figure 4.6: Interview diagrams (researcher's own notes)

This process may be repeated several times throughout the interview with a focus on different home-improvement measures, enabling to the researcher to record the relationships described between these home improvement measures and other measures, competences, and teleological influences. This subsequently aided the researcher in implementing the methodological innovation of analysing the data by home improvement measure, in addition to by household, as described in greater detail in Section 4.6.2. Furthermore, this approach was successful in helping participants to reflect on their tacit assumptions as discussed by Charmaz (2006) and illustrated in the following quote:

"Yeah, I think I've never spoken quite like I have about why... The symbolism of some of the things we've done. It kind of brings it all together, which you don't think about until someone asks you the question. You didn't ask me a direct question but you asked me an open question and the, you think 'well, actually', and then things like I wonder if I partly did because I knew my parents would..."

*(Young Family, Retrofitter,
discussing the interview technique and its affect on her)*

The number of measures discussed in any one interview depended primarily on the breadth and depth of data the participant was able to provide in connection with any one measure.

Finally, the ending questions encouraged participants to reflect on their home-improvement experience, and how they think it could have been better.

b) Walk-through tours

As discussed in Section 4.5.2, academic research has recently begun incorporating building surveys of various levels of detail into studies examining influences on owner-occupier retrofit. Building surveys have been included in previous studies to understand the condition of property (Munro and Leather 2000) or to assess whether the construction is physically appropriate to be retrofitted (Dall'O' et al. 2012). However, Organ et al. (2013b) propose that in addition, a building survey will help to contextualise the retrofit, particularly in terms of how the physical environment has influenced the adoption of these measures. Where permitted by the owner-occupier, this research incorporated a walk-through tour of some, or all, of the home, facilitating a greater awareness of the property and the renovation measures that would have been technically appropriate. However, the dwelling itself was not the sole focus of this walk-through tour, which also observes the owner-occupier's use and perceptions of different parts of the dwelling. Through observation of how different parts of the dwelling are used, the walk-through tour may capture matters that the participant takes for granted and therefore may not mention in an interview (Bryman 2008). To minimise the potential bias that may be caused by owner-occupiers 'preparing' for the walk-through tour, the researcher sought to employ the same approach adopted by Judson and Maller (2014), asking during the interview if the owner-occupiers would be willing to give the researcher a tour of all or some of the home. However, during the majority of interviews, owner-occupiers volunteered to show the researcher around in the course of the interview, and large sections of the interview might take place moving from one room to another. Therefore, the interviews and walk-through tours became more integrated than originally envisaged. For many of the home improvement projects, plans of the proposed changes were available on the Planning Portal website and had been reviewed by the researcher prior to the interview. However, where additional observations were made during the course of the tour, these were recorded using sketches, such as those shown in Figure 4.7, as this is less intrusive than taking photographs (Hurdley et al. 2017). It was made explicit to research participants that as with the other research questions, the tour was entirely voluntary.

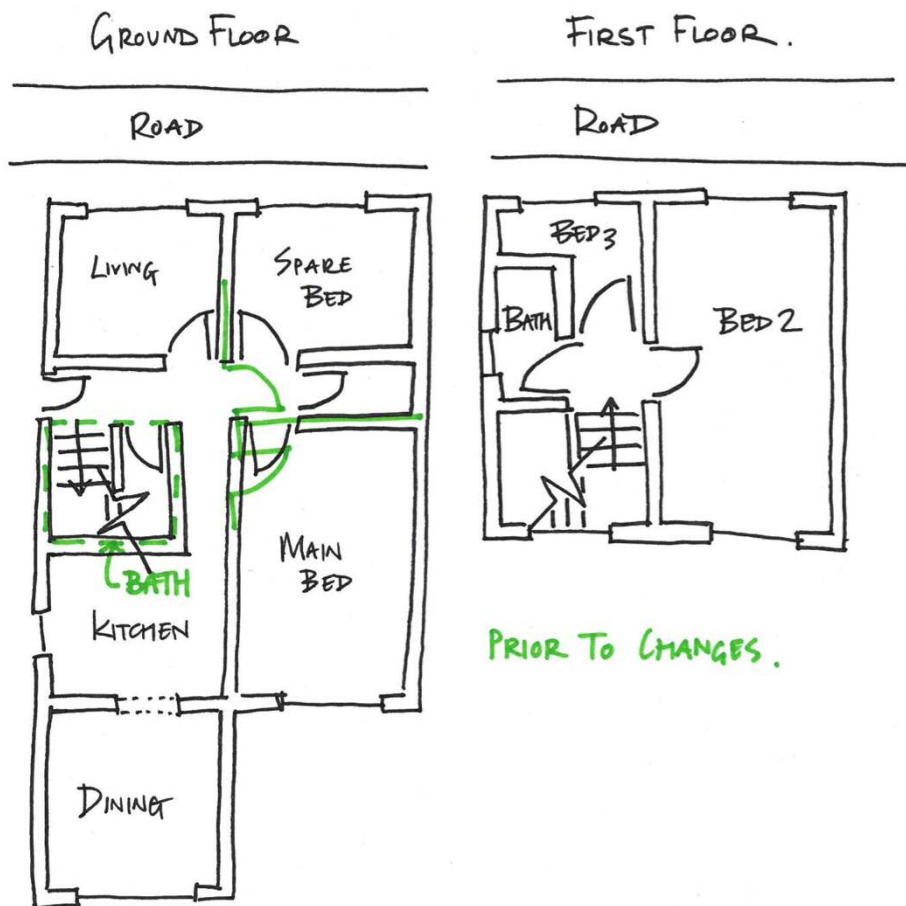


Figure 4.7: Sketches recording observations made during walk through tour (researcher's own notes)

Many renovators opted to give a partial tour of the home – just showing the researcher the part of the house that had been altered. However, retrofitters were more likely to give either a full tour or no tour at all depending on the nature of the improvement adopted (for example, a tour to demonstrate solar PV would not be practical). In total seven full walk-through tours and 12 partial walk-through tours were undertaken. The remaining 12 interviews did not include a tour but many of these were undertaken in the area of the home most affected by the home improvements. The majority of participants appeared to be very comfortable with the interview situation.

4.5.3 Triangulation

The research methods outlined above describe how multiple research methods were used in the investigation of common units of study in order to achieve methodological triangulation. The data gathered through semi-structured interviews with owner-occupiers and the walk-through tour was triangulated to examine influences stimulating home improvements. However, in addition to the triangulation of research methods, the research also includes

elements of *theoretical triangulation* by approaching the research topic with both ABC and practice perspectives in mind. To enable theoretical triangulation, units of study that are common to both perspectives must be identified as discussed in Chapter 3. The research data can then be considered in light of multiple theoretical approaches. In this case, triangulation of methods served to increase the validity of the data by overcoming the inherent biases that emerge from adopting single methods. Meanwhile, adopting units of study common to both theoretical perspectives allowed the relevance and utility of a nexus approach to practices to be considered against ABC alternatives.

4.5.4 Piloting

A pilot study of the owner-occupier postal survey, owner-occupier interview and walk-through tour of the home was undertaken. This pilot took place in the city of Cardiff, to avoid excluding any suitable Bristol residents from the main study. This allowed the researcher to better gauge the amount of time likely to elapse between sending out invitations and undertaking interviews and also resulted in adjustments being made to one of the survey questions to include the dates that various home improvements were undertaken. The interview technique developed and described above was also piloted to ensure that this elicited an appropriate breadth and depth of information.

4.5.5 Limitations of selected methods

A significant practical consideration taken into account in this research design is the limited access the researcher had to private homes. Agreeing to participate in the study required a significant commitment on the part of the owner-occupiers, and this research seeks to use a combination of complementary methods to gather sufficient data in a relatively short period of time, keeping inconvenience for the participants to a minimum. Such triangulation of multiple research methods is employed wherever possible in this study to ensure the credibility of the findings. For example, the inclusion of a 'walk-through' home tour may help to overcome any interference the more 'contrived' nature of the interview creates with understanding the worldview of the interviewees. However, caution should be exercised when interpreting these observations, to ensure they are representative of other times of the day or week. In addition, some owner-occupiers may consider this to be an invasion of privacy and choose to opt out of this element of the research. Therefore, the interview must be carefully designed to provide sufficient information on influences on home-improvements, in the event that complementary data from the 'walk-through tour' is not available. The study has sought to minimize reactive effects, through the selection of research methods and

location. However, given the ethical obligation to obtain informed consent, the influence of such an effect cannot be entirely discounted (Bryman 2008).

4.6 Data Analysis

4.6.1 Considerations when selecting appropriate methods

The analysis of qualitative data has not reached the high degree of codification found in quantitative data analysis, and the most appropriate methods of analysis will be largely dependent on the philosophy and aims of the research. For example, some approaches to analysis such as *analytic induction*, require the formulation of a hypothesis prior to collecting their data. Whilst this hypothesis is rigorously tested against the data collected, and adjusted or redefined as necessary, it focuses on finding universal explanations of the conditions sufficient for a phenomena to occur, but pays little attention to understanding why some individuals are more susceptible to these phenomena than others (Bryman 2008).

A second, and even more prevalent approach commonly cited by qualitative researchers is Grounded Theory Method (GTM). GTM is a highly inductive approach, focussing on concepts emerging from the data itself, postponing researcher engagement with the relevant literature until quite a late stage in the research process. However, Charmaz (2000) argues that the GTM analysis approach as described by Glaser and Strauss (1967) inherently implies an objectivist ontology in which knowledge is pre-existing within the research data, waiting to be discovered by the researcher. In light of this Charmaz (2000) proposes an alternative approach to GTM, which is more compatible with the constructivist ontology adopted in this research. This variation on GTM known as Constructivist Grounded Theory Method (CGTM) “*recognizes the mutual creation of knowledge by the viewer and the viewed, and aims toward interpretive understanding of subjects’ meanings*” (Charmaz 2000, p. 250).

Whilst GTM is the most prevalent approach to data analysis found within qualitative research, it is not without its critics. The most common criticism being that researchers are unlikely to be successful in suspending their knowledge of the relevant theory and literature until the advanced stages of the analysis (Bryman 2008). Contemporary qualitative researchers even consider a degree of awareness regarding the relevant theory and literature to be desirable to focus on specific research questions and build on existing bodies of research (Bryman 2008). Therefore, like many other studies (Bryman 2008), this thesis adopts only aspects of GTM.

4.6.2 Detailed description and justification of selected methods

As previously discussed in Section 4.1, it would not be appropriate to assume that the researcher's prior experience and knowledge of the relevant literature hadn't any influence on the research approach. However, as outlined below, the coding and analysis drew on many aspects of Constructivist Grounded Theory Method (Charmaz 2006) aiming towards an inductive, interpretivist understanding of concepts emerging from the data. Therefore, each interview was transcribed in full in order to avoid early elimination of data on the basis of the researcher's assumptions or preconceptions.

These transcripts were then coded using Computer Aided Qualitative Data Analysis Software (CAQDAS) N-Vivo. Like many CAQDAS programmes this software is based on a code-and-retrieve system, which, whilst dependent on the researcher to code the data appropriately, removes much of the manual or clerical work involved in this process. Some qualitative researchers have raised concerns that such programs will result in increased fragmentation of data associated with coding and subsequent loss of context. However, the use of N-Vivo not only made coding faster and more efficient, but also facilitated a more detailed analysis of connections through 'relationship codes' between two conceptual or substantive codes. Furthermore, analysis of this data using the matrix queries facilitated by NVivo, allowed the researcher to analysis this data by home improvement measure, independently of the research participant, as previously discussed in Chapter 3. Whilst some researchers consider the quantification of qualitative data as a negative consequence of these programs, they may also help to reduce the overuse of anecdotes and provide some indication of the prevalence of the phenomena observed.

It is important to keep coding in perspective as only part of the analysis, however, it is an important first step in the analysis of qualitative data. Unlike quantitative research, codes used in qualitative research emerge from the data itself and are generated by researchers *"interacting with their data again and again, and asking many different questions"* (Charmaz 2006, p. 46). The first stage of coding employed in this analysis involved coding chunks of text under the home improvement measures being discussed, allowing the data to be analysed by measure, independent of individuals. This was then followed by the two main phases of grounded theory coding: an initial line-by-line phase, followed by a more focused, selective

phase that uses the most significant or frequent initial codes (Charmaz 2006) as outlined below.

i) Coding

The initial stage of coding proceeded using a line-by-line coding technique. Guided by the research questions, each line of text was examined to determine the measures being discussed; the influences described and the sources of knowledge cited. However, within these high-level themes, the principles of line-by-line coding were followed, with initial codes kept short, precise, and close to the data. Charmaz (2006) observes that this process of interrogating each line of the data *“encourages you to see otherwise undetected patterns in everyday life”* (p.125).

These codes were provisional, as the aim of initial coding is to remain open to all theoretical directions (Charmaz 2006). Therefore, at this stage a large number of highly precise codes were created, gradually focussing in on the codes that fit the data best as the coding progressed. This process generated approximately 450 initial codes reflecting the actions that participants described undertaking or happening around them. As described by Charmaz (2006) coding for actions keeps focus on what is happening in the data rather than on individuals. Avoiding this bias towards the individual as the unit of analysis is particularly important in the case of this research, where it is the aim to analyse the data using both individuals and measures as the unit of analysis. In addition to coding actions, relationship codes were also used to record the connections and associations participants made between measures, influences and knowledge in the course of the interview.

Of these 450 initial codes, 250 described influences on home improvements and 215 of these codes, that were most frequently mentioned, were then consolidated into 12 focussed codes describing a series of actions. The purpose of these focused codes is to assist with the transition from the concrete initial codes, grounded in the data towards a larger analytic story.

ii) Analysis

The first stage of the analysis looked to understand the teleological influences stimulating home improvements and if/how these varied between home improvement type and

household type (RQ1) by comparing different groups of individuals or measures to determine if each focused code was equally important to both groups. In the case of individuals this was easily facilitated by grouping transcripts together, however, in the case of measures, this was only made possible by applying the matrix queries facilitated by NVivo, allowing data to be sliced according to measure. Where focussed codes were similarly prevalent across both groups, the quotes associated with these codes were then examined to determine how participants were talking about this code and if all participants were discussing it or citing it as an influence in the same way. Where a focussed code seemed to be much more prevalent amongst one group of individuals or measures, the quotes were examined to try and identify why this might be the case.

The second stage of analysis sought to look in more detail at the relationships between influences on home improvements, home improvement measures and competences regarding these measures (RQ2). The analysis examined the following relationships codes and how they varied between each group of participants:

- Influences on home improvements - home improvement measures,
- Home improvement measures – sources of knowledge,
- Sources of knowledge - influences on home improvements,
- Influences on home improvements - Influences on home improvements,
- Home improvement measures - home improvement measures,
- Sources of knowledge - sources of knowledge.

This allowed the researcher to determine if the connections between these elements varied either by participant group or home improvement measure, and if these connections suggest individual linear relationships leading to the adoption of home improvement measures, or non linear relationships, connecting multiple home improvement measures.

In the final stage of analysis, sources of knowledge were distinguished from the practices of acquiring this knowledge and how participants described evaluating and employing them (contributing to RQ3). Having identified the strategies used to evaluate potential sources of skills and expertise, the analysis then proceeded to investigate the connections perceived by different groups of participants between these strategies, different sources of skills and expertise and different home improvement measures.

As with any analysis, the process described above does have its limitations. The fragmentation of interview transcripts associated with coding is sometimes considered to result in the loss of a contextual understanding of this data and the narrative flow of the interviewee. This analysis seeks to minimise the loss of such data by making the associations between topics one of the considerations to be taken into account when developing codes as well as the use of any linguistic indicators that suggest interviewees perceive a causal connection between two events or phenomena. Finally, although the analysis process described above shares many characteristics with a grounded theory approach, as previously discussed it is not possible to adhere entirely to this approach due to the researcher's significant pre-engagement with the industry and the relevant literature. However, it is hoped through a rigorous qualitative analysis and multiple triangulation strategies, any influence this has on the researcher's findings were made transparent and minimised.

4.7 Research Ethics

This research was subject to ethical approval by the Research Ethics Committee (REC) at the School of Geography and Planning, Cardiff University. This committee is established and operates in accordance with the requirements of the ESRC Framework for Research Ethics (ESRC 2015). The ethical considerations taken into account in the design and implementation of this study are discussed in the following section.

4.7.1 Informed consent

Informed consent is defined as participants being given sufficient information to decide if they wish to take part in the study. Whilst this may sound simple to achieve in principle, guaranteeing informed consent can present the social researcher with a number of difficulties. For example, in situations where research is conducted in public settings or as in the case of this research, where the researcher may have minimal control over other activities taking place in the immediate surroundings, it may not be practicable to explain the research in the same level of detail to all individuals the researcher may come into contact during the course of an interview with the main research participant. Equally, as is the case in this research, giving participants too much information could risk influencing their responses to interview questions.

The first component of informed consent, providing research participants with sufficient information to make an informed decision, was achieved by sending research subjects an information leaflet explaining the nature of the research, the methods and timing, the potential costs and benefits and inviting them to participate. The leaflet included in broad terms how and why potential participants had been selected; the information that would be collected; the purposes for which it was to be used; and the potential risks and benefits of the study. The information sheet also explained the participant's rights: that participation was entirely voluntary; that they could refuse to answer any questions they did not wish to; could withdraw from the research at any point up to seven days following the interview; and assured participants of all precautions taken to maintain confidentiality and anonymity. However, it avoided placing unnecessary emphasis on energy efficient retrofit as this could have resulted in a reactive effect on the part of the owner-occupiers that could have influenced their responses. The sheet also provided contact details of the researcher, giving potential participants the opportunity to review and discuss this information with the researcher and ask any questions. This approach gave potential participants ample time to consider this information and decide if they wished to participate. Written consent was gained by asking those participants, who volunteer to take part in the research to sign a consent form immediately prior to the semi-structured interviews being undertaken. This provided participants with a further opportunity to review and clarify this information with the researcher whilst avoiding the negative effects on rates of participation that asking participants to sign a consent form on initial contact has been shown to have (Bryman 2008)

4.7.2 Confidentiality and anonymity

Taking precautions to protect participant confidentiality and anonymity is necessary out of respect for the participants right to privacy; to preserve good will between researchers and participants and finally is a legal requirement under the Data Protection Act 1998. The Act governs the processing of personal data, which is defined in the Act as:

"...data which relate to a living individual who can be identified from those data; or from those data and other information which is in the possession of, or is likely to come into the possession of, the data controller; and includes any expression of opinion about the individual and any indication of the intentions of the data controller or any other person in respect of the individual."

(The Stationary Office 1998, p. 2)

Therefore, anonymised data is exempt from many aspects of the Act. To protect participant's identity, any identifying information was removed from interview transcripts and field notes and each respondent was allocated a code under which field data relating to them was stored. A key, identifying which code relates to which participant will be kept separately in a secure location.

4.7.3 Potential harm to participants and researcher

The potential benefits of this research include an improved understanding of influences on owner-occupier home improvements and how knowledge about these improvements is acquired, that both policy makers and local homeowners could see the benefit of. Meanwhile, the potential harm to research participants is relatively small with the greatest risk being intrusion of privacy. Some owner-occupiers may find the presence of a researcher in their home stressful, however, as outlined in the Social Research Association (SRA) statement of ethical practice the researcher sought to be sensitive when in people's homes and *"try to minimise disturbance to the subjects themselves and to the subjects' relationships with their environment"* (Social Research Association 2003, p. 35). The researcher minimised the potential for intrusion of privacy by being clear about the information that was required of participants and allowing them to refuse to answer questions. Finally, their privacy was maintained by ensuring confidentiality and anonymity by taking the precautions outlined above.

Perhaps the greatest risk of harm is to the researcher, whilst conducting interviews in private dwellings. A system was put in place to ensure that a contact within the university was aware of the researcher's exact whereabouts during interviews. Arrangements were made for the researcher to contact this person shortly following the interview. If the researcher did not make contact (and could not be contacted) then this contact was to alert the relevant authorities immediately.

4.7.4 Authenticity of data

Increasingly, the quality of the research has also become entangled in questions of ethics and it is the quality of the research that is at the heart of the ESRC Research Ethics Framework. Precautions taken to ensure the quality of this research include the triangulation of multiple research methods and theory. However, it is not always easy to reconcile the need for quality with other ethical considerations. For example, in this instance expressing the researcher's aim to apply the research findings to promote higher rates of housing retrofits could have

caused a reactive effect, contaminating the research findings and thus reducing the quality of the research.

4.8 Conclusion

This chapter has described the overarching research philosophy that informs this thesis, allowing the theoretical framework described in Chapter 3 to be implemented. This philosophy seeks to understand owner-occupiers' perspectives of the influences on their home improvements, in order to better understand the relationships between practices as described by participants, and variations in practice this produces. Furthermore, a detailed research design (see Figure 4.1) has been described which addresses the research questions. The comparative aspect of the research design allows the researcher to investigate the similarities and differences between retrofits and amenity renovations, and how these might inform the development of strategies encouraging retrofit in the future. Finally, this chapter has outlined the specific sampling approaches, research methods and approach to analysis that allows this research design to be realised, also giving due consideration to any ethical issues that arise as a result of this research.

PART III: RESULTS & ANALYSIS

5.0 Introduction

This chapter provides an overview of the profile of research participants to which the results reported in Chapters 6-8 relate. While, the interview participants have been selected in accordance with a purposive sampling strategy to maintain a balance of household types, property types and renovation types, as described in Chapter 4, Section 4.4, the questionnaire sample is likely to display many traits and biases of the 'self-selecting' public (Lavrakas 2008). Therefore, this section will describe the profile of these two sample groups and highlight any significant differences between them.

5.1 Profile of interview participants

As outlined in Chapter 4, Section 4.5, the purposive sampling strategy employed by this research sought to create a sample that was balanced between Young Families and Empty Nesters. As such, while the interview participants included a small percentage of 25-30year olds (8%), the age profile of the sample was dominated by three age groups: 35-44 years; 45–54 years; and 55–64 years at 14%, 21% and 18% respectively. Despite this, although, the length of occupancy of interview participants varied between 1 and 40 years, it remained weighted towards shorter periods of occupancy with a median value of 8 years. This reflects the connection between home improvements and residential mobility reported by Baum and Hassan (1999).

This research focuses on owner-occupiers of above average affluence; those who have the means to undertake significant home improvements, as this group has so far been relatively neglected by schemes and incentives promoting low carbon retrofit. As shown in Figure 5.1, households with a total income before tax exceeding £1,000 per week dominate the interview sample at 62%. To put this into context, it should be noted that Average Weekly Household Total Income in Henleaze is estimated to be between £690 and £810 (Office of

National Statistics 2015b), whilst in Bishopston it is estimated to be between £520 and £710 (Office of National Statistics 2015b). Therefore, taking into account a breakdown of which participants reside in each of these two wards it is calculated that between 62% and 80% of households in the interview sample earn above the average weekly household income. Whilst this still leaves between six and twelve households in the sample earning less than the average for their ward, it is worth noting that none of the households earning less than £700 per week had any dependent children and only three households earning less than £700 had mortgages still outstanding. This implies that although these households had a lower weekly income they also have much lower financial burdens and therefore, possibly a similar amount of disposable income to the other households in the sample.

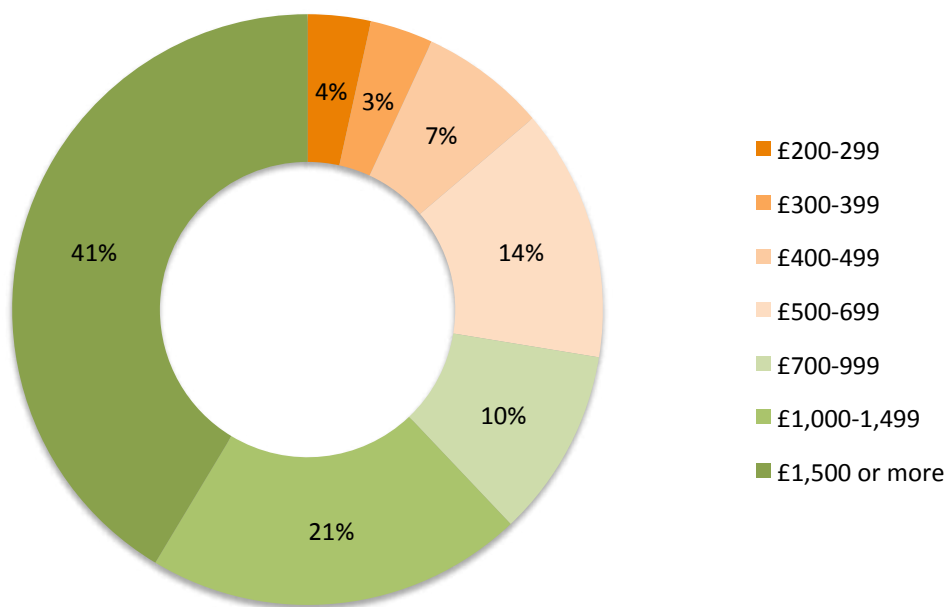


Figure 5.1: Weekly household income of interview participants

Despite only a few of the households with the lowest weekly income having outstanding mortgages, the proportion of interview participants owning their home outright, rather than subject to a mortgage was 42%, compared with a national average of 48% in 2011 (DECC 2013). There are several possible explanations for the higher rate of mortgaged properties amongst the interview participants, which are not mutually exclusive. Firstly, this may be due to the sample's focus on people who have undertaken significant home improvements, many of which may have been funded through extensions to mortgage agreements as reported by several participants. Secondly, the low rate of outright home-ownership could be associated with the relatively short period of occupancy, meaning participants have had less time to pay

their mortgages. Thirdly, the profile of interview participants was monitored throughout the recruitment process and a pronounced increase in the proportion of mortgaged properties was observed as more *young families* were recruited in accordance with the sampling strategy. Therefore, the lower rate of outright property ownership could be due to the younger age profile of the interview participants, including a higher proportion of owner-occupiers who have not yet finished paying their mortgage. These, Young Families (married or co-habiting couples with young, dependent children) made up almost 50% of the sample of interview participants. The remainder of the sample was made up of married or co-habiting couples with non-dependent children who fall into the category of Empty Nesters described in Chapter 4. This category also included one-person households and married or co-habiting couples without children, who also predominantly fell into an older age group looking towards retirement.

In line with the sampling strategy, focussing on the two typologies of housing that are most numerous in the existing UK housing stock and most in need of low carbon retrofitting, the sampling is split between pre-1919 housing (45%) and housing from between 1919 and 1945 (55%). These figures also relate to the property types in the sample, with 48% being the terraced housing that dominated the pre 1919 era while the remainder of the sample is comprised of the semi-detached (36%) and detached housing (10%) or bungalows (6%) that only became prevalent in urban and sub-urban areas in the 1930s (Dowson et al. 2012).

In addition to balancing the sample for household type, the sample was also monitored to include an even distribution of *renovators* and *retrofitters*. However, analysis of measures undertaken by participants indicates that rather than a discrete distinction between *renovators* and *retrofitters*, retrofits may often incorporate many measures associated with amenity renovations. Similarly, there are a group of retrofit (energy efficiency) measures (boilers, loft insulation, and double glazing) that have been adopted by mainstream homeowners (DECC 2013) and are amongst some of the most commonly adopted home improvements, as shown in Figure 5.2 (see below for how this compares with wider housing stock). This supports the assertions made by Wilson et al. (2015) that low carbon retrofit is not distinct from home improvements more generally. For the purposes of the comparative analysis presented in this thesis, those participants above the dotted line are classed as *renovators*, whilst those below the line are classed as *retrofitters*, allowing the 31 households to be subdivided into four groups (as shown in Figure 5.3) facilitating a comparative analysis

between *young families* and *empty nesters* and *renovators* and *retrofiters* as described in Chapter 4.

RENOVATION		RETROFIT			RENOVATION				RETROFIT			
Case No.	Fixtures and fittings	New Boiler/heating system	New Windows/ext. Doors	Loft Insulation	Adding/removing walls	Extension	New Roof/Facade works	Loft Conversion	Renewables	Cavity/EWI/SWI	Advanced Boiler/Heating system	Additional Loft Insulation
01	X	X				X						
02	X	X			X	X						
03	X			X		X						
04	X	X	X		X	X						
05	X	X	X		X	X						
06	X	X		X			X					
07	X	X	X		X	X	X					
08	X	X	X		X	X	X					
09	X	X	X			X	X	X				
10	X	X	X		X	X		X				
11	X	X	X			X	X	X				
12	X	X	X	X	X							
13	X	X	X	X		X						
14	X	X	X	X	X		X					
15	X	X	X	X	X	X	X					
16	X	X	X	X	X		X	X				
17	X			X					X			
18	X	X	X	X					X			
19	X	X			X				X			
20	X		X	X		X	X	X	X			
21	X	X	X	X	X	X	X	X	X			
22	X	X	X	X			X		X	X		
23	X	X	X	X	X	X			X	X		
24	X	X	X	X	X		X		X	X		
25	X	X	X	X	X		X	X	X	X		
26	X	X		X	X	X	X	X	X		X	
27	X	X	X			X	X	X		X	X	
28	X	X	X	X	X		X	X			X	X
29	X	X	X	X	X	X	X		X	X		
30	X	X		X	X			X	X	X		X
31	X	X	X	X	X	X	X		X	X	X	X
TOTAL	31	28	23	20	20	19	18	11	13	8	4	3

Orange = Young Family, Green = Empty Nester

Figure 5.2: Measures adopted by each interviewee.

	Young Family	Empty Nester
Renovator	Cases: 01, 02, 04, 05, 10, 11, 14, 16	Cases: 03, 06, 07, 08, 09, 12, 13, 15
Retrofitter	Cases: 17, 21, 26, 27, 28, 29, 30	Cases: 18, 19, 20, 22, 23, 24, 25, 31

Figure 5.3: Groups of participants facilitating comparative analysis

5.2 Profile of questionnaire respondents

The profile of the questionnaire respondents differed significantly from the interview participants in several key ways. For example, while the age profile of the questionnaire respondents is similar to that of the interview participants, with the three age groups between 35 and 64 years dominating the sample, there was an increase from 7% to 12% in the 65 years and over age groups when compared with the interview participants. This older age profile, could also help to explain why the proportion of outright ownership amongst the questionnaire respondents, standing at 54%, was not only higher than the interview participants but also higher than the national average of 48% (DECC 2013) as older owner-occupiers are more likely to have finished paying their mortgages.

The older age profile and increased proportion of outright property ownership could also be related to the slightly lower weekly income of the questionnaire respondents. Whilst still an affluent community, households earning a total weekly income above £1,000 made up only 56% of the sample, possibly related to the property-based wealth of older owner-occupiers rather than the income-based wealth of younger families.

The sample of questionnaire respondents had a greater variety of property ages than that of the interview participants, with small percentages of properties from 1965 – 1980 (6%), 1981 – 1990 (2%) and post 1990 (2%). Despite this, the sample still had much higher proportions of pre-1919 housing (38%) and 1919 – 1964 housing (52%) than the national averages of 21% and 36% respectively (DECC 2013). This sample also featured much higher proportions of the desired terraced (33%) and semi-detached (36%) properties than the national averages of 28% and 26% respectively. This can be attributed to the careful selection of a ward within Bristol that had a high density of the desired property profile.

This description of the profile of the research participants has demonstrated that the purposive sampling strategy described in Chapter 4 has been successfully implemented. An even distribution between *young family* households and *empty nester* households has been achieved whilst maintaining a degree of homogeneity with regards to property type and affluence. The participant profiles described in this section show how this has been the product not only of the selection of appropriate interview participants from the questionnaire respondents but also, that the probability of recruiting appropriate participants was greatly increased through careful selection of a geographical sampling frame.

As well as this demographic information, the questionnaire also collected data on the sources of knowledge and expertise accessed by participants. Figure 5.4 shows that young families within this sample used a wide range of sources much more commonly than empty nesters. The only sources of knowledge and expertise consulted more commonly by empty nesters in this sample were traditional advertising, local schemes or groups, and their own professional background. Meanwhile the only sources of information used by all four groups of owner-occupiers in the sample were architects, builders, the internet and sub-contractors, also making them some of the most commonly cited sources overall. Questionnaire respondents also cited these sources of knowledge and expertise in association with the widest range of home improvement measures.

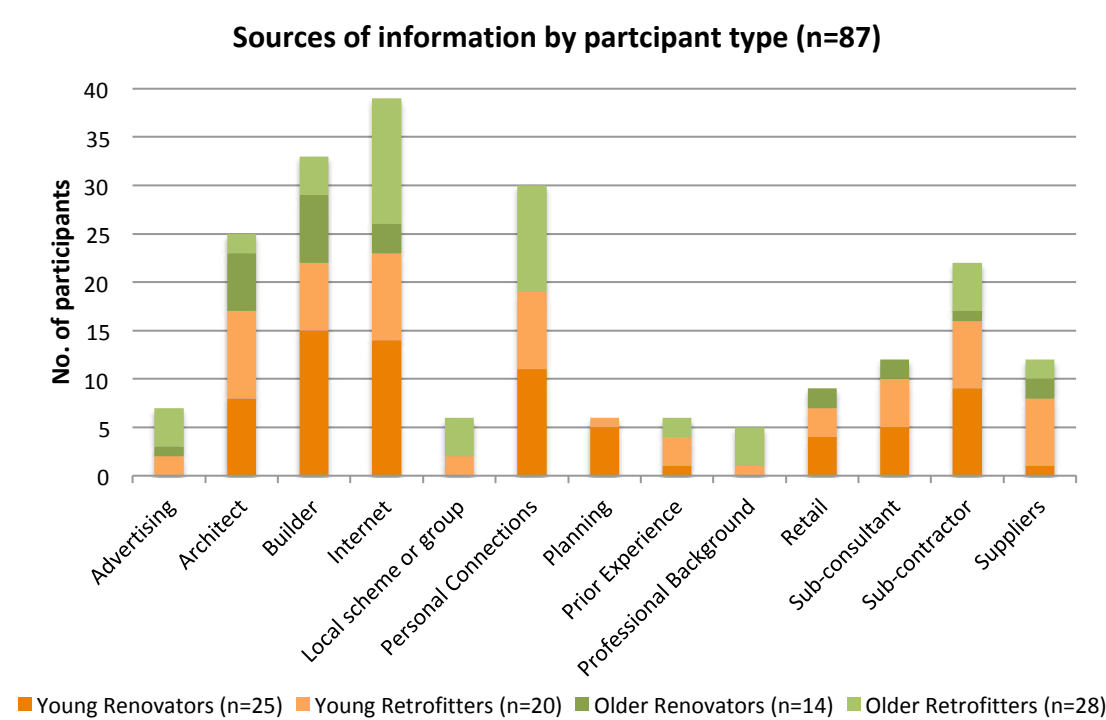


Figure 5.4: Groups of owner-occupiers accessing each information source

5.3 Conclusion

This chapter has provided an introduction to the empirical data on which this thesis is based. The following three empirical chapters (Chapters 6-8) will examine this empirical data in greater detail in order to address the research questions set out in Chapter 1. Chapter 6 will examine the 12 focused codes describing teleological influences on home improvements and investigate how these differ depending on the individuals and measures involved in the home improvement (RQ1). Chapter 7 will examine the relationships between these teleological influences, the home improvement measures and the competences acquired in greater detail (RQ2). Finally, Chapter 8 will examine how sources of knowledge were evaluated and accessed by different groups of owner-occupiers, or in relation to different home improvement measures, with a view to the implications of these findings for encouraging low carbon housing retrofit in future (RQ3).

Chapter 6 | Teleological influences on retrofits and renovations

6.0 Introduction

This chapter discusses 12 focussed codes describing teleological influences on home improvements, arising from the line-by-line coding and analysis of 31 interviews and walk-through tours, as outlined in Chapter 4. These codes take the form of processes in which participants were engaged during their home improvements. The chapter is divided into three sections with the first section (Section 6.1) describing in greater detail, those processes that were equally prevalent across home improvement projects regardless of the individuals or home improvement measures involved. Subsequently, the second section (Section 6.2) will examine actions that were considered more important to one group of individuals (for example *retrofitters* or *young families*). In the third section (Section 6.3) the methodological innovation of identifying those actions that varied in importance depending on the home improvement measure in question will be explored (as previously discussed in Chapter 3, Sections 3.2 and 3.3). The chapter will conclude by reflecting on the insights provided by adopting both individuals and measures as units for comparison, and also on the potential implications of these findings for increasing the adoption of low carbon retrofit measures.

As described in Chapter 4, the focussed codes arose from the line-by-line coding of the data with attention on what participants described *doing*. Where the actions described in these line-by-line codes shared common goals they were grouped into 12 processes describing teleological influences. Structuring analysis around these 12 processes has a number of benefits. Firstly, as described by Charmaz (2006) coding for processes keeps focus on what is happening in the data rather than on individuals. Secondly, it is widely recognised in the existing literature that the adoption of low carbon domestic retrofit is complex (Gupta and Gregg 2012; Christensen et al. 2014; Yarrow 2016) and subject to many influences. Identifying and understanding these concurrent processes provides one way of clarifying our understanding of this complex process. Thirdly, as shown by Wilson et al. (2013), home

improvements are not fixed, but evolve over the course of a project. These actions reflect the constant evolution and development of the home improvements and the priorities underlying them. Finally, building upon this second point, by examining actions, the researcher can not only compare the influences acting on different projects, but also the strategies employed in order to realise home improvements.

As the interviews progressed, it became apparent that participants' described two different ways in which teleological influences acted on their projects: either stimulating a home improvement project to begin or only becoming an influence once the project had already begun. Wilson et al. (2015) refer to these as ultimate and proximate influences:

"...proximate influences explain what renovation decisions are made and how (e.g., with what products, at what cost, with which contractor). Ultimate influences explain why homeowners are deciding about renovating in the first place."

(Wilson et al. 2015, p. 18)

These definitions of ultimate and proximate influences will be employed throughout this chapter to describe the research findings. It should also be noted that some of the issues discussed are not mutually exclusive to a single action and may be taken into consideration multiple times in different contexts.

6.1 Influences in common

This section will describe in greater detail those teleological influences that were equally prevalent amongst all types of home improvement projects, regardless of the individuals involved and the home improvement measures under consideration. These influences were mentioned by at least 27 of 31 participants and include: *managing risk, fulfilling values, thinking long term, improving or maintaining environmental conditions, supporting existing or desired lifestyle, and making the most of things.*

6.1.1 Managing Risk

Managing elements of risk, from safety to financial risks, was mentioned in all but one of the 31 interviews. Some participants described it as an ultimate influence, with home

improvements stimulated by the risk of intruders or risks to occupant safety as previously discussed by Risholt et al. (2013). Concerns for safety were particularly prevalent where children or grandchildren were at risk (UKERC 2013), lending support to the assertion made by Basham et al. (2004) that there is an association between concern for safety and perceptions of 'good parenting'.

"So the most recent thing we've had done was to get those steps done because they were... that one especially, that one that side was dangerous for an adult, never mind a toddler."

(Renovator, Young Family)

The most commonly cited risk amongst research participants – and another ultimate influence - was to the building fabric. The prevalence of such latent risks within the existing housing stock is supported by the results of the English Housing Survey (CLG 2008), which states that more than half of all dwellings had a fault to at least one of the main exterior elements of the building fabric. Participants stated that they considered the adoption of appropriate renovation measures, such as new bathrooms, new roofs or re-rendering of facades, to be imperative to addressing such risks.

"Well we've been in this house for several years and there are slight areas where damp is coming through to the plaster. Not dreadfully so but... just causing paint to bubble slightly, underneath... it was only going to get worse so, it needed sorting."

(Renovator, Empty Nester)

However, participants described some risks to fabric that arose as part of the home improvement itself, and therefore, acted as proximate influences on *how* they went about adopting measures. The perceived risks to fabric were particularly prevalent in association with retrofit measures. This concern is supported by numerous studies acknowledging the damage to building fabric, particularly in older buildings, that can be caused by maladaptation to modern techniques for improving thermal efficiency (Communities and Local Government Committee 2008; Christie et al. 2011; Davies and Oreszczyn 2012; Moran et al. 2014). Of particular concern to participants was the risk posed to the building fabric by investing in poor quality products or workmanship, an issue that would also pose the financial risk of losing the money invested. This lack of trust in contractors is widely

documented (EST 2011; DECC 2012a; Balcombe et al. 2013; Brown et al. 2014). Participants described how they sought to avoid paying for poor quality products or workmanship by seeking guarantees and inferring suppliers' or tradesmen's reliability from the quality of their sales service.

"Yeah, they were prompt with their replies and communications and that. That makes a big difference when you're spending a lot of money. It gives you the peace of mind that they understand that you're spending a lot of money."

(Renovator, Young Family)

Poor workmanship was not the only financial risk cited. With regards exclusively to retrofit measures, domestic stability was seen to be a key issue, as also identified by Galvin (2012, 2014b). Despite findings that moving home can often be a life-event that triggers improvements to the new home (Baum and Hassan 1999), participants who thought they might not stay in their property long-term saw investment in retrofit measures as a significant financial risk.

"I kind of briefly flirted with all that (Solid Wall Insulation), but I think unless you're really sure you're going to stay... it's tens of thousands of pounds."

(Retrofitter, Young Family)

"Also, if you're not sure how long you're going to live in a house, that's another disincentive to get work done, where you're not sure whether it would add value."

(Renovator, Empty Nester)

In the broadest sense, these findings show how the teleological influence of *managing risk* acts on almost all of the home improvements in this study, but manifests itself in different ways and at different times from one project to another. Financial risks and risks to the building fabric were often associated with low carbon retrofit measures and must be addressed if adoption of these measures is to increase. In particular, there is a need to instil greater confidence in innovative products and in tradesmen through the provision of high-quality sales services; as well as addressing the challenges presented by financial risks associated with regular house moves.

These findings also suggest the importance of influences that are not currently commonly cited in the literature such as risks to safety, especially in owner-occupiers caring for young children. While the impact of home improvement measures on occupant safety, both positive (Basham et al. 2004; Schofield et al. 2012; Willand et al. 2015) and negative (Wilkinson et al. 2007; Davies and Oreszczyn 2012) is acknowledged, safety concerns are rarely documented in the existing literature as a potential stimulus for home improvements. Conversely, whilst the long-term health benefits of home improvements are widely recognized in the literature (Bernier et al. 2010; Zundel and Stieß 2011; Fawcett and Killip 2014; Mortensen et al. 2014; Vlasova and Gram-Hanssen 2014; Klockner and Nayum 2016), participants seldom mentioned this.

6.1.2 Fulfilling Values

This focussed code was developed to consolidate line-by-line codes describing participants' actions to fulfil a wide range of values (see Chapter 3, Section 3.1.1). The intention to fulfil at least one value was universal across all participants even though the values themselves varied considerably. These included, but were not limited to, aesthetics, heritage, community, health, wealth and environment.

The most frequently mentioned of these was aesthetics, which as in the existing literature, was described by participants as both an ultimate (EST 2011; Karvonen 2013; Horne et al. 2014) and a proximate influence (Banfill et al. 2012; Risholt et al. 2013; Chiu et al. 2014; Sunikka-Blank and Galvin 2016; Yarrow 2016). Some retrofitters describe adopting low carbon retrofit measures precisely for their aesthetic qualities (Galvin and Sunikka-Blank 2014; Pelenur and Cruickshank 2014). However, although discussed most often in association with retrofit measures, it was renovators who most commonly discussed aesthetics. This preoccupation with the aesthetics of retrofit measures reflects concerns raised in the literature (Crosbie 2010; Zundel and Stieß 2011; Karvonen 2013; Mortensen et al. 2014; Fyhn and Baron 2016) and renovators specifically described how they had made 'trade-offs' between aesthetics and other features such as comfort or structural stability as exemplified in the statement below.

"But if you want to keep the integrity of the house in terms of it's Victorian origins, obviously we have got lots of modern stuff in here, but if you're not happy to put in uPVC and you're not happy to change the aesthetics, to compromise to make it more environmentally efficient, it's prohibitive..."

(Renovator, Young Family)

In contrast, concerns that were more dominant amongst retrofitters included financial gain, environmentalism and reducing their carbon footprints. As these benefits have dominated much of the discourse encouraging the adoption of retrofit measures to date it is not surprising that those who have already adopted retrofit measures would cite these as influences. Many retrofitters mentioned the financial gains associated with their home improvements, supporting much of the existing literature that has focussed on this area as a major concern for owner-occupiers (Palmer et al. 2012; Christensen et al. 2014; Pettifor et al. 2015; Simpson et al. 2015). However, these participants also qualified this by saying this was not their main influence, supporting the arguments put forward by Mills and Rosenfeld (1996) and more recently by Wilson et al. (2015). For example, with the adoption of solar PV panels, a number of participants, described that whilst they wouldn't have adopted the panels if it had meant taking a huge financial hit, the financial gains they stood to make out of the Feed-in Tariff, only sped up the rate of adoption, as also described by UKERC (2013).

"I think I wanted to do it actually because I thought it was a very good idea. It made sense for me, but it also made sense for this country and the world. You know, it actually did matter. Umm, so I think the money thing was what lent it the urgency, but actually wasn't the main motivation."

(Retrofitter, Empty Nester)

Despite not prioritizing financial gains more than a third of participants described a responsibility to preserve the existing value of the property as previously discussed by Munro and Leather (2000). Maintaining the character of the property through preserving original features, maintaining the number of bedrooms and keeping the property relatively neutral were all cited as ways of achieving this.

"...whilst we haven't done anything to make money out of it... what we don't want to do, is anything silly that is going to devalue our house. So taking out a bedroom would have been crazy if we weren't then going to do the loft conversion. And also don't do anything too quirky."

(Retrofitter, Young Family)

Evidence of activities such as composting, use of ecological detergents and wearing multiple layers of clothing rather than using central heating, were observed by the researcher more

commonly amongst retrofitters, implying a strong concern for the environment amongst this group as previously identified by Crosbie (2010); Stieß and Dunkelberg (2012); Christensen et al. (2014) and Tjørring (2016). However, whilst a number of these participants identified a wider environmental concern or pro-environmental attitude as their main reason for adopting retrofit measures as proposed by Desmedt et al. (2009); Pelenur and Cruickshank (2014); Kastner and Stern (2015), others were keen to emphasise that this was not their main priority:

“Yeah, primarily a house for living in and not an environmental project!”

(Retrofitter, Young Family)

Finally, concerns relating to modernisation and heritage were common across all groups of individuals. In the case of heritage this was common to both renovation and retrofit measures with participants discussing their desire to preserve or reinstate original features. This could be particularly challenging when looking to install low carbon retrofit technologies as widely discussed by Watts et al. (2011); Judson et al. (2013); Bartiaux et al. (2014); Chiu et al. (2014); Galvin and Sunikka-Blank (2014); Shrubsole et al. (2014); Sunikka-Blank and Galvin (2016); Yarrow (2016); Claude et al. (2017); and Galvin and Sunikka-Blank (2017). This often resulted in participants describing trade-offs being made between heritage and other priorities, a phenomenon that will be discussed in more detail in Chapter 7. The reluctance to change the character of the property was particularly strong in Victorian properties reflecting the focus of many existing studies (see Crockford 2014; Galvin and Sunikka-Blank 2014; Rodrigues and Freire 2017), whilst 1930s properties were considered by some owners to be more open to adaptation.

“Yeah, the sash windows - I think that looks terrible when people replace those with...we had a Victorian house before this one and yeah...you want to keep sash windows really. I think in these house it's maybe...most of the neighbours have got UPVC and I don't know.”

(Retrofitter, Young Family)

“Victorian houses, ...you don't really know what you're getting and they usually are slightly more of a premium than a sort of 1920s 30s house like this ...they haven't got fancy features and the rooms are quite sort of plain, they haven't got

mouldings and all that sort thing... but we've ended up with something where we know that everything has been done. We won't have any surprises."

(Retrofitter, Empty Nester)

...we decided then to buy a larger property and when we were looking for a new property, the thing which was one of our main considerations, was were we able to version this property to include some of the alternative energy... a lot of properties for various reasons weren't suitable. They tended to be the older properties, Victorian, Edwardian and we went for a rather ugly 30s house which we wouldn't have bought on aesthetic reasons, but we bought it because of environmental reasons.

(Retrofitter, Young Family)

While relatively equal across different groups of individuals, the intention to modernise was more commonly discussed in association with renovation measures as previously identified by EST (2011); Karvonen (2013) and Risholt et al. (2013). When participants described modernisation, this could refer to either the stylistic design of the property or to functional aspects of the home as also described by EST (2011), or sometimes both. If a greater understanding of how and why modernisation is associated with renovation certain measures in a positive way can be gained, then this might also be used to broaden the appeal of certain low carbon retrofit measures.

"I think by and large downstairs, it was sort of twofold. One was just to modernise it, but it was almost to make it into what would work more, let's put it into a stereotype as a modern family home. Does it flow? Open it up a bit. Make it a bit brighter."

(Retrofitter, Young Family)

With the fulfilment of values the focus of much existing research on pro-environmental behaviours (see Jackson 2005; Abrahamse and de Groot 2014; Organ 2015), it is unsurprising that participants' descriptions support the findings of existing research that heritage, aesthetics, financial gain and environmental concern are common influences on the adoption of low carbon retrofit measures. However, it is also clear from participants' accounts that while financial gain and environmental concern are common influences, they are rarely the overriding concern. Therefore, it is necessary to understand how they interact with other

influences as discussed in Chapter 2, Section 2.2.2. Similarly, greater understanding of the trade-offs made by renovators between aesthetics or heritage and other priorities could further our understanding of how low carbon retrofit measures might be improved and promoted.

In broader terms, these influences appear to manifest themselves and interact differently, not only between groups of households and home improvement measures, but also in relation to Victorian and 1930s properties. This supports the importance attributed to material arrangements in determining the outcomes of processes such as retrofit by practice theorists.

6.1.3 Thinking Long-term

This focussed code was universal to all home improvement projects and describes participants' process of implementing plans to address their long term needs and desires. The most common way in which participants thought long term about their home improvements was in making decisions to reduce the time, effort and financial costs associated with future maintenance, as previously described by Mills and Rosenfeld (1996) and Munro and Leather (2000). This was described by participants as both a proximate and an ultimate motivation and was similarly prevalent across all groups of individuals.

"Well the structure of the windows is quite complicated, lots of glazing bars and that to paint. And often there was lots of rust around. They weren't galvanised the previous things, you were there with all the rust treatment stuff first, then the primer, the undercoat, oh god, yeah. Every summer you know."

(Retrofitter, Empty Nester)

Taking this concern for reducing future works further, the notion of future-proofing incorporated a much wider range of adaptations to the home in preparation for the long term that were equally shared across all groups of participants, but more common in association with renovation measures.

“I’ve future-proofed us as much as possible. I tend to be a person who has moved every five years, so whenever I mention it to my wife I get a look of horror. But in theory we could quite happily stay here ten years or tens years plus.”

(Renovator, Young Family)

Meanwhile, empty nesters were predictably more concerned with adapting their home to accommodate their physical requirements as they got older as described by Wilson et al. (2015). For example, participants explained how shower rooms were installed downstairs, with potential difficulty using the stairs in mind, as they got older. However, it was also observed that this was described as a consideration more often by renovators or in association with renovation measures.

Another common consideration, more prevalent amongst retrofitters and in association with retrofit measures, was long-term financial savings, which have been the focus of much of the existing literature including EST (2011); Bartiaux et al. (2014); Fawcett and Killip (2014); and Haines and Mitchell (2014) and Long et al. (2014). Much of the discourse encouraging adoption of retrofit measures to date has focussed on long-term financial savings (see Chapter 2, Section 2.2.2), therefore, it is not surprising that many people who have already adopted retrofit measures cited this as a key consideration. Many retrofitters described how they saw these financial savings as a return on what they considered to be a long-term investment as discussed by Munro and Leather (2000); Zundel and Stieß (2011); Galvin (2012) and Stieß and Dunkelberg (2012). As discussed with regards to managing risk, this also suggests why domestic stability was described as such an important consideration for retrofitters and in association with retrofit measures, as this stability would be required in order to stay in the property and receive this return on their investment.

The existing literature consistently presents the long-term nature of many low carbon retrofit measures as an impediment to their adoption by owner-occupiers (see Wilkinson et al. 2007; Davies and Osmani 2011; Achtnicht and Madlener 2014) and these findings suggest that where participants do not feel they have domestic stability, a common theme amongst young families, this is certainly the case. However, these findings also indicate that making the house more accessible in the event of reduced mobility in old age is commonly cited by participants as a reason for undertaking home improvements. Whilst this might be most relevant to empty nesters, even young families display considerable interest in reducing

future maintenance costs or future-proofing their house in the medium term, an influence that is seldom reported in the literature.

6.1.4 Improving or Maintaining Environmental Conditions

This focussed code is used to describe the various ways in which improvements to their environment influenced owner-occupiers, looking beyond the more commonly discussed concerns regarding thermal comfort. Discussed by over 90% of interviewees, comfort is also identified widely in the existing literature as a factor stimulating low carbon retrofit (Bernier et al. 2010; EST 2011; Zundel and Stieß 2011; Galvin 2012; Stieß and Dunkelberg 2012; Karvonen 2013; Achtnicht and Madlener 2014; Bartiaux et al. 2014; Christensen et al. 2014; Fawcett and Killip 2014; Gupta et al. 2014; Mortensen et al. 2014; Pelenur and Cruickshank 2014; Simpson et al. 2015; Wilson et al. 2015; Klockner and Nayum 2016). This was sometimes described as a proximate influence on how participants implemented their home improvements, but most often, was cited as an ultimate influence, stimulating the improvement to begin with. More specifically, and in accordance with the existing literature such as Communities and Local Government Committee (2008); DECC (2014e) and Fawcett and Killip (2014), three quarters of participants associated this improvement in comfort, both ultimate and proximate, with increased warmth.

“But R [partner] likes to live in a warm comfortable house, and I don’t have to worry knowing that our energy is coming from the sun and the Air Source Heat Pump. We can be comfortable all the time rather than feel that in the future we might have to worry about putting the heating on for two hours a day...”

(Retrofitter, Empty Nester)

“It was freezing... so there was an element of wanting to have a warm kitchen as well... we knew if we did that, this part of the house would be warmer.”

(Renovator, Young Family)

However, environmental comfort is not limited to thermal comfort but also includes the visual and acoustic environment (McMullan 2012). Natural light was considered important by almost two thirds of participants and the researcher observed high levels of natural light in more than a third of participant homes, particularly those of young families and renovators. Again, this was most often cited as an ultimate influence.

“So you've got light coming in from the front, but also because we've raised the height of the glass here. On this back wall, you can actually see the sky, which we couldn't see before; you could see people's windows. So it's given a sense of space and sense of light even if it isn't massively lighter it just feels better. You feel less excluded. So yeah what was a really dark gloomy room, isn't anymore, it's a much nicer space to be in.”

(Renovator, Young Family)

Warmth, natural light, and draughts were all discussed more often by empty nesters than young families, with several participants inferring that natural light in particular becomes of greater importance to occupants with age.

“I mean I'm working full time so I don't have a lot of time at the moment, but my plan is when I've got more time, I will do more sewing. So I've got to the age where I need nice natural light to do that...”

(Retrofitter, Empty Nester)

Whilst comfort in a broad sense was discussed equally by all groups of participants, retrofitters more commonly discussed the acoustic environment.

“So that became an immediate priority above everything else, to try and get those done to reduce the sound impact as much as possible.”

(Retrofitter, Young Family)

Finally, renovators were less concerned about acoustics and appeared to be more preoccupied with reducing draughts, a benefit typically associated with retrofit measures such as replacement windows or cavity wall insulation (Schofield et al. 2012; Thomson et al. 2013).

“When we moved in here, there we aluminium windows, so there was condensation on the inside so they needed...and it was draughty, so they needed to be done.”

(Renovator, Empty Nester)

The desire for thermal comfort, most commonly increased warmth, is well documented as a motivation in the literature and this is supported by these findings. However, these findings also support the assertions of Sunikka-Blank et al. (2012); Risholt and Berker (2013); and Ellsworth-Krebs et al. (2015), that interpretations of comfort will vary from one household to another, with participants reporting varying emphasis on thermal comfort, natural light and acoustics. The potential for low carbon retrofits to increase natural light levels (Wiseman and Summerson 2014; Gupta and Gregg 2016); reduce draughts (Gilbertson et al. 2012; Schofield et al. 2012; Gupta and Gregg 2016); and improve acoustic comfort (Mills and Rosenfeld 1996; Achtnicht 2011; Schofield et al. 2012; Achtnicht and Madlener 2014; DECC 2014d; Rovers 2014; Thomsen et al. 2016) is well documented. Similarly, the association between natural light and improved occupant mood or sense of wellbeing (Mills and Rosenfeld 1996; Heerwagen 2012; Wiseman and Summerson 2014) and reductions in noise pollution and improved health and child development (Evans 2003; Schofield et al. 2012) are well reported in the existing literature. Despite this, these are much less well documented as potential means of stimulating low carbon retrofits in the literature.

6.1.5 Supporting Existing or Desired Lifestyle

A number of concerns were identified as having a relationship with participants' existing or desired lifestyle including domestic stability; preference for living in a certain neighbourhood; and the functionality afforded by the dwelling. Whilst the overall trend of supporting a certain lifestyle was equally important across all groups, domestic stability was identified as being of particular concern among young families and retrofitters. This is most likely due to instability being seen to increase the risks associated with adopting retrofit measures, as well as being closely associated with access to good schools and therefore of greater concern amongst young families. This latter concern is demonstrated in the below response to being asked if they planned to stay in that property indefinitely.

P1: "No, because of schooling, secondary schooling here is not...there's not a lot of choice here, because of location. Primary school is great, but secondary school is not so great."

P2: "We may do, it depends if that situation changes but we've got a seven year old so we're thinking in four or five years we might have to think about moving... which is a shame because we like it."

(Retrofitter, Young Family)

Preference for living in a certain area was commonly mentioned as being associated with maintaining a desired lifestyle, leading participants to seek to adapt a home in their desired area rather than move properties as previously discussed by Baum and Hassan (1999) and Billings (2015). Therefore, identifying households who have a preference for staying in a particular area could also help to locate households who might seek to resolve any discrepancy between their housing needs and their current home through home improvements. However, what is valued about the area, will vary depending on the household, and may also be associated with the changing housing conditions out of which the need to make home improvements arises. For example, the preference for a particular geographic location was more common amongst young, expanding families and was often associated with access to good schools (as discussed above) and easy commutes to work (Helms 2003). Meanwhile, reflecting home improvements to increase accessibility, that are common amongst empty-nesters (EST 2011), older participants' preference for particular locations was informed more by distance from essential services:

"It's a nice house and it's very convenient for the shops and things like that. So if...I moved away, it would be a place I would come back to as an old lady if you know what I mean."

(Renovator, Empty Nester)

The influence of domestic instability revealed by these findings emphasizes the importance of understanding home improvement processes in the context of other activities such as schooling or shopping. However, the importance that parents place on the education of their children, also presents a more immediate strategy for encouraging adoption of low carbon retrofit measures. The existing literature reports that adoption of low carbon retrofit measures can improve health leading to fewer missed days of schooling (Howden-Chapman et al. 2007; Wilkinson et al. 2009; Thomson et al. 2013) as well being able to heat more areas of the home leading to less overcrowding and corresponding benefits to educational achievement (Basham et al. 2004; Schofield et al. 2012; Garrett et al. 2014). Other features and facilities that attract affluent owner-occupiers to specific areas (e.g. cafes, shops; train stations) can also be identified and serve as a base from which the benefits of low carbon retrofit measures can be publicised.

6.1.6 Making the most of something

Participants described multiple ways in which they sought to make the most of the resources available to them, from energy to space. Participants most commonly referred to this as efficiency, which by definition implies increasing *“the ratio of useful work performed to the total energy expended”* (Oxford University Press 2017). Efficiency is commonly discussed in the existing literature as a means-to-an-end (Zundel and Stieß 2011; Wilson et al. 2013; and Simpson et al. 2015) and is discussed most commonly by retrofitters in terms of the efficiency of building fabric.

“...what seemed to me pretty obvious, was the cheapest thing you could possibly do with most effect, is insulating and stopping the draughts. You can put any kind of gismo and wood-burning stoves and fancy radiators but if it’s all pouring out the roof, then it’s pointless. You could keep this place hot with a few candles almost. It’s really efficient. “

(Retrofitter, Empty Nester)

Whilst efficiency of the fabric was discussed almost exclusively with regards to retrofit measures, renovation measures were associated with addressing other types of efficiency such as space efficiency.

“We had a single skin extension there, where the kitchen currently is. It was a bit of a waste of space.”

(Retrofitter, Young Family)

The connection between increasing energy efficiency in housing and the motivation to reduce waste has been discussed by Fawcett and Killip (2014); Mills and Rosenfeld (1996) and Pelenur and Cruickshank (2014). Indeed, the most common strategy to achieve efficiency that retrofitters employed was reducing waste. This ranged from not wasting money, to reusing or recycling products, and reducing wasted energy by adopting localised heating strategies. These findings would suggest that whilst ‘energy efficiency’ may seldom be owner-occupier’s ultimate motivation for making home improvements, making the most of a given situation or avoiding unnecessary waste appears to be of intrinsic importance to individuals and already stimulates home improvements that respond to ‘wasted space’.

This section has shown how framing the benefits of low carbon retrofit as avoided waste, as previously discussed by Fawcett and Killip (2014); Mills and Rosenfeld (1996) and Pelenur and Cruickshank (2014), or as beneficial to a family's long-term health, might better align the outcomes of these measures with the teleological influences acting on home improvements.

Furthermore, this review of teleological influences indicates that the adoption of these measures must be understood within the context of concurrent processes as advocated by practice theory approaches to studying retrofit. However, these findings highlight the importance of going beyond understanding the process of adoption in the context of other home improvements, to also understanding them within the context of apparently disparate activities such as schooling. This could potentially be facilitated by conceptualising these home improvements as part of the nexus of practice developed by Hui et al. (2017). This would require a greater understanding of the relationships between practices. However, if this understanding is to extend outside of practices within the home, it must embrace connections beyond the material relationships and chains of actions described by Schatzki (2016). This could include different types of relationships between materials, in addition to the causal relationships described by Schatzki (2016) and Hui (2017), as well as relationships between competences (Blue and Spurling 2017), and exploring the connective power of teleological influences.

Despite the teleological influences discussed in this section being equally prevalent amongst all groups of households and types of home improvement measure, this analysis has revealed how these influences manifest themselves in different ways depending on the household and the home improvement measures in question. For example, older occupants are likely to have greater need for natural light to compensate for failing eyesight, and therefore measures that increase natural light are likely to be associated by these individuals with the teleological influence *facilitating activities*. These influences appear to manifest themselves and interact differently, not only between groups of households and home improvement measures, but also in relation to Victorian and 1930s properties. In broader terms, this supports the importance attributed to material arrangements in determining the outcomes of processes such as retrofit by practice theorists.

The variations between how teleological influences manifest themselves differently, depending on the household type, the home improvement measure, and the material fabric of the existing dwelling identified in this section begin to address gaps in our understanding of

variations in practice, as identified in Chapter 3, Sections 3.2 and 3.3. The following section will build on the variations identified in this section by examining those teleological influences that were significantly more prevalent amongst one household type.

6.2 Variations by household type

This section will explore those processes that were found to be more prevalent amongst *young families*, as outlined in Figure 6.1 below. This will begin by examining the process of *responding to a crisis*, which was more common amongst retrofitters, before moving on to the process of *accommodating a changing family*, which was of importance to young families from both renovator and retrofitter groups.

	Young Family	Empty Nester
Renovator	<ul style="list-style-type: none"> • Accommodating Changing Family 	-
Retrofitter	<ul style="list-style-type: none"> • Accommodating Changing Family • Responding to a Crisis 	-

Figure 6.1: Influences to undertake home improvements found to be more important amongst some groups of individuals.

6.2.1 Responding to a Crisis

A number of participants, and most commonly retrofitters and young families, described how their home improvement had involved responding to a crisis such as part of the building services or fabric failing or reaching the end of its life as discussed by EST (2011); Wilson et al. (2013); Pettifor et al. (2015) and Wilson et al. (2015). Such incidents most commonly included boilers breaking down or the roof beginning to leak. These were seen as a risk to the building fabric (see Section 6.1) or a safety risk and therefore deserving of immediate attention.

“Bloke came in, took one look at it and said, ‘first thing, it’s illegal; second, it isn’t working, it’s leaking; and third, you’re lucky you didn’t go up in smoke...’ Anyway, so that was it and so we got a gas combi or whatever they are. The modern thingies.”

(Retrofitter, Empty Nester)

Dealing with a crisis or failure associated with the fabric or services is reported to be the starting point of approximately one third of low carbon retrofits (Wilson et al. 2013) and this is well documented, particularly in the social practice literature. However, further investigation of this relationship between measures whose failure stimulates home improvements and low carbon retrofit measures is required if these situations are to be harnessed to increase the adoption of low carbon retrofit measures.

6.2.2 Accommodating Changing Family

This influence was dominated by the conditions experienced by growing families that led to home improvements (Baum and Hassan 1999; Watson and Shove 2008; Bartiaux et al. 2011; EST 2011; UKERC 2013; Wilson et al. 2013). Identifying the pressures experienced at different stages of the household lifecycle could give insight into when households might be more amenable to incorporating retrofit measures into their home improvements.

“...we already had one son, we had enough room down here, we wanted to kind of live like that for a bit, but we sort of saw how we lived in here for a bit and straight away, we thought right we need to loose this bathroom. We need to get the boys some bedrooms at some point, it’s going to take however long to build them. So we kind of need to get going with that really.”

(Retrofitter, Young Family)

Unexpectedly, though less prevalent, this was also the most common way in which changing families influenced empty nester home improvements, often through making appropriate spaces for grandchildren to come and stay.

“...that fits a swing and a trapeze because I’ve got two grandchildren... I just wanted space for the kids to be able to just...so they’ve got baskets of stuff that they can do creative stuff with, they can just grab boxes out and so on but they’ve got this space here, that they can just glue and stick and create things and you know. In the flat you had to be careful not to bump your head on the corner of the table when you were going past.”

(Retrofitter, Empty Nester)

Older children presented different concerns, such as the need for more bathrooms (see Maller et al. 2012; Owen et al. 2014) and more flexible living spaces. This was also supported by the researcher's observations during the interviews, where parents of growing children were often ducking in and out of interviews to pick up children from various sporting activities and children's belongings appeared to have colonised most rooms in the house:

"With the girls getting older, when they had friends around, there was only really one area for sitting in, which meant we'd have to go and sit upstairs if the girls wanted to watch a film or have a sleepover with friends, which didn't seem like a particularly good thing to do. So by creating another sitting area that just seems to have made it more family friendly."

(Renovator, Young Family)

Education was another way in which growing children's needs influenced home improvements as previously identified by Munro and Leather (2000). This often manifested itself through adaptations of houses close to good schools as discussed in section 6.1. However, especially in the case of renovation measures, was also seen to influence the timing of home improvements, either to avoid disrupting study during important exam periods or by using capital that might otherwise have been invested in private education:

"...from a financial point of view we were thinking would be going for private education and things, but when my elder daughter got into a state school that we were happy with we decided to go ahead. I think we found out what school we were going to and then actually the next day I got in touch with an architect."

(Renovator, Young Family)

These findings have shown how *accommodating a changing family*, and in particular the needs of young children is an influence not only young families, but also on older households looking to accommodate grand children. Therefore, this should be taken into account when targeting home improvement measures at older owner-occupiers. However, as children get older, the demands on space in the home are likely to change, leading to further home improvements such as additional bathrooms and potentially hot water heating systems to support them. Understanding these needs and how they interact with other practices that unfold over time can provide us with insights into *when* such improvements might be both

appropriate and possible. For example, the transition of children to secondary school, can not only coincide with altered demands on the home, but also with an altered financial situation, depending on whether private or state schooling is selected.

Meanwhile, the prevalence of *responding to a crisis* amongst retrofitters indicates the importance of understanding how home improvements connect to one another. This approach could permit understanding of how a replacement for a broken boiler can result in a low carbon retrofit.

Finally, while demographics (see Pelenur and Cruickshank 2014) or household conditions (see Wilson et al. 2013) are often employed to identify households that may be considering certain types of home improvements by ABC and practice theory-based studies respectively, this analysis revealed only two teleological influences that are significantly more prevalent depending on the household type. This indicates that to address the gap in current understandings of variations in practice, identified in Chapter 3, Sections 3.2 - 3.3, analysis must look to how variations might arise through other components of practice such as competences (Alkemeyer and Buschmann 2017) or through material components such as the existing fabric of the home, or home improvement measures themselves.

6.3 Variations by measure

This section will discuss those actions that appear to be more important in association with either renovation or retrofit measures, as outlined in Figure 6.2 below. As discussed in Chapter 3, Section 3.2, despite seeking to move away from individualism, existing practice-theory-based studies have continued to compare narratives of practice between individuals. Adopting the home improvement measure as the unit of analysis is not only more appropriate to practice theory perspectives, but also aligns better with the organisation of expertise within the construction industry. Therefore, understandings of owner-occupier retrofit by measure could potentially make it easier to mobilise this expertise in order to increase the rate of low carbon retrofit.

Accommodating a changing family is more commonly associated with renovation measures and has been discussed in Section 6.2. Therefore, this section will discuss managing costs; facilitating activities; and exercising hospitality which are also more commonly associated

with renovation measures, as well as considering appearance, which was mentioned more commonly when discussing retrofit measures.

Renovation Measures	Retrofit Measures
<ul style="list-style-type: none"> • Managing Costs • Facilitating Activities • Accommodating Changing Family • Exercising Hospitality 	<ul style="list-style-type: none"> • Considering Appearance

Figure 6.2: Influences found to be more important in association with some types of home improvement measures.

6.3.1 Managing Costs

This influence includes a wide range of costs, from financial to time costs, as well as the strategies participants used to manage them. Despite the existing literature identifying high capital costs as being one of the biggest barriers to adoption of low carbon retrofit measures (Davies and Osmani 2011; UKERC 2013), financial costs, discussed almost universally by participants, were more often associated with renovation measures and always cited as a proximate influence. The most commonly discussed strategy to manage costs was the omission of both retrofit and renovation measures from the project in order to reduce capital costs.

“It got, like all these things, the cost runs away from you and that was one of the things that got cut.”

(Renovator, Young Family)

Meanwhile, other measures to reduce cost such as DIY (see Bogdon 1996; Fawcett and Killip 2014; Galvin and Sunikka-Blank 2014; Fyhn and Baron 2016) were employed exclusively in relation to renovation measures, possibly due to the specialist skills associated with retrofit measures.

“The builder. We thought the builder's estimate to do it was too high, so I did it, me and the boys did it.”

(Renovator, Young Family)

Even when employing professionals to do the work, some participants described reducing costs by taking on the project management themselves. However, whilst the time costs associated with project management were discussed in relation to both renovation and retrofit measures, householders only described adopting this role in the case of renovation measures.

“I mean XXXXX got drawn into so many conversations with the planning people almost everyday she was on the phone or having to write emails and all the rest of it.”

(Renovator, Young Family)

As previously reported in the retrofit literature by Fawcett (2013) and Organ (2015), timing is also an important aspect of managing costs. In the case of renovation measures, this included delaying the start of a project due to financial concerns; avoiding delays during a project and the associated costs; and making the most of sales to lock in low prices. While in the case of retrofit measures, this was limited to concerns about making the most of the weather.

“The whole point of getting the kitchen when we did was to, because you can obviously, design it, pay a deposit and then just “oh, I don’t want it for six months”, but you lock in the reduced price from the Christmas sales and then just defer and defer until you need it...”

(Renovator, Young Family)

“The other thing was we wanted it done that summer, and I think there was quite a lot...I got the sense, it was quite busy, so when they said they could do it. It went in - in the end - about June. So obviously to maximise...get as much of the summer as we could.”

(Retrofitter, Young Family)

Despite this, all groups of participants described offsetting costs against other influences for some renovation and retrofit measures. In the case of renovation measures this was commonly paying to avoid effort and disruption, whilst in association with retrofit measures it was more likely to be choosing slightly more efficient and therefore expensive products in anticipation of a better financial return in the long-run as previously identified by Bartiaux et al. (2011).

“And we were given a quote for two different ones, one which was more expensive but was more efficient, we thought lets go for the more efficient one. If you’re doing this, and this is about making it as efficient as possible...”

(Retrofitter, Empty Nester)

Access to capital was described as important for all types of home improvement measures. Across both renovation and retrofit measures, that capital was described as coming from inheritances or lump-sum payouts upon retirement. However, whilst renovation measures were also commonly funded through capital released through the sale of the previous home, this was seldom the case with retrofit measures, which were more likely to be paid for through accumulated savings. Many previous schemes designed to encourage adoption of low carbon retrofit measures have focussed on providing access to capital by providing loans and subsidies (see Chapter 2, Section 2.2.2). Therefore it is not surprising that accessing incentives was the only strategy for managing costs that was more common amongst, in fact exclusive to, retrofit measures.

The most common incentive scheme, accessed by over a third of all participants, was the FiT (Feed in Tariff). Whilst none of the participants described the FiT as the influence stimulating the adoption of micro-generation measures, a number described how they perceived the FiT to be particularly generous (see also Owen et al. 2014) and this had been a proximate motivation. In particular, several participants discussed the regular reductions in the tariff and speeding up the process of installation in order to benefit from a higher FiT. However, one participant described how she thought FiT was too generous and this actually put her off installing micro-generation.

“It would have been fine and it would have been affordable, but it didn’t seem like terribly good use of taxpayers’ money to subsidise me for the Feed-In-Tariff that the government would have been awarding. And if you drive through Dorset at the moment, you see endless fields of solar panels, so I just thought it was a bit of a drop in the ocean, this, with regards to the sort of roofs that that sort of installation should be on.”

(Renovator, Empty Nester)

While, the overall trend of managing costs was more commonly discussed in association with renovation measures, some more specific aspects of this were equally prevalent across renovation and retrofit measures. This included the non-financial costs to the participant such as tension with neighbours, effort or disruption to the home, and time costs. The time pressures that many young families in particular were under, was evident during the interviews with parents ducking in and out of interviews to attend to children's needs. However, a number of participants described *how* they implemented their renovation and retrofit measures in order to minimise the amount of effort they would have to put in and the disruption they would experience. While, as previously reported by Mills and Rosenfeld (1996); and Pelenur and Cruickshank (2014), one participant described adoption of a smart-heating controls system as being stimulated by time pressures.

"...we knew full well, we would get planning, we didn't want any hassle we wanted a safe thing."

(Renovator, Empty Nester)

"Well who goes round and turns their TRVs up and down. You don't realistically have time. Or we certainly don't have time in our life to do that."

(Retrofitter, Young Family)

Financial costs are indeed a barrier causing retrofit measures to be abandoned, however, cost was mentioned even more often in relation to renovation measures than retrofit measures. By interviewing participants who were able to overcome these barriers, they were able to share their strategies for doing so. These included DIY; taking on project management; adjusting their expectations of quality or carefully timing the home improvements. However, many of these participants did not have such strategies in order to overcome retrofit measures. Whilst the literature indicates that some owner-occupiers undertaking low carbon retrofits do take on DIY (Committee on Climate Change 2013; Hamilton et al. 2014; Galvin and Sunikka-Blank 2017); project management (Fawcett and Killip 2014); or time their retrofits carefully in order to manage costs, these tend to be limited to specific measures or individuals with a higher level of interest and expertise than would be representative of the wider population (Fawcett and Killip 2014).

These findings also support the existing literature suggesting that non financial costs such as conflict with neighbours (Galvin 2014b; Owen et al. 2014; Klockner and Nayum 2016); effort

(Eto et al. 1996; Bernier et al. 2010; Weiss et al. 2012; UKERC 2013; Long et al. 2014; Pettifor et al. 2015; Gillich et al. 2016; Klockner and Nayum 2016) and disruption (EST 2011; Weiss et al. 2012; Fawcett 2013; Gillich et al. 2016; Klockner and Nayum 2016) all present challenges to the adoption of low carbon retrofit measures.

6.3.2 Facilitating Activities

Overall, facilitating activities such as entertaining friends, working from home and watching TV were more often associated with renovation measures, but may provide a means to identify those households that might be considering home improvements in order to facilitate these activities. One of the most commonly described activities, discussed previously by Maller et al. (2012); and Horne and Dalton (2014) was entertaining family and friends. Creating more or bigger spaces to facilitate this was often described as an ultimate influence.

“Family. Family and friends, socially. So, you know, it would be nice if we could accommodate more people. Our previous house was more limited and we could get people in but it’s a bit of a squeeze. This space gives us a bit more flexibility, so you can have a family group around and it’s a lot easier.”

(Renovator, Young Family)

Facilitating hobbies such as cycling or walking also stimulated some home improvements. This mainly consisted of providing shower rooms on the ground floor and the associated change in the capacity of the boiler to allow easier showering following exercise. Increasing levels of natural light (an outcome of low carbon identified by Wiseman and Summerson (2014)) for activities such as painting, sewing or making bobbin lace was also discussed by a number of participants. However, home improvements not only facilitate leisure activities. Participants described undertaking home improvements in order to create additional rooms or spaces that would give them an office or study space as reported by the Value propositions for Energy efficient Renovation Decisions (VERD) study (UKERC 2013). Creating these spaces within the living and dining areas was also seen as giving children a space to do homework in which they would not be cut off from parents and other family. Furthermore, more than a fifth of participants described working from home and this was supported by a number of participants being in the course of working prior to or even during the interviews.

Where the house was occupied all day in this way, participants sought to use localised heating strategies, rather than heating the whole house when only the office was in use.

“I work from home as well, so I’m here during the day and in the winter if it’s really cold and I need to keep warm but with central heating, you end up heating the house rather than just the space that you’re working in. So situations like that it might be better from a financial and an energy point of view to just heat the one living area using the stove.”

(Retrofitter, Young Family)

Both renovation and retrofit measures were seen as facilitating participants watching television. This could be through prioritising warmth in TV rooms as places where significant time was spent or creating alternative television rooms to accommodate different age groups in the family wanting to relax and watch TV separately.

“Because when you’ve got children you want to a space to perhaps... especially when they’re teenagers they want to watch... they don’t want to watch telly with us do they? And now, it’s the same. You know. They’re often watching different things in here.”

(Renovator, Empty Nester)

Many of the activities described above are mentioned in the existing home improvement literature, but with exception of entertaining, are seldom identified as having the potential to stimulate home improvements. For example, whilst Gram-Hanssen (2010) observes that basements are commonly used as spaces to facilitate hobbies and Williams et al. (2013) reports that some householders view DIY as a hobby in itself, the role that hobbies play in stimulating demand for specific alterations to the home is not well documented in the existing literature on home improvements. Similarly, the impact of working from home on heating consumption (Marshall et al. 2016) and competition for domestic space (UKERC 2013) is acknowledged, but there is little in the literature regarding how this might drive demand for more efficient or localised heating systems. Finally, television is discussed in the home improvement literature only as a source of information regarding energy efficiency campaigns (Hinchliffe 1996; Gillich 2013; Christensen et al. 2014) or inspiration regarding home improvements for those who see their homes as a means of expressing their own identity (UKERC 2013).

6.3.3 Exercising Hospitality

This influence describes the various ways in which participants described making home improvements in order to exercise hospitality in some way. The most common way in which participants talked about exercising hospitality was entertaining people, and having an appropriate space in which to do that. However, whilst most commonly associated with renovation measures, reference to retrofit measures, such as boilers, were made occasionally.

“I had a big square bath and it took a lot of water. And at one time, I used to have walking friends staying and we used to come home and we wanted bath after bath after bath. So we wanted something [boiler] that would cope with that.”

(Renovator, Empty Nester)

Another common way in which participants discussed exercising hospitality was having people stay. This was commonly associated with providing an extra room through loft conversions or extensions.

“...we wanted a spare room because my mum comes and PXXX's parents were coming at that point, and various visitors and things.”

(Retrofitter, Empty Nester)

Basham et al. (2004) report that householders who had made improvements resulting in improved thermal environment and building fabric were more likely to entertain friends and family without fear of “falling short of social norms of warmth or cleanliness” (Willand et al. 2015, p. 7). As the findings indicate that exercising such hospitality is clearly important to many participants, this could be an alternative way of presenting the benefits of low carbon retrofit measures such as insulation.

6.3.4 Considering Appearance

Considering Appearances was an influence most commonly discussed in association with retrofit measures and was usually cited with broad references to aesthetics, which is intuitively surprising. However, in many of the associations participants described how aesthetics were offset against or interacted with other considerations such as light or

warmth, creating different perspectives on the aesthetics of the measure amongst owner-occupiers. This was far more prevalent amongst retrofit measures and will be discussed in greater detail in Chapter 7.

“...this window was tricky because we didn’t know whether to cut it... so we have three panels in the middle, but the neighbours across the road have got four panels... so we weren’t sure about that. Because I think four looks nicer from the outside but you get more light... less plastic on the inside if you have three, which is what we went with.”

(Renovator, Young Family)

“...several [people] said ‘how are you going to disguise that?’ and you can only disguise it to a certain extent because you’ve got to keep the air flow and there’s got to be a certain meterage around it. RXXXXX and I looked at him and said ‘well we love it. It’s not an eyesore to us. It’s something that is making our house comfortable...’”

(Retrofitter, Empty Nester)

More specifically, architectural style and finding ways to reconcile it with low carbon retrofit measures as discussed by Watts et al. (2011); Sunikka-Blank and Galvin (2016); and Yarrow (2016) was also discussed by participants:

“...the windows less so, because I just wanted to mimic the style for what was there originally.”

(Renovator, Young Family)

Maintaining the character of the property was mentioned by over a third of participants in association with both renovation and retrofit measures with some participants stating the belief that maintaining the architectural style of the windows would maintain the value of their properties. In the majority of cases this was described as a proximate motivation, influencing *how* measures were implemented as discussed by Yarrow (2016):

“So what’s here now looks... the same as what was here before except it doesn’t have the same maintenance problems... We’ve sought to maintain the character

of the building as much as possible whilst getting rid of the hassle and improving the comfort of the house.”

(Retrofitter, Empty Nester)

Contrary to these accounts, some participants described how the adoption of both renovation (including EST 2011; and Gram-Hanssen 2014a) and retrofit (including Galvin and Sunikka-Blank 2014; and Pelenur and Cruickshank 2014) measures had been considered as a way of improving or addressing a concern regarding aesthetics, therefore acting as an ultimate motivation as described by Wilson et al. (2015):

“We were going to do it [install wood burner] this winter, but we didn’t really feel the need. But we decided probably wait another year or so, and probably then more aesthetic than for actual heating needs.”

(Renovator, Young Family)

These comments indicate that many participants perceive the aesthetic properties of retrofit measures negatively (see Crosbie 2010; Karvonen 2013; Sunikka-Blank and Galvin 2016). With aesthetics being discussed most often by renovators, but in relation to retrofit measures, this explains why some renovators may have rejected the adoption of these measures. However, the existing literature identifies situations where original features have been lost or are deemed ugly and retrofit measures are seen as a way of improving the aesthetics of the property or bringing it closer to its ‘authentic’ state (Yarrow 2016). The other benefits a measure brings can influence how participants perceive its aesthetics.

These findings support the need to understand home improvements within the context of concurrent practices, as well understanding how variations between practices might arise through home improvement measures or the existing fabric of the home as identified in Sections 6.1 and 6.2. These insights offer potential points of intervention at which to encourage retrofit. For example, if the measures and individuals associated with concurrent activities can be identified, this could provide an alternative way of framing the benefits of these measures. Furthermore, by understanding how strategies to overcome costs associated with renovation measures are acquired, this could assist our understanding as to how owner-occupiers could acquire similar knowledge relating to retrofit measures. This could replace less successful financial incentives that focus only on overcoming capital costs.

Finally, given the importance of maintaining character as reported by the research participants, identifying historical properties that have lost their original features, could provide an alternative means of promoting some retrofit measures.

6.4 Conclusion

This first empirical chapter has confirmed the importance of many influences commonly cited in the literature such as financial risk; risks to building fabric; distrust of tradesmen; heritage; aesthetics; environmental concern; and thermal comfort. However, as discussed more recently in the literature relating to retrofit, financial savings and environmental concern are seldom the overriding influences. Therefore, simply providing access to capital or information about environmental impacts is unlikely to result in the adoption of low carbon retrofit measures. However, beyond these influences, these findings have identified further concerns that are less well documented in the existing literature and rarely acknowledged as potential influences. For example, parental concerns regarding the safety, long-term health and educational attainment of their children might increase the appeal of many reported benefits associated with low carbon retrofit measures. Young families' home improvements are often closely linked to their strategies for securing a good education for their children, with the domestic instability this often entails, making the adoption of low carbon retrofit measures more challenging. With grandparents also making significant home improvements in order to assist in the care of these children, the appeal of these measures may be broadened even further. As children get older, pressure on space can increase, stimulating further home improvements into which low carbon measures could be incorporated. Additional influences that are not well reported in the literature include reducing future maintenance, facilitating hobbies, avoiding waste, and working from home. These findings emphasize the importance of moving away from merely understanding the adoption of home improvement measures in isolation, and a move towards a greater understanding of how these processes interact and connect with concurrent activities as facilitated by the nexus of practices developed by Hui et al. (2017). The use of overarching teleological influences in this analysis has allowed the connections between otherwise temporally and spatially disparate activities to be conceptualised.

The finding of this analysis have identified a core group of teleological influences that appear to be universally important regardless of household type, home improvement type or the

home improvement measures adopted. In many ways these processes encapsulate many of the concerns around risk; values and comfort that have traditionally dominated research concerning owner-occupier adoption of low carbon retrofit measures. However, by examining these as broader actions (for example including risks that go beyond financial risks; or visual and acoustic comfort as well as thermal comfort), these findings have revealed how these influences manifest themselves in diverse ways from one household type or home improvement to another. Furthermore, by comparing findings between different groups of individuals (renovators and retrofitters; young families and empty nesters) this chapter has identified processes which although less prevalent overall, are of increased importance to particular groups. Identifying these differences begins to address a gap in current understandings of variations between practices as identified in Chapter 3, Sections 3.2 and 3.3.

By comparing the actions associated with renovation and retrofit measures, four further differences were revealed that did not appear in the comparisons between individuals. This indicates that moving away from the individual as the unit of analysis, as advocated by practice theorists such as Shove (2009) and Strengers (2014), could provide an alternative perspective on how adoption of these measures could be encouraged that may offer a degree of independence from the individuals concerned. The role that the material fabric of the home and the meaning associated with it play in mediating influences such as 'considering appearance' also supports the importance that practice theorists such as Reckwitz (2002b) attribute to these homes as material arrangements.

Adopting these 12 actions for analysis in this thesis has also helped to identify the strategies for managing the costs of home improvements adopted by owner-occupiers and how these compare, depending on the individuals and the measures in question. For example, taking on project management, adjusting their expectations of quality or carefully timing home improvement projects was associated with renovation measures. This is rarely employed with regards to retrofit measures, potentially due to a lack of experience or expertise of these measures. Therefore, greater understanding of how these strategies for managing costs were acquired could facilitate ways of developing similar skills with regards to retrofit measures.

Findings of this chapter support many of the arguments advocated by practice theorists, namely:

1. The need to understand how adoption of retrofit measures connect with other activities, including but not limited to other home improvements (Schatzki 2011; Blue and Spurling 2017);
2. The need for a greater understanding how teleological influences manifest themselves differently between households and home improvement measures (Hui 2017);
3. The need for a greater understanding of the role that the material form of the home plays in determining the outcome of home improvements (Reckwitz 2002b);
4. The additional insights revealed by moving away from the individual as the unit of analysis (Shove 2010; Strengers 2014).

These findings suggest that a nexus approach to practice, with particular focus on the connective power of teleological influences could offer additional insights into variations between owner-occupier home improvements and potential points of intervention to encourage low carbon retrofit. However, as identified in Chapter 3, Section 3.3, examination of the relationships between the components of competences, teleological influences and home improvement measures is necessary to determine if a nexus of practices is the most appropriate way of conceptualising these relationships. The following chapter (Chapter 7) will focus on these relationships in greater detail.

Chapter 7| Home improvement measures, teleological influences and knowledge

7.0 Introduction

This chapter will examine in detail the relationships between the 12 teleological influences on the adoption of home improvement measures (see Chapter 6, Sections 6.0-6.3), the individual home improvement measures, and the sources of knowledge and advice participants consulted during their home improvements (RQ 2). As discussed in Chapter 3, Section 3.3, this thesis focuses on the relationships between elements of practices in order to address gaps in our current understanding of large phenomena such as retrofit, variations between practices, and how interventions in practice. The chapter is divided into six sections. The first three sections will examine the relationships *between* these three elements. The fourth, fifth and sixth sections will examine the relationships *within* each of these three elements, for example, how one home improvement measure might relate to another. This chapter will conclude by reflecting on these findings to support a conceptualisation of home improvements within the context of the wider nexus of practices that make up social life, as well as on the insights this analysis has provided and their potential implications for increasing the adoption of low carbon retrofit measures or practices.

As discussed in Chapter 6, Section 6.1 this analysis of relationships within and between practices seeks to move beyond the causal chains described by Schatzki (2016), to include other types of relationships. This chapter will refer to three distinct types of relationships revealed by the analysis. The most common of these were associative relationships where participants described a connection *between* or *within* home improvement measures, influences, and sources of information that was not directional or causal. Examples include

the association between building an extension and creating an office or study as exemplified in the following quote.

"It's [the computer] now in the new bit they built on at the back. Because this is south facing which is lovely, because I sit up there and do my emails."

(Renovator, Empty Nester)

The second type of relationship identified was causal relationships *between* or *within* home improvement measures, influences, and sources of information. For example, the need for a new boiler arising out of the installation of additional bathrooms, as exemplified by the following quote.

"...there's a high chance that more than one person is going to be having a shower at the same time when you have quite few bathrooms... and the combi-boiler didn't allow for that."

(Retrofitter, Young Family)

Finally, the third type of relationships identified were trade-offs or compromises *between* or *within* competing home improvement measures or influences, such as the trade-off between investing in a loft conversion or a conservatory described below:

"...at the time we thought, shall we do a loft extension, or a conservatory? And it was so strongly in favour of the conservatory in terms of usability"

(Retrofitter, Empty nester)

These three relationship types; associative, causal, and trade-off, will be used throughout the chapter to describe the nature of the relationships examined, and so assist understandings the implications of these relationships for the future adoption of low carbon retrofit measures. This approach, focussing on these relationships between home improvement measures, teleological influences and sources of knowledge and expertise, moves away from taking the individual as the unit of analysis as is common in much existing literature on owner-occupier low carbon retrofit (Balcombe et al. 2013; Organ et al. 2013a; Fawcett and Killip 2014). In doing so, the approach facilitates a greater understanding not only of connections between these components within the adoption of a *single* home improvement

measure, but also allows the identification of connections between *multiple* home improvement measures.

7.1 Relationships: Teleological influences and home improvement measures

This section examines the relationships that participants described between specific home improvement measures and the 12 teleological influences described in Chapter 6. Existing practice theory based studies such those by Gram-Hanssen (2014a) and Maller et al. (2012) have compared the meanings or teleological influences associated with home improvement from one individual to another. In contrast, the analysis adopted in this thesis permits the individual to be temporarily removed from the analysis, and the home improvement measures to be analysed according the range of teleological influences with which they are associated. Figure 7.1 shows the number of teleological influences related to each home improvement measure, and the number of participants whose accounts support those relationships. As shown in this Figure, some home improvement measures were commonly associated with particular teleological influences. These included new boilers, extensions, solar PV, fitted kitchens, windows, loft conversions, and loft insulation. For example, new boilers or heating systems were associated with all 12 influences. The most common relationship, described by almost a third of participants from all groups of households, was a causal relationship with *responding to a crisis*, as existing boilers broke down or reached the end of their life (EST 2011; Wilson et al. 2013).

“It definitely needed replacing. The boiler was on its last legs.”

(Retrofitter, Young Family)

Participants also described how cost had informed the choice of their replacement boiler:

“I looked at quite a few of them [heating systems] and looked at the price differentials.”

(Retrofitter, Young family)

Home Improvement Measure	Teleological Influences	Number of Participants	Relationship Type
New Boiler/Heating System	12	22	Causal, Trade- Off & Assoc.
End of Life (Responding to a Crisis)		10	Causal
Cost (Managing Cost)		8	Causal
Extension	12	21	Causal, Trade-Off & Assoc.
Size (Improving Environment)		8	Causal
Size (Accommodating Changing Family)		8	Causal
Size (Supporting Lifestyle)		8	Causal
Size (Exercising Hospitality)		8	Causal
Size (Facilitating Activities)		8	Causal
Solar PV	12	18	Causal and association
Feed In Tariff (Managing Cost)		11	Associated
Cost (Managing Cost)		9	Causal
Environmental Concern (Fulfilling Values)		8	Associated
Investment (Thinking Long Term)		8	Associated
Financial Savings (Thinking Long Term)		7	Causal
Fitted Kitchen	11	20	Causal and association
Cost (Managing Cost)		8	Association
New Bathroom	11	21	Causal and association
Roof lights	11	10	Causal and association
New Windows	10	19	Causal and association
Cost (Managing Cost)		14	Associated
Comfort (Improving Environment)		13	Causal
Aesthetics (Fulfilling values)		9	Causal
Aesthetics (Considering Appearance)		9	Causal
Natural Light (Improving Environment)		8	Causal
Fixtures and fittings	10	16	Causal and association
Loft Conversion	9	14	Causal, Trade- Off & Assoc.
Need for extra bedroom (Accommodating Changing Family)		7	Causal
Need for extra bedroom (Exercising Hospitality)		7	Causal
Loft Insulation	8	15	Causal, Trade- Off & Assoc.
Comfort (Improving Environment)		8	Causal
External Wall Insulation	8	11	Causal and association
Adding or removing walls	7	12	Causal and association

Figure 7.1: Home improvement measures and key influences

Extensions were only causally related with size. However, size plays a role in a number of processes including *improving environmental conditions*, by creating bigger spaces with more natural light; *accommodating a changing family, supporting a desired lifestyle*, and *facilitating activities* by creating large spaces where occupants can congregate and undertake multiple activities at once. Amongst young families, size was also related to *exercising hospitality*, by creating bigger spaces in order to entertain guests as previously reported by Horne and Dalton (2014).

"...this is the space where we eat which is fine for us as a family of four, but you can imagine. We can get six around it not too bad, but any more than that and it is difficult and sometimes at Christmas we have about 13 or 14 people which last time we moved the dining room table into the front room but it meant a lot of hassle moving furniture and it still wasn't really big enough."

(Retrofitter, Young family)

Retrofitters identified solar PV as having a relationship with *managing cost*, *fulfilling values* and *thinking long-term*. Participants described cost having a direct, causal relationship with solar PV panels, mainly due to costs being lower than anticipated, as well as describing how the Feed-in-Tariff (FiT) was also associated with *managing costs* associated with the adoption of the panels. Retrofitters saw solar PV technology as an investment and described a causal relationship between *thinking long-term* about financial savings and the adoption of PV panels. Meanwhile, panels were also associated with fulfilling their values regarding concern for the environment.

"...when he quoted us [for the solar PV panels], we were pleasantly surprised..."

(Retrofitters, Young Family)

"...I think because of the Feed-in Tariff, photovoltaic is a much better option..."

(Retrofitters, Young Family)

"So therefore that's a good ten per cent return on the investment and we're getting some free power at the same time..."

(Retrofitters, Empty Nester)

"But I think it's better because of the fact it's producing electricity in such a way that it doesn't have sort of unforeseen or unfortunate long-term negative impacts on the environment."

(Retrofitters, Empty Nester)

Fitted kitchens and new windows were frequently associated with significant cost, whilst windows were also associated with *fulfilling values*. Amongst renovators in particular, there was a direct relationship between windows and realising their aesthetic values and considerations regarding appearance (Gram-Hanssen 2014a). New windows were also related, through yet more causal relationships, with a desire to improve natural light levels or comfort, with increased comfort being of particular concern amongst renovators and young families.

"...that [bi-fold doors] was our biggest individual purchase wasn't it?"

(Renovator, Young Family)

"Purely aesthetics really. Sat here looking out, just didn't want too much frame."

(Renovator, Young Family)

"...we put in that window there to add light as the sun goes around in the afternoon; we get light through there. It was very important."

(Retrofitter, Empty Nester)

"...then we got the windows done at some point, which made a big difference because the windows were pretty draughty before."

(Renovator, Young Family)

Participants frequently described loft conversions as the direct consequence of requiring an additional bedroom. This might be either to *exercise hospitality* or to *accommodate an expanding family*. In addition to causal and associative relationships, loft conversions were also subject to relationships where participants described making a trade-off between undertaking a loft conversion and retaining valued storage space in the existing loft. This highlights the importance of understanding the relationship between home improvement measures and the multiple teleological influences they might be associated with. This

example shows how the material constraints of the home improvement measure can create tensions between teleological influences acting on the home improvement process.

"...it was done [the loft conversion] to house then kids basically, and it's served its purpose."

(Renovator, Young Family)

"...we needed more storage space, we didn't want a live-in room, we just wanted storage space."

(Retrofitter, Empty Nester)

Finally, loft insulation was related through a causal relationship, with a desire to improve comfort as previously reported by Chappells and Shove (2005). The remaining home improvement measures (new bathrooms, roof lights, fixtures and fittings, external wall insulation, adding or removing walls, new roof, and under-floor insulation) were also related to between two and eleven teleological influences. However, these influences did not manifest themselves in a consistent way, making it harder to mobilise them to encourage higher rates of housing retrofit.

These findings indicate that home improvement measures may be subject to multiple teleological influences that can create competing requirements on a single, material object. Furthermore, the association between the measure and the teleological influence may vary from one household type to another. Inverting this Figure to show the number of measures associated with each teleological influence, and the number of participants who support these relationships, as shown in Figure 7.2, obviously does not reveal new relationships. However, it does identify those teleological influences that are likely to act on the largest number of home improvement measures. This Figure identifies that *managing cost* is connected to the widest range of measures. However, all teleological influences were associated with at least 15 home improvement measures.

Teleological Influences	Number of Improvement Measures	Number of Participants	Relationship Types
Managing Cost	31	31	Causal and Association
Cost - New windows		14	Associated
Feed In Tariff - Solar PV		11	Associated
Cost - Solar PV		9	Causal
Cost - Fitted Kitchen		8	Associated
Cost - New Boiler or Heating System		8	Causal
Improving Environment	29	31	Causal and Association
Comfort - New windows		13	Causal
Comfort - Loft Insulation		8	Causal
Natural Light - New Windows		8	Causal
Natural Light – Extension		8	Causal
Size – Extension		8	Causal
Fulfilling Values	28	31	Causal and Association
Aesthetics - New Windows		9	Causal
Environmental Concern – Solar PV		8	Associated
Supporting Lifestyle	25	30	Causal and Association
Size – Extension		8	Causal
Thinking Long Term	24	31	Causal, Trade-off and Assoc.
Investment - Solar PV		8	Associated
Financial Savings – Solar PV		7	Causal
Considering Appearance	23	27	Causal and Association
Aesthetics - New Windows		9	Causal
Acc. a Changing Family	21	31	Causal, Trade-off and Assoc.
Size – Extension		8	Causal
Need Extra Bedroom – Loft Conversion		8	Causal
Managing Risk	21	27	Causal and Association
Responding to a crisis	18	25	Causal and Association
End of Life - New boiler or heating system		10	Causal
Making the most of things	18	24	Causal and Association
Facilitating Activities	16	25	Causal and Association
Size – Extension		8	Causal
Exercising Hospitality	15	27	Causal and Association
Size – Extension		8	Causal
Need Extra Bedroom – Loft Conversion		8	Causal

Figure 7.2: Number of home improvement measures by influence

This analysis has revealed how measures may be connected to multiple teleological influences and vice versa. Therefore, studying the adoption of a single home improvement measure in isolation does not seem appropriate, pointing towards an understanding of home improvements as part of a nexus of practice as described by Hui et al. (2017). The installation of new windows provides perhaps the best example of these findings. The common association between new windows and significant costs is perhaps most intriguing as, despite this association, windows are one of the most widely adopted home improvement measures (see Figure 7.1, Chapter 7). This could be seen to support the findings of UKERC (2013) and Fawcett and Killip (2014) that when the intention to adopt measures is sufficiently strong, owner-occupiers will find ways to overcome the barriers of capital cost. Alternatively, it could be that the competences required to replace windows are sufficiently absorbed into mainstream home improvement practices (Bartiaux et al. 2014). The role that comfort benefits, such as reduced heat losses and draughts, play in the adoption of modern glazing units are widely acknowledged in the existing literature (Mills and Rosenfeld 1996; Banfill et al. 2012; Bartiaux et al. 2014). Mortensen et al. (2014) also reports that homeowners were willing to pay more in order to achieve an improved indoor environment, going some way to explaining why new windows are one of the most popular measures adopted despite the significant costs associated with them. Meanwhile, although the importance of natural light is discussed in retrofit guidance (see Wiseman and Summerson 2014), it is seldom identified as an influence on the adoption of home improvement measures. This is perhaps because many studies assume that glazing will be replaced with higher efficiency glazing, area for area. While these findings suggest that the opportunity for replacing windows may present itself as part of an attempt to increase glazing and therefore, natural light. Furthermore, the association between new windows and aesthetic concerns indicates that the significant costs associated with replacing windows may be overcome - not due to any functional shortfalls - but purely to aesthetics. To understand owner-occupier adoption of such measures, their position at the intersection of multiple teleological influences must be appreciated.

The relationships that consistently manifest themselves between home improvement measures and teleological influences vary from one household type to another. While all groups, with the exception of retrofitters, mentioned the relationship between windows and managing costs, only renovators and young families talked of comfort, and only renovators discussed aesthetics. These findings address gaps in current understandings of how variations between practices occur through the relationships between teleological influences and the material object. By understanding these variations the outcomes of adopting those retrofit

measures such as new boilers and heating systems, solar PV, and new windows, that already appear to have well-developed associations with a range of teleological influences could be framed in multiple ways to align with these different influences.

However, some teleological influences act on a wider range of measures than others, indicating they could have the greatest impact on adoption of retrofit measures. Likewise, retrofit measures, such as EWI and under-floor insulation were not strongly associated with any particular influences, and other measures such as ASHPs, DPCs, solar thermal, cavity wall insulation, and SWI, were scarcely discussed in association with these processes at all. It may be possible to identify how these retrofit measures could be 'piggy-backed' onto other associated improvements, such as a loft conversion to facilitate study or the emergency installation of a new boiler. The relationships between these measures and sources of knowledge that might facilitate this will be examined in the following section.

7.2 Relationships: Home improvement measures and sources of knowledge

This section will explore the relationships between home improvement measures and competences or sources of knowledge and expertise. While existing literature has sought to establish which sources of knowledge or expertise are most appropriate to encourage adoption of low carbon retrofit measures, these have tended to treat retrofit as one homogenous entity (see for example Stieß and Dunkelberg 2012). In contrast, this analysis sought to disaggregate these findings by determining why some sources of knowledge or expertise might be accessed more commonly in association with individual home improvement measures. However, unlike the relationships between teleological influences and home improvement measures discussed in the previous section, there were no sources of knowledge that were commonly associated by participants with a particular home improvement measure. Furthermore, the range of sources of knowledge with which measures were associated was generally quite small.

The home improvement measure associated with the largest range of information was solar PV panels. These relationships could be causal or associative, although predictably, the range of sources of knowledge was much smaller amongst renovators.

“I saw a couple of places [at Bristol Green Doors] which had interesting things done and I learned about a local company there called 1 World Solar...”

(Retrofitter, Young Family)

“Solar PV panels just because you see it a lot on TV, you see it in newspapers, building shops...”

(Retrofitter, Young Family)

Home Improvement Measures	Sources of knowledge	Participants	Relationship Type
Solar PV	13	14	Causal and Associated
New Windows	10	14	Causal and Associated
Fixtures and fittings	8	13	Causal and Associated
New Bathroom	8	9	Causal and Associated
Fitted Kitchen	7	13	Causal and Associated
Loft Insulation	7	8	Causal and Associated
New Boiler/Heating System	6	15	Causal and Associated
External Wall Insulation	5	7	Causal and Associated
Extension	4	9	Causal and Associated

Figure 7.3: Number of sources of information by home improvement measure

New windows, fixtures and fittings, new bathroom, fitted kitchen, loft insulation, and new boilers were all related to a relatively small range of sources, either through causal relationships where a source directly led to adoption of a particular measure, or through associative relationships where a particular source was commonly used to gather information on a certain home improvement measure. However, extensions, EWI, loft conversions, roof lights, under-floor insulation, ASHP, adding/removing walls and new roofs were seldom discussed in relation to sources of knowledge or expertise. The lack of commonly discussed relationship indicates that within the range of sources of knowledge available, owner-occupiers are accessing disparate sources. This could be viewed as a lack of common understanding of where to access appropriate advice as previously reported by Bartiaux et al. (2014).

Examining the number of home improvement measures associated with each source of knowledge as shown in Figure 7.4, suggests there are a small number of sources that are accessed with regards to a wide range of measures. This included builders and personal connections, and to a lesser extent, architects, the Internet, and traditional forms of advertising such as magazines and TV. While personal connection were commonly used by retrofitters, renovators depended more on builders, who due to a lack of knowledge of retrofit measure, often present a barrier to the adoption of these measures (Risholt and Berker 2013).

“...the internal [wall insulation] I know about because of these friends that had got a Victorian house that had... when they moved in they had the whole of the internal wall along one side done.”

(Retrofitter, Empty Nester)

“...he said [the builder] ‘it would be easier to actually, build the concrete up to a certain level and if we go over, we could put in electric central heating which comes in like a mat format.’”

(Renovator, Empty Nester)

Sources of knowledge	Home Improvement Measures	Participants	Relationship Type
Builder	16	24	Causal and Associated
Personal connections	16	18	Causal and Associated
Architect	10	10	Causal and Associated
Internet	8	12	Causal and Associated
Advertising	8	9	Causal and Associated
Supplier	7	8	Causal and Associated
DIY	7	8	Causal and Associated
Retail	6	10	Causal and Associated
Sub-contractors	5	7	Causal and Associated

Figure 7.4: Number of home improvement measures by source of information

Further interpersonal sources of knowledge and expertise, such as architects and suppliers, were related through causal or associative relationships with a smaller number of measures.

“So then she [the architect] said ‘you need to keep the rest of the lighting very sort of low-key and plain’, which I probably wouldn’t have done otherwise.”

(Renovator, Young Family)

“...so when it came to changing the boiler, they [the suppliers] had been the main source of information for the hot water tank and boiler so I got them to do it rather than the builders.”

(Renovator, Young Family)

In contrast to the assertions made in Rogers (1962) Diffusion of Innovations Model, traditional forms of advertising such as magazines, TV and newspapers, were discussed in relation to a wider range of measures by renovators than retrofitters, through both causal and associative relationships:

“...then the magazines would do a special on kitchens, or a special on bathrooms. So those are quite good to have a look at.”

(Renovator, Empty Nester)

“We didn’t actually visit any others [bi-fold doors] but we looked at magazines and online at different designs.”

(Renovator, Empty Nester)

There are no commonly cited relationships between home improvement measures and sources of knowledge, and this is reflected in the lack of existing literature connecting sources of knowledge with specific measures. This could indicate a wide range of appropriate sources to choose from. However, in light of the small number of sources associated with each measure, it would appear to be indicative of a lack of common understanding about where to access appropriate advice as reported by Bartiaux et al. (2014). This analysis also revealed that whilst renovators were largely dependent on builders and mass media for advice, retrofitters were seeking advice from their personal contacts. It is unclear if this is a cause or a consequence of the measures adopted by these participants. However, it does

illustrate that acquiring knowledge regarding retrofit measures requires participants to move beyond the sources of expertise commonly utilised to research renovation measures. This supports findings by Fawcett and Killip (2014) that retrofitters often access 'specialist' sources of knowledge in order to achieve their low carbon retrofits, that owner-occupiers might not ordinarily have access to. This variation in access to expertise provides another potential component through which variations in practice occur. The connections between practices could give insight into how access a wider range of sources of expertise arises and how such access could be facilitated amongst more owner-occupiers.

The dependence of renovators on the expertise of builders indicates they are a strategic point of intervention. However, Risholt and Berker (2013) previously describe how builders can often act as a barrier to the adoption of retrofit measures. Therefore, interventions to increase retrofit could either encourage builders to become more knowledgeable of retrofit measures or focus on providing owner-occupiers with greater skills for accessing appropriate expertise, therefore, reducing their dependence on builders. This would require a more detailed examination of how sources of advice are sought and evaluated, which will be considered in Chapter 8. The following section will examine relationships between teleological influences and sources of advice, which may also provide further insight into renovators' apparent dependence on builders.

7.3 Relationships: Influences to sources of knowledge

This section examines the relationships between the influences described in Chapter 8 and the knowledge or sources of expertise that participants consulted during home improvements. By examining these relationships it will be possible to identify if certain sources of knowledge or expertise commonly support particular influences, or if participants subject to these influences are more likely to seek out particular knowledge. As shown in Figure 7.7, builders were associated with the widest range of teleological influences, with the most frequently discussed, particularly by renovators being *managing costs* through different mechanisms. This might be through the selection of builders based on cost or previous experience of the quality of their workmanship (identified in Chapter 6 as one strategy for managing costs), or advice from builders regarding costs likely to be incurred as the result of a home improvement.

“But we made that choice didn’t we? Because he was significantly cheaper than the other contractors.”

(Renovator, Young Family)

“This guy had worked for us previously and I was totally happy with this work.”

(Renovator, Young Family)

“It wasn’t a five star job, because we couldn’t afford that but we just wanted a competent builder...”

(Renovator, Empty Nester)

“But when I spoke to the builders they said ‘you can do it but it’s a lot extra hassle and a lot extra money’”

(Retrofitter, Young Family)

Sources of knowledge	Teleological Influences	Participants	Relationship Type
Builder	12	27	Causal and Associated
Builder - cost (managing costs)		20	Associated
Builder - previous experience (managing costs)		12	Causal
Builder - quality (managing costs)		7	Associated
DIY	12	6	Causal and Associated
Supplier	12	23	Causal and Associated
Supplier - cost (managing cost)		14	Causal
Suppliers - local company (fulfilling values)		8	Associated
Supplier - Quality of sales service (managing cost)		7	Causal
Architect	12	16	Causal and Associated
Architect - cost (managing cost)		9	Associated
Personal connections	11	14	Trade-Off and Association
Professional Background	6	7	Associated
Regulations	6	7	Causal and Associated
Sub-Consultant	5	7	Associated
Sub-contractor	4	10	Associated

Figure 7.5: Number of influences by source of information

Similarly, suppliers were also associated with a wide range of influences, particularly amongst renovators. Particularly common relationships included a direct causal relationship between cost and suppliers, as well as an associative relationship with fulfilling values by choosing local suppliers.

*“...we wanted to go to that company, one because they’re local but also...
we’re very big supporters of Bristol Pound...”*

(Retrofitter, Young Family)

Architects, personal connections and DIY (as previously discussed by Bartiaux et al. (2011)) were also associated with a wide range of influences. In the case of architects this was more prevalent amongst renovators, while young families reported a wider range of influences associated with DIY.

*“...it is semi-cost but it was also the fact that I quite don’t mind doing it. And plus,
you know, if I mistake, it’s only me to blame.”*

(Renovator, Young Family)

Conversely, examining the number of sources of knowledge related to each influence, it is not surprising that managing costs was related to by far the widest range of sources of information as outlined in Figure 7.6. Conversely, there is very little association between sources of knowledge and influences such as facilitating activities and exercising hospitality. The relationships between measures and these teleological influences most commonly manifest themselves in extensions and loft conversions designed to facilitate these activities or hospitality (see section 7.1). While the activities to be accommodated may be diverse, information about these measures could be provided at the location of related activities, such as sports centres or craft groups. This expands on proposals by Shove (1997) that retrofit measures should be communicated to owner-occupiers in terms of the routine activities they facilitate.

Teleological Influences	Sources of knowledge	Participants	Relationship Type
Managing Cost	32	31	Causal and Associated
Cost – Builder		20	Associated
Cost – Supplier		14	Causal
Previous Experience – Builder		12	Causal
Cost – Architect		9	Associated
Quality of sales service – Suppliers		7	Causal
Quality - Builder		7	Associated
Fulfilling Values	17	28	Causal and Associated
Suppliers - Local Company		8	Associated
Managing Risk	11	27	Associated
Thinking Long Term	11	17	Causal and Associated
Improving Environment	10	19	Causal and Associated
Considering Appearance	10	14	Causal and Associated
Accommodating Changing Family	9	9	Causal and Associated
Supporting Lifestyle	8	27	Causal and Associated
Making the most of things	7	13	Causal and Associated
Responding to a crisis	3	8	Associated

Figure 7.6: Number of sources of information by influence

These relationships clearly reveal the very important role that costs and strategies for managing them, such as adjusting expectations of quality or using previous experience, play in the selection of the construction project team, especially amongst renovators. Therefore, these teleological influences are not the inevitable outcome of carefully tailored informational messages, but actively inform the selection of a builder, and therefore the kind of information and advice received. Therefore, the relationship between knowledge and teleological influences is not linear as conceptualised in many psychological models of motivation as previously discussed by Shove (2010). Teleological influences and the knowledge an individual holds mutually constitute one another as advocated by practice theorists.

This section has discussed the relationships between teleological influences and sources of knowledge and expertise. As discussed in Chapter 6, participants also described making

associations or trade-offs between multiple teleological influences. These relationships between teleological influences will be the focus of the next section.

7.4 Relationships: Influence to influence

As discussed in Chapter 3, Section 3.3, this thesis seeks to understand not only connections within practices but also connections between practices, in particular the connective power of teleology. Greater understanding of these connections could help to address current gaps in our understanding regarding how variations in practice arise, and how interventions might be made to increase desirable practices. As previously discussed in Chapter 6, and shown in Figure 7.7, the influences discussed are not mutually exclusive, with participants describing each teleological influence as being related to at least nine of the other teleological influences in some way.

Teleological Influences	Teleological Influence	Participants	Relationship Type
Thinking Long Term	12	30	Causal, Trade-Off & Assoc.
Fulfilling Values	12	30	Causal, Trade-Off & Assoc.
Managing Cost	12	28	Causal, Trade-Off & Assoc.
Supporting Lifestyle	12	27	Causal, Trade-Off & Assoc.
Accom. a Changing Family	11	31	Causal, Trade-Off & Assoc.
Improving Environment	11	31	Causal, Trade-Off & Assoc.
Making the most of things	10	25	Causal, Trade-Off & Assoc.
Considering Appearance	10	24	Causal, Trade-Off & Assoc.
Responding to a crisis	10	23	Causal, Trade-Off & Assoc.
Managing Risk	10	14	Causal, Trade-Off & Assoc.
Facilitating Activities	9	28	Causal, Trade-Off & Assoc.
Exercising Hospitality	9	27	Causal, Trade-Off & Assoc.

Figure 7.7: Number of influence by influence

Thinking long term, fulfilling values, managing costs, and supporting lifestyle were all associated with all of the other 11 influences. Relationships between *thinking long-term* and

other influences such as *responding to a crisis, managing risk, making the most of things, improving environmental conditions, supporting a desired lifestyle and facilitating activities* could be either associative or causal. For example, the activity of working from home could directly influence the implementation of measures to make long-term financial savings.

"I work from home as well, so I'm here during the day and in the winter if it's really cold and I need to keep warm but with central heating, you end up heating the house rather than just the space that you're working in. So situations like that it might be better from a financial and an energy point of view to just heat the one living area using the stove."

(Retrofitter, Young Family)

In addition to the causal and associative connections described in previous sections, relationships often consist of trade-offs between influences. These trade-offs between teleological influences are only of interest when looking to examine the relationships between concurrent activities, and therefore, have not previously been studied in the context of housing retrofit. For example, the relationships between *thinking long term* and *managing costs, fulfilling values, or considering appearance* included trade-offs between competing influences such as striking a balance between considering the appearance and architectural style of the property with reducing long term maintenance requirements.

"Sort of steel windows that hadn't been galvanised or anything so hard to maintain, always problems with rust, difficulties with repair and a hell of job repainting them every few years... we've sought to maintain the character of the building as much as possible whilst getting rid of the hassle..."

(Retrofitter, Empty Nester)

Fulfilling values was also related to a wide range of other influences across all groups of participants. The majority of relationships in this case were trade-offs, including those with *considering appearance, improving environmental conditions, making the most of something, managing cost, supporting desired lifestyle, thinking long term*. There were also trade-offs with fulfilling other values, such as between environmental concern and heritage as previously discussed by Judson et al. (2013); Crockford (2014); Moran et al. (2014); Martínez-Molina et al. (2016); and Claude et al. (2017); and between environmental concern and aesthetics as previously identified by Banfill et al. (2012).

“...if you’re not happy to put in uPVC and you’re not happy to change the aesthetics, to compromise to make it more environmentally efficient, it [the cost] is prohibitive...”

(Renovator, Young Family)

More specifically to low carbon retrofit, trade-offs were made between wanting to act out of concern for the environment, but not being willing to take a financial hit to do that. However, when making trade-offs between cost and efficiency, participants would often opt for increased efficiency. As well as making the most of things, this efficiency could be seen as managing costs over two different timescales.

“...we were given a quote for two different ones, one which was more expensive but was more efficient, we thought lets go for the more efficient one.”

(Retrofitter, Empty Nester)

Other trade-offs included those between space and increased energy efficiency through greater depths of insulation, as described by Chiu et al. (2014), and between efficiency and maintaining the character of original features such as windows as described by Galvin and Sunikka-Blank (2014) and Yarrow (2016). Relationships between *considering appearance* and *managing costs*, as well as between *considering appearance* and *improving environmental conditions*, also included trade-offs such as those between financial savings, warmth, and preserving the original features and appearance of the property.

“It seems a shame to get rid of the originals and put plastic but definitely from a...unless you can figure out a way of getting secondary glazing it is probably better for your heating bills.”

(Renovator, Young Family)

“They’re cold [original sash windows]. But they’re part of the fabric of the building.”

(Retrofitter, Young Family)

Retrofitters and young families in particular, associated *accommodating a changing family* and *facilitating activities* with a wide range of other teleological influences. This included

trade-offs such as sacrificing a fourth bedroom in favour of a property with a garden, or more associative relationships such as *improving environmental conditions* in a particular part of the house to facilitate working from home.

"...we ended up buying a three bed in the end because there's so many, all the others ones we looked at had tiny gardens and we had two children at the time, two boys, and we wanted somewhere with a slightly bigger garden..."

(Retrofitter, Young Family)

"...at the moment my wife has so much work that she uses it as her office most evenings and a lot of weekends... she doesn't like working in this room, that room tends to be sunnier..."

(Retrofitter, Young Family)

This section has discussed the different types of relationships between influences that this analysis has identified. Beyond the causal relationships between practices described by Schatzki (2016) and Hui (2017), this analysis has also revealed a large number of relationships describing trade-offs between conflicting teleological influences. This was particularly evident in the case of influences such as *fulfilling values* and *improving environmental conditions*. Whilst comfort is associated in the existing literature with a range of other influences including health (Banfill et al. 2012; Clark and Kearns 2012; Heerwagen 2012; Schofield et al. 2012; Thomson et al. 2013; DECC 2014e; Garrett et al. 2014); aesthetic pleasantness (Heerwagen 2012); sense of belonging (Clark and Kearns 2012); and increased market value (Dall'O' et al. 2012), the trade-offs made between comfort and influences described in the literature are relatively few. These include the trade-off between heritage and comfort described by Sunikka-Blank and Galvin (2016) or trade-offs between thermal comfort and daylight as described by Baborska-Narożny et al. (2016). However, these findings would indicate that trade-offs are far more commonplace than this.

Detailed examination of how widely reported influences such as *fulfilling values* interact with other influences reveals that interpretations of these values are nuanced and the relationships formed with other influences are diverse. This provides some explanation to the variations between practices and why it is so difficult to predict whether influences such as environmental concern will result in the adoption of retrofit measures. The following section will examine how home improvement measures themselves may be directly related to one

another.

7.5 Relationships: Home improvement measure to home improvement measure

Home improvements measures were sometimes associated with each other as material arrangements that link practices together (Schatzki 2002). Detailed examination of these relationships, as undertaken in this section, could provide one way of examining how some retrofit measures might be ‘piggybacked’ onto more popular measures. However, measures were generally only related with a small number of other measures, as shown in Figure 7.8, and like relationships between influences, these often included trade-offs between different measures.

Home Improvement Measures	Home Improvement Measures	Participants	Relationship Type
Extension	9	15	Trade-Off and Association
New Boiler/Heating System	8	11	Causal and Associated
New Bathroom	6	28	Causal, Trade-Off & Associated
Loft Conversion	6	9	Trade-off and Associated
Loft Insulation	4	15	Causal, Trade-Off & Associated

Figure 7.8: Number of measures by home improvement measures

Extensions and boilers were linked to the widest range of other measures. Extensions were most commonly related through associations, as extensions either required, or evolved to include, measures such as new windows; new bathrooms; new roofs; and the addition or removal of internal walls.

“...in having to remove some of the roof to add the new bit on, the old roof, really needed redoing so we ended up with a whole new roof.”

(Retrofitter, Empty Nester)

In addition to these relationships, participants also described how they had made trade-offs between extensions and other measures such as loft conversions or reconfiguring the existing space by adding or removing internal walls:

“But I suppose we did have to make the decision of the, you know the loft thing or the extending out the back...”

(Retrofitter, Young Family)

In the case of retrofit measures more specifically, participants often described how loft insulation was associated with other measures, such as a new roof; installation of a new heating system or a loft conversion as previously reported by Bartiaux et al. (2011). However, in the case of loft conversions, renovators described making a trade-off between a loft conversion, and installing loft insulation. While, retrofitters described retrofit measures such as loft insulation and the installation of solar PV panels as being associated with loft conversions.

“You know, you can have loft insulation, but if you’ve got loft done, you can’t put that in either.”

(Renovator, Young Family)

“I don’t think we ever came to this house thinking, we need to have solar energy, it was a by product or redoing the roof anyway...”

(Retrofitter, Young Family)

New boilers, new bathrooms and loft conversions were also associated with a range of other measures; however, the associations identified by retrofitters were very different to those identified by renovators. Whilst both groups associated a new boiler or heating system with a new bathroom, renovators also associated it with an extension, fixtures and fittings, and new kitchen, whilst retrofitters identified associations with loft insulation (as discussed above), Air Source Heat Pumps (ASHP), and solar PV.

“We’ve also got a thing called a solar I-boost [heating system]... whenever the sun comes out it will pinch whatever is free, incrementally up to 3 kW it’ll take.”

(Retrofitter, Empty Nester)

Very few participants discussed relationships between the remaining measures. These measures include many of those identified in Section 7.2 as not being strongly related to any particular influence, making ‘piggy-backing’ them onto other, more popular measures, potentially a better approach. However, as Figure 7.9 shows, with the exception of the relationships with loft insulation discussed previously, a closer examination of the association between these measures suggests only occasional associations between re-rendering facades and EWI; and SWI and installing a DPC.

Home Improvement Measure	Home Improvement Measures (number of participants)
Roof lights	<i>None</i>
Loft Insulation	Loft Conversion (2); New boiler or heating system (1); New roof (1); re-rendering façade (1).
External Wall Insulation (EWI)	Re-rendering the façade (3); New Windows (1).
Under-floor Insulation	<i>None</i>
Air Source Heat Pump (ASHP)	New boiler or heating system (1); Solar Thermal (1).
Damp Proof Coursing (DPC)	SWI (1)
Cavity Wall Insulation	<i>None</i>
Solid wall insulation (SWI)	DPC (1)
Solar Thermal	ASHP (1)

Figure 7.9: Detailed breakdown of relationships between home improvement measures.

Analysis of the relationships between measures has revealed opportunities for measures such as new boilers; new windows; loft insulation, and solar PV to be ‘piggy-backed’ onto measures such as extensions and loft conversions. However, the opportunities to use relationships between measures to promote those retrofit measures that do not have strong relationships with a particular influence, would appear to be limited with these measures also having few relationships with other measures as shown in Figure 7.9. While some participants saw loft conversions and loft insulation as having an associative relationship, others saw these two measures as requiring a trade-off to be made. This would indicate that different participants have different understandings of the combination of measures available to them and these understandings lead to very different associations between measures. Understanding these differences in associations between measures contributes to

our knowledge of how variations between practices arise. This indicates that calls for retrofit measures to be piggy-backed onto amenity improvements (see for example EST 2011; UKERC 2013) are unlikely to be successful, unless stronger associations with other elements can be established, incorporating these measures into the nexus of practices.

7.6 Relationships: Between sources of knowledge and expertise

This final section will examine the relationships participants describe between different sources of knowledge and expertise as shown in Figure 7.10. As shown by Blue and Spurling (2017), jurisdictions, and the competences on which they are based, can be an organising and connective element of practice. Examining these relationships in greater detail could provide insight into how access to specialised advice might be improved, providing owner-occupiers with the knowledge facilitating the adoption low carbon retrofit measures.

Builders were associated with the widest range of other sources of knowledge, and most commonly with personal connections. These personal connections were either associations or direct influences on the selection of a builder. In turn, builders could influence the selection of architects, suppliers and sub-contractors or vice versa. This implies that the small building firms that undertake the majority of home improvement work mediate many of the subsequent specialists who are then brought onto a home improvement project. However, as previously identified by Risholt and Berker (2013) these builders currently often present a barrier to the adoption of retrofit measures. Therefore, as stated previously strategies to increase adoption of retrofit measures must seek to mobilise builders to encourage adoption of retrofit measures or provide owner-occupiers with strategies to reduce their dependence on advice and expertise from builders. This chapter shows how this effects not only advice on the home improvement measures themselves but also on the appointment of other tradesman involved in the home improvement.

“I felt as if I could rely on him if you know what I mean. There was a personal bit there because my daughter has used them [builders]...”

(Renovator, Empty Nester)

“...but I knew that I really wanted it to be NXXX [the builder], because I knew

XXXXXXXXX [the architect] had worked with him before..."

(Renovator, Young Family)

"And actually the guy, the builder doing it, knew someone, so it was a relatively painless experience, in terms of organising it, finding a company [suppliers]..."

(Retrofitter, Young Family)

"No, all the ancillary workers all came through this guy [the builder]."

(Renovator, Empty Nester)

Information	Sources of knowledge	Participants	Type
Builder	14	27	Causal and Associated
Personal Connections – Builder		16	Associated
Personal Connections – Builder		12	Causal
Architect - Builder		10	Causal
Builder – suppliers		8	Causal
Builder – sub-contractor		7	Causal
Supplier	14	23	Associated and Causal
Internet – suppliers		10	Causal
Personal connection – suppliers		9	Causal
Builder - suppliers		8	Causal
Architect	12	19	Causal, Trade-Off & Assoc.
Architect - Builder		10	Causal
Personal connections - architect		7	Causal
Personal Connections	11	29	Associated and Causal
Personal Connections – Builder		16	Associated
Personal Connections – Builder		12	Causal
Personal connection – suppliers		9	Causal
Personal connections - architect		7	Causal
Internet	9	18	Causal and Associated
Internet - suppliers		10	Causal
Professional Background	9	7	Causal, Trade-Off & Assoc.
Sub-contractors	8	14	Causal, Trade-Off & Assoc.
Builder – sub-contractor		7	Causal
Local Group/Scheme	8	8	Causal and Associated
Advertising	7	7	Associated
Regulations	5	9	Causal and Associated
Sub-Consultant	5	8	Associated

Figure 7.10: Relationships between sources of information

These findings indicate that connections between sources of knowledge and expertise may also provide links between the adoption of concurrent home improvement measures. As one expert recommends the next, the interests and expertise of each professional is likely to influence their contacts within the industry, and the interests and expertise of the people they recommended. These connections, based on the expertise of these sources, could be conceptualised as jurisdictional relationships as previously described by Blue and Spurling (2017).

7.7 Conclusion

This more detailed analysis of the relationships between home improvement measures, teleological influences, and sources of knowledge and expertise has shown how home improvement measures may be related to multiple teleological influences and vice versa. This again supports the assertion that adoption of these measures cannot be considered in isolation, but must be placed within the context of a nexus of concurrent activities. While this approach has been advocated by practice theorists such as Schatzki (2011); Shove et al. (2012); and Nicolini (2017), this focus on how practices interact has not yet been applied to the understanding of low carbon retrofit. Furthermore, this thesis moves beyond understanding causal relationships between practices (Schatzki 2016; Hui 2017) to also investigate associative relationships and trade-offs. This includes not only the connections between material objects discussed by previous research (Schatzki 2002), but also explores the connective power of teleology. This has shown how apparently disparate practices are linked by a common teleological influence.

Detailed analysis of the relationships between home improvements measures and influences has revealed retrofit measures including new boilers and heating systems; solar PV; and new windows that have strong associations with a variety of teleological influences, though these may manifest themselves differently between different participants or home improvement measures. Therefore, understanding these relationships can help to address the current gap in our knowledge regarding how variations in practice arise. However, perhaps the most interesting finding, that would not be possible without examining these relationships, is how often participants feel obliged to make trade-offs between competing influences or home improvement measures.

Furthermore, this analysis shows how the teleological influences are not the outcome of information campaigns as proposed by the knowledge deficit model previously critiqued by Eden (1998); Myers and Macnaghten (1998); and Shove (1998). This chapter has explicitly shown how teleological influences can inform which sources of knowledge and expertise are accessed, creating a mutually constitutive relationships between knowledge and teleological influences, that is more comparable to practice theory understandings of the relationship between these elements as described by Shove and Pantzar (2005). In contrast, analysis of the relationships between home improvement measures and sources of information revealed very few commonly cited relationships. Combined with the small number of sources associated with each measure, this suggests a lack of common understanding of where to access appropriate information as previously identified by Bartiaux et al. (2014). While retrofitters often turned to their own personal connections for advice, renovators were largely reliant on builders. As previously identified by Owen et al. (2014), builders have often been neglected by previous attempts to encourage higher rates of retrofit, and through lack of expertise in these retrofit measures, can often present a barrier to their adoption (Risholt and Berker 2013). This analysis builds on these findings by Killip (2013a) revealing that in addition to the advice they provide on home improvement measures, builders, and to a lesser extent, architects and suppliers, seem to be a key point of connection, signposting owner-occupiers to other sources of more specialist information (as discussed in Section 7.6). These connections are based on expertise and the associated power to select appropriate specialist tradesmen, and could be conceptualised as the jurisdictional links between practices, described by Blue and Spurling (2017). This indicates that strategies should either provide incentives for builders to direct owner-occupiers to sources of specialist retrofit advice, or focus on providing owner-occupiers with strategies for accessing this specialist expertise directly.

These findings suggest a number of ways in which the adoption of low carbon retrofit measures could be encouraged in the future. These include:

1. Providing additional support in association with measures such as solar PV where participants reported feeling incapable of adopting adaptive strategies to minimise cost and disruption;

2. Redirecting financial support towards supporting owner-occupiers making difficult trade-offs between competing home improvement measures or influences (that include cost);
3. Providing information and advice that allows retrofit measures to be 'piggybacked' onto more familiar measures;
4. Using prevalent sources of information such as builders, architects, and suppliers to direct people to less well-known, more specialised sources of advice;
5. Developing stronger links between home improvement measures and sources of specialised support, allowing owner-occupiers to access this expertise directly.

As identified above, the relationship between teleological influences and sources of advice is not linear. Therefore, to implement these strategies a greater understanding of how owner-occupiers go about seeking and evaluating sources of knowledge and expertise, and how different levels of competence and access to advice arise, is required. This will be examined in Chapter 8.

Chapter 8 | Acquiring knowledge on home improvements

8.0 Introduction

Chapter 6, Section 6.1.1 and 6.3.1, identified that participants have strategies they employ to manage the costs of home improvements or identify appropriate and trustworthy sources of expertise. However, as discussed in Section 6.3.1 participants are not always able to apply the same strategies to retrofit measures that they use for renovation measures. Furthermore, Chapter 7, Section 7.3 shows the relationship between teleological influences and home improvements are non-linear. Therefore, teleological influences affect the sources of expertise that are sought. This, in turn produces variations in competences, and subsequent variations in home improvement practices. Therefore, to address the aim of this thesis to contribute to a gap in current understandings of how variations between practices arise this Chapter will begin (Section 8.1) by examining the practices employed by different groups of owner-occupiers to acquire knowledge regarding home improvements. Subsequently, Section 8.2 will explore how these practices of acquiring knowledge vary depending on the source of the expertise sought of the home improvement measure. Finally, the chapter will conclude (Section 8.3) by discussing practices of acquiring knowledge contribute to variations in practices and what the implications of this might be for increasing low carbon housing retrofit.

8.1 Practices of acquiring knowledge

Previous studies examining owner-occupier use of available expertise have tended to be based on large-scale quantitative studies of which households access which sources (see for example Stieß and Dunkelberg 2012). By examining practices of acquiring knowledge regarding home improvement measures and how these vary from one group of owner-occupiers to another, this research will help to address a gap in our current understanding of how variations between practices arise, as well as revealing points of intervention where

higher rates of low carbon retrofit could be encouraged.

8.1.1 Renovators and Retrofitters

None of the practices of acquiring knowledge described in this Chapter were discussed equally by all groups of participants, implying that different groups of owner-occupiers have different priorities when seeking out knowledge and expertise regarding home improvements. Renovators discussed more commonly how they felt dependent on the expertise of professionals, supporting the findings of Chapter 7, Sections 7.2 and 7.6 previous studies by Risholt and Berker (2013) and Fawcett and Killip (2014). In particular, participants discussed how floor planning and design were areas of expertise for which they commonly relied on the advice and guidance of professionals.

"It's this long process and we had an architect and within a week, 2 weeks all our preconceived ideas went out the window. I think he put us on the right path ...this is fairly narrow site ...and he guided us and made the best use of it."

(Empty nester, renovator)

However, whilst dependent on the technical expertise of professionals, participants also described practices they used to help them determine which professionals to depend on. For example, as discussed in Chapter 6 (Section 6.2), almost a third of participants described how their selection of professionals was influenced by the quality of sales service they received during their initial enquiries. This supports the findings of Myers and Macnaghten (1998) that participants judged the credibility of sources based on the way they behave (in Chapter 3, Section 3.1.2).

"Some of the building companies, they didn't even bother phoning to ask how the quote is ...how is their communication going to be when they're on a job, if they can't even be bothered to do that?"

(Young family, renovator)

"...none of the other building companies, when we put the job out to tender, came back on time. So I just thought, we got a good feeling about him ...and we'd seen his work."

(Young family, renovator)

In contrast to the priorities of renovators discussed above, two thirds of all retrofitters discussed the importance of being aware of the energy their renewable energy technologies were generating, supporting Kolb's (1974) assertion that whilst some individuals like to receive specific recommendations, others prefer to receive more abstract information that they can analyse themselves. As illustrated by the quote below, analysis of such information can lead to changes in behaviour that seek to take advantage of peaks in electricity generation as previously described by Brown et al. (2014).

"I don't think it's altered how we use the house but it has altered how we use the electricity, so that we try to do stuff that is a relatively high user of power when we're generating. So you know you put the washing machine on or... you could probably have the washing machine on and the vacuum cleaner in high summer, when you're generating fast but probably not other times.

(Empty nester, retrofitter)

While retrofitters described feeling confident interpreting abstract information such as generation data, renovators reported feeling particularly dependent on the expertise of building professionals, as previously identified in Chapter 7 and supporting the assertion made in Chapter 3 (Section 3.1.2) that there remains a lack of procedural information supporting low carbon housing retrofit. This dependency was particularly evident in the case of floor planning and design expertise, which as documented in the existing literature can prefigure both routine practices (Gram-Hanssen 2010; Maller et al. 2012) and low carbon retrofit strategies (Watson and Shove 2008; Killip 2013a; Crockford 2014; Guerra-Santin et al. 2017). However, participants described how where possible they used competences acquired through previous experiences to select building professionals. This supports not only a nexus approach of connected practices, but also a practice approach to learning (Sahakian and Wilhite 2013; Fyhn and Baron 2016) and subjectivation (Alkemeyer and Buschmann 2017), in which one practice informs the next.

8.1.2 Young Families and Empty Nesters

In addition to the different priorities between renovators and retrofitters discussed above, there were also types of knowledge and expertise discussed more commonly amongst young families or empty nesters. Empty nesters more commonly echoed some of issues discussed in section 8.1.1 such as awareness of renewable energy generation as well as a lack of

expertise. This lack of expertise could potentially be associated the smaller range of sources of knowledge and expertise accessed by empty nesters in this sample, as shown in Figure 5.4. Meanwhile, the quotes from participants below, support previous findings reported by Peng (2012), and show how young families employed practices such as obtaining multiple quotes to determine appropriate sources of knowledge and expertise.

"I had spread sheets where I put all the quotes we got, compared the differences, tried to price out any elements they'd missed... add that into their quote to compare them and have that all on a spread sheet. So I was comparing, how quickly people had got back to me, you know, and the prices..."

(Young family, retrofitter)

"We did go to another architect, just to check costs and whether her quote was competitive, they gave us a slightly reduced rate because we were friends."

(Young family, renovator)

In addition to obtaining multiple quotes, young families also described how accessing examples of previous work undertaken by tradesmen, was employed to determine appropriate and trustworthy sources of knowledge and expertise, as described in the quote below. This supports arguments for more experiential forms of learning and information dissemination made by Kolb (1974), Mileti and Peek (2002), Risholt and Berker (2013) and Berry et al. (2014), as well as practice theories of learning discussed by Sahakian and Wilhite (2013) and Fyhn and Baron (2016). Furthermore, this practice of seeking out examples of previous work makes the proximity of the tradesmen or supplier to the owner-occupier, an important feature when identifying potential sources of knowledge or expertise. This builds on existing literature identifying the importance of localised initiatives and social networks as sources of knowledge and expertise (see for example Stieß and Dunkelberg 2012; Johnson et al. 2013; Berry et al. 2014).

"...to be honest it came down to the fact of seeing the guy's work... and the brickwork was just immaculate."

(Young family, renovator)

While several studies have reported that owner-occupiers do not necessarily trust the information given to them by experts (Palmer et al. 2012; Stieß and Dunkelberg 2012; Syal et al. 2013; Kastner and Stern 2015), and will seek to verify this themselves (Risholt and Berker 2013), or through social networks (Stern 1992; Watts et al. 2011; Stieß and Dunkelberg 2012; Bartiaux et al. 2014; Brown et al. 2014), these findings provide greater detail about the practices that owner-occupier use to acquire knowledge and assess the trustworthiness of the source of expertise. This would indicate that it is not only important to provide trustworthy sources of information, but also provide owner-occupiers with the means to gauge their trustworthiness. However, it is intriguing that these practices of determining trustworthiness are more dominant among young families. The relationships between these practices of acquiring knowledge, sources of knowledge and expertise, and home improvement measures will be discussed in the following section with a view to understanding why certain groups of owner-occupiers may be drawn to certain information sources.

8.2 Practices of acquiring knowledge from particular sources of expertise

As discussed above, the practices employed to acquire appropriate knowledge regarding home improvement measures varies between one group of owner-occupiers to another. However, as outlined in Chapter 3, Section 3.3, this thesis moves away from the individual as the unit of analysis in order to better understand how variations in practice arise. This section will explore the relationships between the types of information sought and sources of knowledge and expertise, and home improvement measures described by interview participants. These will be examined in light of the findings of the section 8.1, and Chapter 5-7, with a view to understanding why different sources of information are accessed by different groups of owner-occupiers.

8.2.1: Types of Information with sources of knowledge and expertise

This section will examine the relationships owner-occupiers describe between practices of acquiring knowledge and specific sources of knowledge and expertise. While previous literature on the use of different sources of information has identified that mass media can raise awareness of issues, whilst interpersonal communication is better at delivering more personalised information, this analysis will identify more specifically the practices used to access different sources of competence and expertise by owner-occupiers.

Participants most commonly discussed how they sought to access the expertise of three sources of knowledge and expertise: builders, architects, and suppliers. This is not surprising given that as identified in Chapter 7, these were some of the commonly cited sources of knowledge and expertise overall. Unsurprisingly, participants described relying on architects for the floor planning and design expertise they felt they needed to obtain as identified in Section 8.1. Meanwhile, the practices employed by young families to determine the trustworthiness of sources of expertise, such as obtaining multiple quotes or seeking out examples of work were associated most commonly with builders, and to a lesser extent, suppliers and architects. Obtaining a large number of quotes from builders, architects, and suppliers, was a way of gathering information beyond predicted costs, as described by the following quotes.

"I probably contacted fifteen or twenty [building] companies and we must have had ten quotes... they gave us information. Each one maybe said, 'oh, what about this?' 'But, what's going to happen there?' So it actually helped us to spec in what we wanted."

(Young family, retrofitter)

"...it wasn't just about price, because I think some people think, shopping around [for suppliers] is just about getting the cheapest quote for whatever. But actually it is also getting ideas."

(Empty nester, retrofitter)

Furthermore, accessing examples of previous work was a practice commonly associated with builders and architects. Participants described how this was important, both in terms of the quality of the workmanship and the experience of the build. As proximity facilitates this practice, this makes a good geographic distribution of builders and architects with the appropriate skills to facilitate low carbon retrofit especially important.

"...he also did a friend's extension, so we had seen the work going on there and the finished work and we were quite pleased with how our friend's experience was, and what it looked like."

(Young family, retrofitter)

Practices for assessing sources of knowledge were most commonly reported by young families, as discussed in Section 8.1. This suggests that equipped with these strategies for gauging the trustworthiness of sources, namely: obtaining multiple quotes, finding examples of previous workmanship, and locally accessing physical examples of skills and products, young families feel more confident in accessing the expertise of professionals such as builders, architects and suppliers. This would account for the greater use of these sources by young families, as shown in Figure 5.1 (Chapter 5). These findings go beyond existing literature showing that different individuals prefer to access different sources of information (Stieß and Dunkelberg 2012), to examining the practices used by different groups of owner-occupiers to identify sources of knowledge and expertise they believe to be appropriate and trustworthy.

Furthermore, these participants used these quotes to collect a wider range of information than just cost, also appropriating ideas and suggestions from these conversations, indicating that builders, architects and suppliers could begin to influence home improvement projects before they have even been appointed. This suggests that some participants would welcome further suggestions from construction professionals, indicating that builders' concerns that making suggestions will put clients off hiring them, as previously reported (EST 2011) may be unfounded and are certainly not universally true.

8.2.2: Practices of acquiring knowledge about particular home improvements

This section will examine the practices of obtaining knowledge described by owner-occupiers in association with specific home improvement measures. This adds to existing literature that has identified the types of information required to encourage low carbon retrofit (see for example Parnell 2003; Syal et al. 2013; Christensen et al. 2014) by disaggregating retrofit into individual measures that owner-occupiers may seek to learn about in different ways or may present particular challenges. For example, access to physical examples was considered important in association with new windows and fitted kitchens. This is unsurprising given the high level of concern regarding the aesthetics of these measures (as discussed in Chapter 7).

“When you’re spending so much money you want to make sure. With Crittal [window manufacturer] they had a number of addresses around here where they’d done their modern thing so we could go and have a look and straight away

you could see the not-so-good bits. When you're looking at small pictures it doesn't quite strike you the same, but actually seeing it..."

(Empty nester, retrofitter)

Meanwhile, a shortage of installers and lack of expertise was described as a challenge to acquiring knowledge in association with External Wall Insulation (EWI), as in the following quote where one participant described trying to obtain a second quote for the installation of EWI. This builds on previous literature that has identified a lack of skilled tradesmen as a barrier to low carbon retrofit more generally (see for example Tuominen et al. 2012; Risholt and Berker 2013; Brown et al. 2014).

"I think we probably went back to the Centre for Sustainable Energy, and said 'is there anyone else?' and they said 'not really'. And that's not very good is it?"

(Empty nester, retrofitter)

In the case of some measures, such as EWI, the supply infrastructure is not sufficiently developed for owner-occupiers to employ these strategies. This shortage of installers is compounded by the relatively high costs of EWI, with findings by Peng (2012) showing that the greater the cost of home improvement measures the more quotes owner-occupiers obtain. This indicates that if a wider range of owner-occupiers, including more young families who depend on these strategies of obtaining multiple quotes, are to adopt EWI, suppliers and expertise regarding this home improvement measure need to be more widely available. For highly visible measures such as solar PV, windows, fitted kitchens, it is not only important to obtain multiple quotes but also to be able to view multiple physical examples of the product or workmanship.

These findings have further highlighted that relationships between sources of knowledge and expertise, practices of acquiring this knowledge and home improvement measures are. For example, as identified in Chapter 7 (Section 7.2), cost was an influence commonly associated with home improvement measures such as fitted kitchens and windows, and with sources of knowledge such as builders, architects and suppliers. These sources of knowledge were also strongly associated with access to examples, which was also reported by participants to be particularly important in the case of highly visible measures such as windows and fitted kitchens. This indicates an iterative process of gathering information regarding cost and comparing this with examples of previous work in order to select construction professionals,

who in turn provide information about cost of home improvement measures, which are then compared with examples of other products or measures before making a selection (see Figure 8.1).

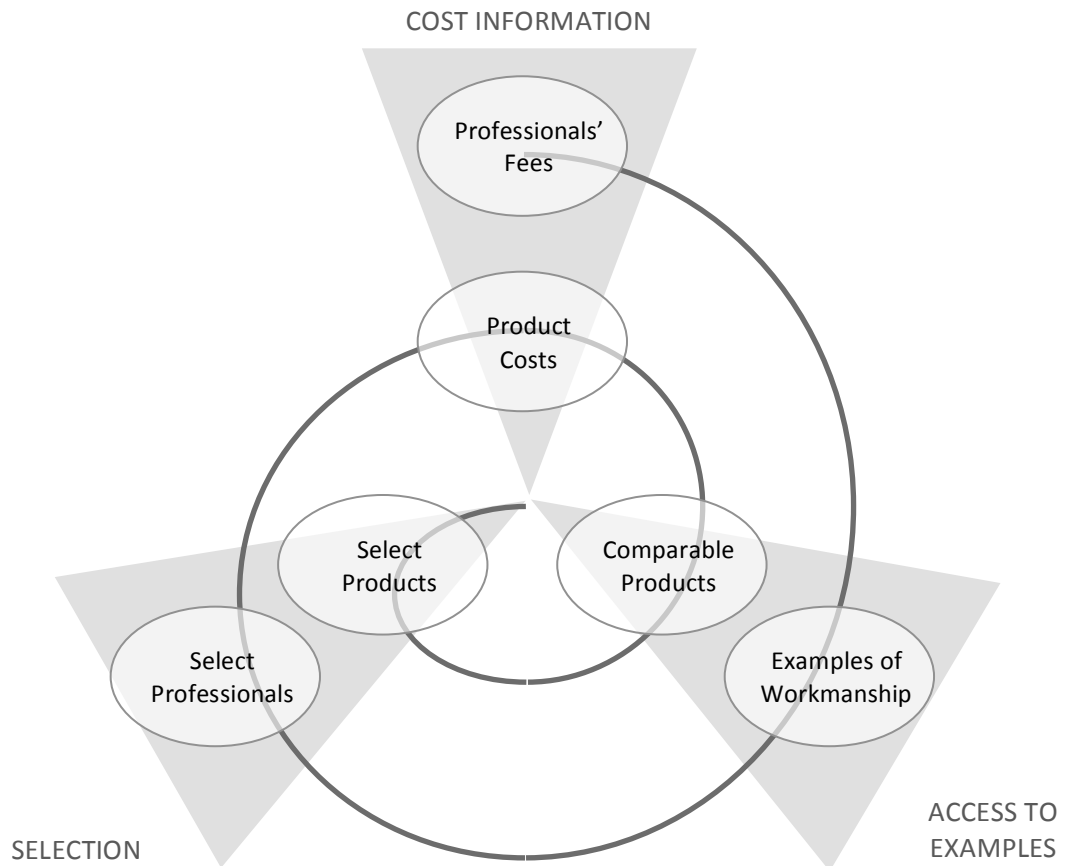


Figure 8.1: Iterative selection process influenced by cost and access to examples of comparable work/products

8.3 Conclusion

The findings presented in this chapter have revealed a clear division between how young families and empty nesters seek to acquire the knowledge necessary to undertake renovation and retrofit projects. Empty nesters were found to access a much narrower range of sources than young families and often expressed suffering from a lack of expertise. Much of the existing literature which focuses on the lack of expertise of owner-occupiers, attempts to distil professional expertise into decision support models (see for example Yaw Addai Duah et al. 2014) or provide sources of information designed to appear credible (Stern 1992; Bator

and Cialdini 2000). In contrast, these findings have revealed that owner-occupiers and young families in particular - whilst being dependent on professionals for expertise such as floor planning, employ practices to acquire knowledge and assess the trustworthiness of sources of professional expertise. This supports the assertion that owner-occupiers learn through previous practices (Sahakian and Wilhite 2013). It is through this process that practitioners undergo a process of subjectivation that leads to variations in practice (Alkemeyer and Buschmann 2017), and potentially unequal capacities to act (Watson 2017). Therefore, providing access to multiple quotes or previous example of workmanship in association with sources of knowledge and expertise such as builders, architects and suppliers, and specific home improvement measures, such as new windows and fitted kitchens, would facilitate participants in implementing these strategies.

Furthermore, these findings have provided further insight into the non-linear relationships between teleological influences, sources of knowledge, home improvement measures, and practices of acquiring knowledge. Expertise does not only affect teleological influences, but teleological influences also affect the expertise that is sought and how it is acquired. An example of this includes the relationship between new windows, managing costs, builders or suppliers and access to examples of the products as described in Figure 8.1. This would indicate that the opportunities to integrate energy efficiency measures within projects are multiple in the early stages. However, as the process unfolds, opportunities for integration are gradually eliminated, until the project is complete and further opportunities for integration of low carbon measures within the current project are (close to) zero.

These observations support a practice theory understanding of how knowledge is acquired through previous practice and embodied understanding (Sahakian and Wilhite 2013). One practice, for example, obtaining multiple quotes may produce competences that, in turn, inform the subsequent practice (Hui 2017). Therefore, through this process of practice, participants become enabled and their disposition towards further practices is altered (Alkemeyer and Buschmann 2017). This suggests that a nexus approach focussing on the connection within and between practices, and the mutual contingency of these practices has significant explanatory power for large phenomena such as retrofit. Focus on these connections between practices can reveal how variations in practices arise and therefore where interventions might be made to encourage desirable practices. This addresses some of the key criticism of practice-theory understandings of large and varied phenomena, providing a way of conceptualising the transformative power of the individual, without adopting an

individualistic approach. It also makes practice theory more tractable and therefore more practicable to policy-makers. The wider policy and theoretical implications of these findings will be discussed in the following chapter.

PART IV: DISCUSSION & CONCLUSION

Chapter 9: Discussion

9.0 Introduction

This chapter will discuss the wider implications of the findings of this research (reported in Chapters 5-8), which has sought to address the following research questions:

- What are the teleological structures supporting renovation and retrofit measures respectively? (RQ 1)
- How do teleological structures, home improvement measures, and associated competences or expertise, connect to one another? (RQ 2)
- What are the implications of understanding the wider nexus of practices and the connections between practices that comprise it for encouraging higher rates of owner-occupier, low carbon retrofit? (RQ 3)

The chapter is divided into two sections. The first will examine the implications these findings have for practice theory and, more specifically the application of practice theory to low carbon housing retrofit. Subsequently, the second section, will examine the implications of these findings for policies designed to induce low carbon housing retrofit.

9.1 Implications for Theory

This section will discuss the implications of the findings of this research for practice theory, and the application of practice theory to low carbon housing retrofit. This discussion is divided into three parts. It begins by examining the need to understand retrofit within the context of the wider nexus of practices and describes the ways in which home improvements may be linked to other practices in this nexus. This is followed by an exploration of why the connections between elements of practice and between practices may vary, depending both

on the home improvement measure and the practitioner. It concludes by exploring how the competences that support practices are developed.

9.1.1 Understanding home-improvements within the wider nexus of practices

Previous research applying practice theories to the low carbon retrofit of housing has advocated a shift from the ontology of abstract and isolated ‘houses’ to inserting the notion of ‘home’ into its wider social context (Wilson et al. 2015); and from understanding low carbon retrofit as a discrete practice to understanding it within the wider practice of dwelling (Maller et al. 2012). The research findings presented in this thesis, as outlined in Chapters 5 to 8, suggest that practice theories can potentially provide greater insights into large or complex phenomena such as home improvements when these horizons are broadened further as advocated by Schatzki (2010). Following this approach, the adoption of different types of home improvement measures is viewed not only within the wider context of household practices, but within the broader nexus of practices that make up social life.

The practices described by participants in this study, were linked by 12 broad teleological influences, as outlined in Chapter 6. For the purposes of the illustrative model shown in Figure 9.1, the wider nexus of practices that makes up daily life is portrayed as a cuboid to more clearly depict the alternative dimension of analysis that teleological constellations bring to this nexus. Constellations of practice are described by Schatzki (2016) as bundles of practices and material arrangements connected together that, in turn, interconnect to make up the nexus of practices. As identified in Chapter 3, this definition has always given materials a privileged place in the formation of constellations. For example, a material component of practice, such as a window, may link practices associated with spending, heating, and improving aesthetics (explored in greater detail in Figure 9.2) along a notional ‘Y-Axis’, as shown in Figure 9.1. However, this thesis proposes that if materials, as a component of practice as introduced by Reckwitz (2002b), are able to inter-connect practices, then teleological influences should also be able to form constellations, through which bundles of practices interconnect. While these influences may manifest themselves differently from one practice to another, the practices would share the same underlying teleological structure, connecting bundles of practices together into constellations along a notional ‘X-Axis’. These constellations provide an alternative way of understanding the connections between home improvements, as well as how these home improvements might be linked to practices that extend *beyond* the home. For example, the constellation ‘*accommodating the needs of a changing family*’ led families to both move from previous houses in order to access desired

state schools, as well as adapting these new houses in order to provide bedrooms, study, or play-spaces for their children. The researcher does not seek to claim that these constellations are fixed or universal. However, it is proposed that the identification of these teleological structures, which have received relatively little attention in practice research to date, facilitate closer study of connections between seemingly unrelated practices, as well as adding another dimension through which variations between practices can be explored.

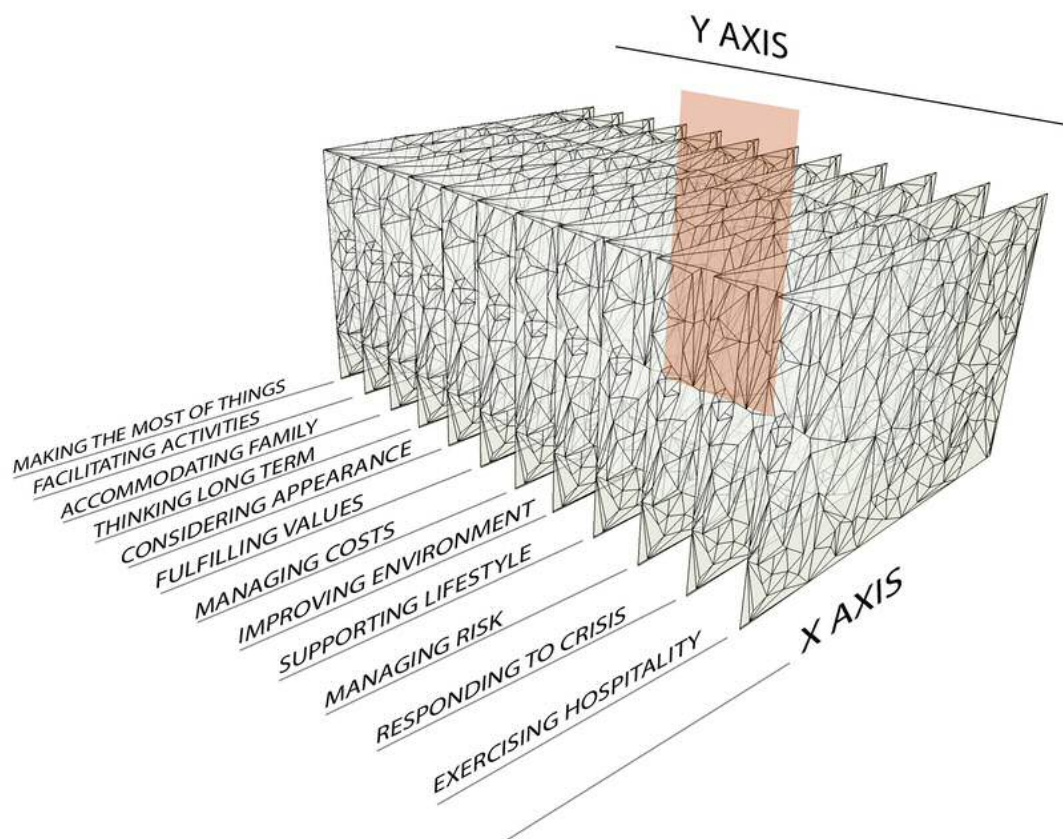


Figure 9.1: The nexus of practices as a cube, with teleological constellations providing an alternative dimension for understanding connections and variations (source: researcher)

Examining these wider constellations shifts the conceptualisation of the home from a space containing relevant practices, to a space in which relevant constellations of practice intersect within and beyond the home. In this context, the home itself becomes one of the material-spatial components that constitutes the intersections between practices as described by Blue and Spurling (2017). Within and around the home, some home improvement measures also act as material connections between multiple constellations. For example, new windows connect the constellations of managing cost, improving comfort, fulfilling values and considering appearance as shown in Figure 9.2.

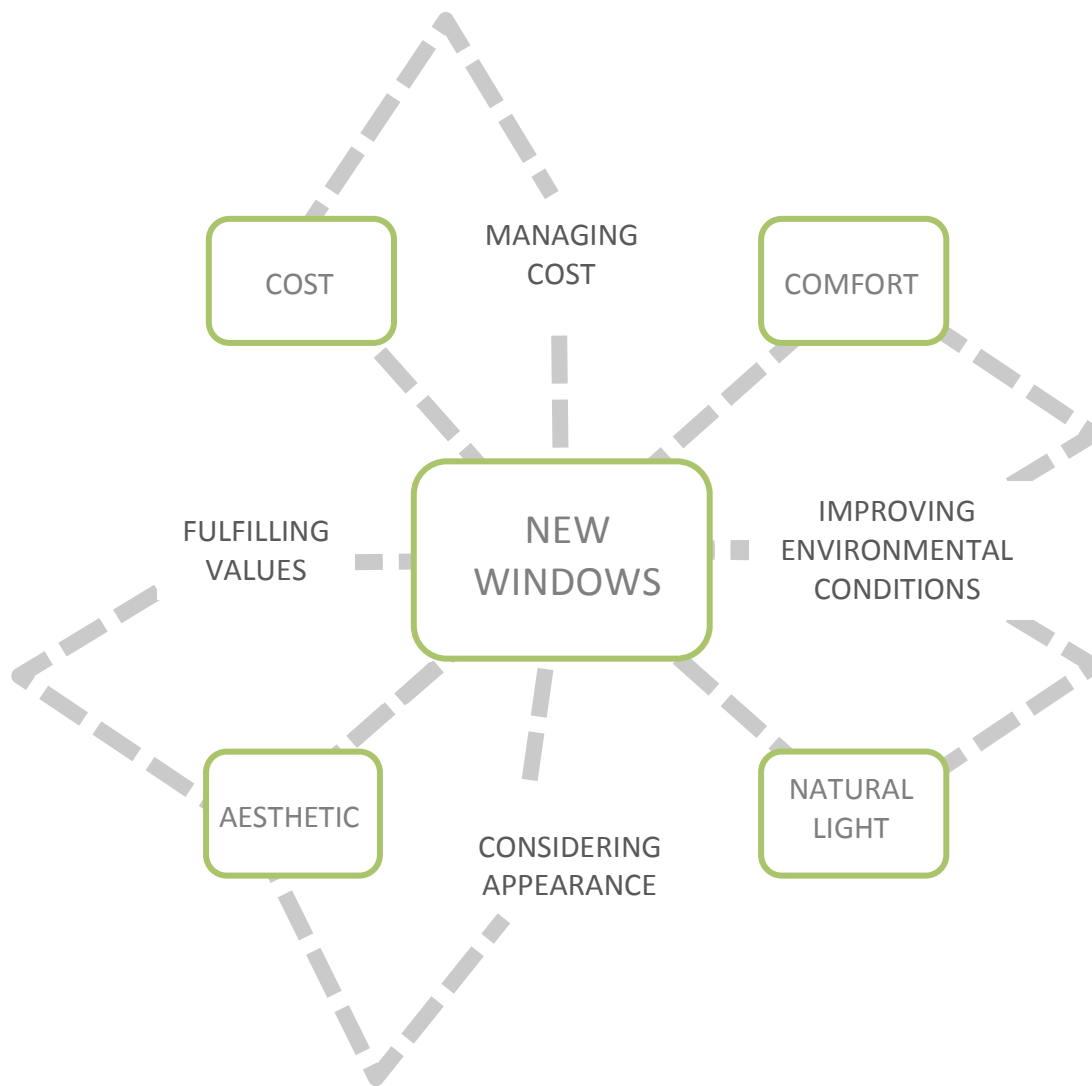


Figure 9.2: Single home improvement measure as intersection between multiple constellations in the nexus of practice.

Where materials or products sit at the intersection of multiple practices, encouraging a shift to new materials or products can be especially complex. For example, if one seeks to replace these windows with an alternative material or product, then one must consider and address how the proposed alternative material object engages with each of the teleological constellations of which the existing windows form a part. There are multiple variations and design specifications of window that could positively engage with up to three of the teleological constellations with which windows are related. Refurbishment of the existing sash windows would maintain aesthetics and keep costs relatively low, but would be unlikely to have much impact on comfort, whilst modern, efficient windows would meet requirements in terms of comfort and cost, but are likely to cause aesthetics concerns. Meanwhile, high efficiency replica sash windows should meet both comfort and aesthetic

requirements but, as illustrated in this thesis, were repeatedly described by participants as being too costly. Whilst these compromises between conflicting goals have been identified by previous empirical studies of home improvements (see Fyhn and Baron 2016; Sunikka-Blank and Galvin 2016), practices have been conceptualised as competing against each other only for practitioner's time (see for example Shove et al. 2012). In light of the affordances (Gibson 1986) of current window specifications, the conflicting demands placed on the replacement window by different teleological structures could be interpreted as competition for practitioners, between practices associated with different teleological constellations. Once practitioners have been recruited into one practice or another, the appropriate variation or design specification of a window that supports this practice would be selected. However, it is the constraints of the material object that create this conflict. Understanding material-objects as the intersections between practices, and the conflicting demands this can place on artefacts (such as windows), could increase the value of practice theory to designers, including architects.

In addition to these material-spatial intersections, this research also found temporal connections between practices. For example, some teleological structures only became salient to the intersection of practices once the home improvement process has begun. Wilson et al. (2015) describes these as proximate influences, which affect how a home improvement is undertaken rather than why it is initiated. As previously discussed by Blue and Spurling (2017), this temporal organisation "is less a result of the features of the practice itself and more about the scheduling and coordination of (parallel) patterns of practice" (Pg. 30). However, other forms of temporal organisation do rely on the features of a practice, where such features can lead to the performance of subsequent practices in a causal relationship. This research supports previous findings by Wilson et al. (2015), that many home improvement projects are triggered by a crisis or failure associated with the building fabric or services. These chains of practices could sometimes be the result of material or spatial intersections, such as installing PV solar panels at same time as replacing a failing roof, but could also be connected by specialist trades or skills, referred to by Blue and Spurling (2017) as 'jurisdictional' connections. For example, one participant described how the expertise of a PV panel installer, also led him to install a hot water tank in order to cope with the increasing demand for hot showers from his growing children. Understanding the temporal connections between practices elucidate when appropriate interventions might encourage desirable practices.

Furthermore, while Shove (2010) has argued that policy interventions to encourage sustainable behaviour are part of the process that generates these teleological structures, this research also elucidates how the relationship between advice or expertise and teleological constellations is far from linear. As discussed in Chapters 7 and 8, teleological constellations actively inform the selection of expertise, and therefore advice received, further suggesting that the role they play in practice theory warrants further investigation and that in the case of large and complex phenomena, this should be examined longitudinally.

In summary, a shift in focus from the constitution and change of individual practices to the relationships that connect multiple practices together in a wider nexus can offer valuable insight into complex, large phenomena such as home improvements or low carbon retrofits more specifically. Furthermore, the identification of teleological constellations provides an additional dimension through which practices that are seemingly temporally, spatially, and jurisdictionally dispersed are inter-connected. By applying this approach - which focuses on the connections within and between practices - to low carbon housing retrofit, components and connections at strategic intersections for affecting change can be identified. A greater understanding of how practices intersect in a wider nexus, allows us to consider Blue and Spurling's (2017) proposal that transitions in performances might be enacted not by changing individual practices, but by reconfiguring ways in which constellations of practices interconnect. This, in turn, implies that policies or other interventions might induce desirable practices by shifting their focus from practices themselves, to making adjustments to the relative strength of connections between practices.

9.1.2 Variations between practices

As discussed by Hui (2017), while variation is a basic feature of practice, which as a performance rather than an entity will never be exactly the same twice, much previous work on variation in practice has focused on variation within a single practice over time. In contrast, this research has focused on the variation between practices, which thus far, is 'underdeveloped' (Hui 2017, p. 52). As shown in Chapters 6 and 7, these variations are strongly dependent on both the material artefact comprising the practice - in this case a home improvement measure - and the practitioner.

Certain material objects are more strongly associated with particular practices, bundles or

constellations of practices due to a level of reflexivity in practice, described in the previous section. For example, it is likely that previous incentive schemes have played a role in constructing associations between managing costs and retrofit measures. However, as described in Chapter 7, some elements of the home, especially those connected with the teleological constellation of *considering appearances*, exerted an affective power over owner-occupiers. However, the same material objects did not have the same affect on all owner-occupiers. As described in Chapter 6, newer renewable energy technologies such as Air Source Heat Pumps (ASHP), were not always successfully interpolated into the underlying teleological structure, as described by Reckwitz (2017). This resulted in some individuals experiencing affective relationships with technologies whilst others viewed them as an eyesore. While the concept of affect is relatively under-researched within practice theory, in her study of affective relationships with art, Hicky-Moody (2013) discusses how previous assemblages of material objects, aesthetic landscapes and practitioners “...can change established patterns of affect” (p. 85). Drawing on the work of Deleuze and Guattari (1994), Hicky-Moody (2013) asserts that people experiencing ‘affect’ will be changed by the experience, although this change may not be prescribed or consistent between individuals. This is further supported by the work of DeSilvey (2012) who discusses how previous points of reference shape inter-subjective experiences of affective relationships with material objects.

However, beyond these affective relationships, other connections can be associated with the affordances related to the material objects as discussed previously by Reckwitz (2002b) and Alkemeyer and Buschmann (2017), and investigated in the context of domestic energy consumption by Gram-Hanssen (2009) and Tweed (2013). For example, a new heating system affords that “when the kids play sport everyone can shower at the same time and there’s loads of water” (BS7 051). However, as identified by Gibson (1986) a material object can simultaneously be related to multiple affordances, and realization of these affordances depends not just on the material object, but the ability of the practitioners to perceive it (Gibson 1986; Ingold 2000). Therefore, for other practitioners a new heating system afforded ‘making the most’ of available resources through increased efficiency. There have been attempts to include insights from theories of both affordances (Alkemeyer and Buschmann 2017) and affects (Reckwitz 2017) within practice theories. However, the variations in the relationships experienced between practitioners and material objects found in this research suggest that these inter-subjective variations deserve further attention in future research.

In addition to home improvement measures being subject to connections with different teleological constellations amongst practitioners, there was also considerable variation in how practitioners engaged with teleological constellations. With each constellation comprised of individual goals, manifesting different interpretations of the same underlying teleological structure, this led to the performance of different practices and adoption of very different measures by practitioners. For example, for empty-nesters, the teleological constellation *thinking long-term* meant adopting their home for their changing physical requirements as they got older, often resulting in measures such as the installation of a downstairs shower room. However, for retrofitters, *thinking long-term* often meant investing in long term financial savings, resulting in the adoption of solar PV or measures to include fabric efficiency. However, the variations in the relationships experienced between practitioners and material objects found in this research suggest that these inter-subjective variations deserve further attention in future research. Differences in the connections made, or level of engagement with, different teleological constellations between younger families and empty-nesters support the assertions of Hui (2017) that there is a temporal dimension to practitioners connections with different practices that constitute a form of variation. In this case, these differences demonstrate how desired practices, and therefore the material conditions and alterations desired to support them vary across the lifecycle of a household.

Finally, while it is not clear if the different sources of advice and expertise accessed by participants was a cause or consequence of the measures adopted by these practitioners, the findings from this research have shown that practices comprising retrofit measures must also comprise specialist skills and expertise. Therefore, such practices pre-suppose existing expertise or at least the knowledge of how to access them. This introduces an inequality in the capacity to act between practitioners as previously discussed by Watson (2017). This inequality exists not only between professionals who exercise power over practices through the expertise they hold, but also amongst owner-occupiers in association with uneven access to the expertise of these professionals. For example, technologies such as solar PV or ASHP require expertise beyond that of most participants. Those participants who were able to access this expertise often relied on personal connections with friends or colleagues to do so. These inequalities also constitute and reproduce variations between practices and practitioners. How such inequalities arise and subsequently influence the connections made, and path taken through the nexus of practices by a practitioner, warrant further study.

In summary, many of the variations between practices discussed in this thesis are dependent on both the material artefacts and the practitioner performing the practice. These findings support the value of understanding not only how different practitioners engage with different teleological constellations, but also how material objects lend themselves to being connected with different constellations, through the practices they afford or the affective relationships they engender. Furthermore, if we wish to induce participation in certain practices, such as low carbon retrofit, by making the connections between this and adjacent practices as smooth as possible, we must also pursue a greater understanding of how and why these relationships between practitioners and material objects form in some cases but not in others. Finally, in recognising that an unequal capacity to perform certain practices accounts for some of this variation, further research must examine how this inequality or power differential within practices can be addressed or mediated.

9.1.3 Enabling practitioners

Whilst participants were often dependent on the expertise and advice of professionals as described in the previous section, they also described shared understandings of how to access and implement such advice. For example, owner-occupier understandings of how to manage costs often played a role in the selection of professionals, the timing of home improvements, expectations of quality, and which practical or project management tasks owner-occupiers would take on themselves, rather than employ a professional.

These findings support previous findings by Sahakian and Wilhite (2013) and Fyhn and Baron (2016) that participants only become enabled to “...participate as competent ‘players’...” (Alkemeyer and Buschmann 2017, p. 8) through participation in practices. The changes in competences acquired through the practice of obtaining quotes, become the competences carried forward into further practices, allowing further connection within and between practices. As asserted by Alkemeyer and Buschmann (2017), participants are not only one of the elements involved in the performance of practice and enabling transformation in practices, but through the distributed agency of practice, they themselves are transformed and enabled – otherwise known as subjectivation. However, this process of enablement by subjectivation, as proposed by Alkemeyer and Buschmann (2017) was not only associated with transforming competences but also with more affective relationships such as the feelings of trust owner-occupiers felt towards professionals. Through practices of obtaining and comparing multiple quotes, as well as visiting local showrooms and examples of

professionals' previous work, these professionals became more or less trustworthy in the eyes of the owner-occupiers. This would indicate that it is important to not only provide trustworthy sources of information, but to support the practices through which these feelings of trust are created. However, the practices that allow such relationships and competences to develop cannot be taken for granted. For example, in some cases the infrastructure of supply was insufficiently developed to facilitate those practices and owner-occupiers reported being unable to access multiple quotes. Furthermore, participants described that, for specific retrofit measures such as solid wall insulation, they lacked the adaptive strategies to overcome the non-financial costs such as disruption that these home improvement measures posed. The lack of strong association of less well-known measures such as Air Source Heat Pumps (ASHP) and Solid Wall Insulation (SWI) could also be both a cause and a consequence of a lack competencies and affective relationships with these material objects, resulting in participants not being able to engage with these objects and the practices they might support.

Similarly, as discussed in the previous section, the capacity to act is not equally distributed amongst practitioners. Those owner-occupiers who have previously performed practices that have produced competences with regards to possible combinations of material alterations or feelings of trust in particular professionals, will be able to engage in practices that other practitioners struggle to engage with, accounting for further variation between individuals as described above. This further supports the case for long-term studies of complex phenomena, in which the temporal organisation of practices across a number of individuals can be used to examine how relationships and competences develop and evolve over time resulting in such a wide degree of variations between practitioners. Furthermore, by understanding the practices that help to build these relationships and competences, it may be possible to support these practices through policy intervention.

The theoretical implications of these findings, that variations between, and changes to, practices can be understood and affected by the relationships, both temporal and teleological, that bind them together in a wider nexus, also suggests that by influencing these connections, practitioners could be steered towards more desirable practices. Policy recommendations to induce low carbon retrofit, formulated in response to the findings of this research, will be the focus of the following section.

9.2 Implications for Policy

The second section of this chapter will examine the implications of the findings of this thesis for policy designed to induce low carbon housing retrofit. This discussion will be divided into five parts. The first three parts will discuss different aspects of policy recommendations and how they might be applied to home improvement measures, namely: how financial incentives could be targeted to greater effect; the training and development of the construction industry; and cross-departmental policymaking. These recommendations are not mutually exclusive and a more detailed explanation of policy recommendations by measure is included in Appendix C). Subsequently, the challenges and opportunities of applying these findings to encourage higher levels of low carbon retrofit in light of current policy transitions, namely devolution of additional powers to cities and the United Kingdom's proposed exit from the European Union ('Brexit') will be examined.

9.2.1 Targeted financial incentives

As discussed in Chapter 2, Section 2.2.2 financial incentives can be effective in encouraging high rates of low carbon retrofit, but must be understood in the context of other influences on retrofit. The findings of this research contribute to understanding the relationships between financial concerns and other influences and can therefore inform when financial incentives might be most effective.

Previous government incentives, such as the Carbon Emissions Reductions Obligation (CERO) part of the Energy Company Obligation (ECO) as well as Warm Front (DECC 2014e; Hough 2017), have acknowledged that some homes, such as those with solid walls are harder to make more energy efficient than others. The findings of this research support the assertion that these properties, Victorian terraces in particular, are difficult to make energy efficient. These difficulties arise not only where these have Conservation Area Status or because of their material construction, but also because they often include various period features that owner-occupiers themselves associate with heritage and aesthetics (Crockford 2014; Sunikka-Blank and Galvin 2016; Yarrow 2016; Sunikka-Blank et al. 2017). As described in Chapter 7, and in the previous section, this also places conflicting demands on home improvement measures such as new windows that might replace these features. Owner-occupiers often find themselves in the situation of making compromises between comfort

and retaining heritage, or achieving both but at higher costs. For example, by replacing original sash windows with double-glazed timber replicas or allowing time for period mouldings to be carefully removed and reinstalled on top of internal or external wall insulation

The long-term solution could be the development of products whose constraints do not create such a conflict. However, in the short-term, targeted financial incentives could help to relieve some of the conflicts between managing costs and other teleological constellations. More specifically, such incentives might include:

- i. **Providing additional funding for installation of Solid Wall Insulation (SWI) or External Wall Insulation (EWI) to include the replication, or removal and reinstatement of period features.** As demonstrated by the findings of this thesis, a significant concern discussed by participants regarding the adoption of SWI and EWI, is the association between this measure and damage to the character of the property. As discussed above, the constraints of the available products and cost associated with them create a material intersection between conflicting practices. As reported by Fylan et al. (2016), participants believe that ECO price requirements compromise the quality of installations, with providers only willing to undertake work in standardised ways. However, if funding could be allocated to such properties to support the installation of measures in a way that is sensitive to the values participants associate with their homes, this could help to address this conflict and encourage the installation of SWI and EWI.
- ii. **Providing additional funding for replica wooden, high-efficiency, sash windows in place of standard, uPVC, high-efficiency models.** New windows were one of the most commonly adopted measures within the interview sample despite being associated with significant financial costs. An exception to this would appear to be those families living in Victorian properties where new windows were associated with damaging the character of the property, associated with *considering appearance*, leaving participants to make compromises between heritage, aesthetics, comfort and cost. This suggests that for families living in Victorian properties additional funding to support the installation of the more expensive replica sash-windows would help to address the conflicts presented by replacement windows as described in Chapter 9.

Providing sufficient funds to facilitate bespoke work to be undertaken to increase energy efficiency whilst retaining valued heritage and aesthetic features, at little or no additional cost to owner-occupiers could provide an immediate method of dissipating the tension between these practices. Of course it could be argued that such an approach to funding would be too expensive. At the broadest scale, it would almost certainly require a refocussing of government attention and funds, away from nuclear power as a means to decarbonize the energy supply (DECC 2011c) towards a renewed interest in energy efficiency measures as a means to reduce overall energy consumption. Furthermore, incentives would potentially need to be reorganized to remove the authority to select appropriate projects away from energy companies for whom many of these energy investments may not meet their short-term financial objectives (IPCC 2014).

9.2.2 Development of infrastructure and training in the construction industry

The identification of temporal connections in this thesis has revealed practices that must be supported by policy in order to create the appropriate conditions in which owner-occupier competence and trust in low carbon retrofit measures can develop. This indicates that policies should seek to facilitate the practices through which trust is established rather than seeking to deliver information that is 'pre-packaged' as trustworthy. This research has shown how practices such as accessing multiple local installers, quotes and examples of completed installations are instrumental to establishing this trust. This suggests that specialist training must be disseminated more widely, especially amongst many of the Small and Medium Enterprises (SMEs) that dominate the construction industry in addition to the proliferation of low carbon open doors events (e.g. Superhomes, Bristol Green Doors) that allow owner-occupiers to access examples of completed work. Facilitating practices through which trust is built is perhaps most important for those low carbon retrofit measures with which owner-occupiers have the least familiarity, and are therefore most distrustful of, such as Cavity Wall Insulation and External Wall Insulation. However, even relatively popular low carbon retrofit measures such as Solar PV could benefit from greater dissemination of relevant expertise amongst roofers and other tradesman more broadly, in order to allay fears regarding the potential future maintenance associated with these measures. Proposals to facilitate practices through which trust is established may include:

- iii. **Overlaying generation data from local domestic PV installations, onto owner-occupiers 'live' consumption data.** Solar PV was by far the most common home improvement measure in which participants expressed a particular interest, especially with regard to energy generation profiles. The planned roll out of smart-meters by 2020 (BEIS 2018), providing all households with real time information regarding their energy consumption, could create an environment in which owner-occupiers have the opportunity to interrogate generation data themselves. This could lead to the development of greater trust and competence regarding how this technology would fit into their lives and their associated domestic energy consumption profile.
- iv. **Development of infrastructure to provide access to suppliers/installers and completed installations of retrofit measures at local level.** The perceived risks to the existing building of hidden or unfamiliar technologies, such as solar PV, External Wall Insulation (EWI) or Cavity Wall Insulation (CWI), might be alleviated if owner-occupiers could perform practices to gauge the trustworthiness of these measures and the tradesmen who install it. These practices might include obtaining quotes from local suppliers, accessing local firms, and visiting examples of installations in their local areas, potentially even by the same tradesmen.

Furthermore, jurisdictional or material intersections between practices provide an opportunity to 'piggy-back' specialist low carbon retrofit measures onto more mainstream renovation measures. This requires that tradesmen, and architects, involved in design and floor-planning of more traditional building work, also have an awareness of when it would be appropriate to suggest the incorporation of other low carbon technologies. This includes not only knowledge of materials, technology and construction methods, but also the relative benefits of these technologies and how they might fit into the overall aims of the home improvement project as it currently stands. Such training relies upon the investment of private enterprises. However, as previously identified by Gouldson et al. (2015) the financial crisis and associated period of instability, uncertainty, recession and austerity has made many in the industry reticent to make such investments. In the UK, this period has been marked by a withdrawal of support from schemes supporting energy efficiency and solar power towards a focus on de-carbonising the electricity supply by subsidising nuclear power infrastructure (DECC 2011c). As outlined in Chapter 2, these sudden changes are financially undermining those companies who have already invested in resources and training based on the work

these incentives and standards would generate (RIBA 2015a, b). Therefore, if private companies, especially the more vulnerable SMEs, are to invest in skills and training, the government must convince or guarantee to the industry that it is committed to a selected strategy for the long-term.

v. **Development of greater awareness of retrofit measures amongst more mainstream construction professionals. This may include:**

- Greater understanding of solar PV technology amongst roofers and tradesmen, alleviating owner-occupiers concerns regarding potential complications to the future repair and maintenance of the building fabric.
- Architects, builders or loft conversion contractors could encourage solar PV or solar thermal panels to be ‘piggy-backed’ onto other home improvement projects, such as loft conversions. This would assist owner-occupiers in *making the most* of having the scaffolding in place, often one of the greatest expenses involved in the installation of solar PV panels.
- Architects, builders or loft conversion contractors to identify opportunities to piggy-back loft insulation onto home improvements such as loft conversions. This could address renovators’ existing preconceptions that through a spatial intersection between these two measures, they are mutually exclusive.
- External Wall Insulation (EWI) was associated by some participants with re-rendering facades or installing windows, with the appropriate training, tradesmen involved in these improvements would be in a key position to influence the piggy-backing of EWI onto these measures.
- Specialists involved in the installation of Damp Proof Courses (DPCs), and other home improvements that involve the removal of the plaster, are in a key position to encourage the simultaneous adoption of SWI at a time when it would cause little additional disruption.

9.2.3 Cross-departmental policy development

The connection through teleological constellations of home improvement measures and practices which are seemingly temporally, jurisdictionally, and spatially dispersed indicate that not only do policies need to be long-term, but would also benefit from being consistent and supported across policy departments. While this may be difficult to achieve at a national

level, an increased interest in City Deals and the devolution of powers over housing, health, and social care spending, may allow collaborative strategies addressing specific local problems and concerns to be negotiated at a local level. Providing patients in fuel poverty with access to energy efficiency measures through the NHS has already been experimented with at a local level (de Selincourt 2014) and there have been a raft of health-related fuel poverty schemes such as 'Affordable Warmth' and 'Warm and Well' (DECC 2015). Furthermore, this thesis has shown how amongst this more affluent group of owner-occupiers, new bathrooms were frequently associated with facilitating sports activities, and with providing more accessible showering and toilet facilities amongst empty nesters specifically. The UK's Department of Health and Social Care could play a role in developing owner-occupiers' competences of the health benefits of home improvements. Collaborative policies between health services and housing services may include:

- vi. **Medical specialists providing advice on environmental improvements that alleviate symptoms of health conditions, such as Chronic obstructive pulmonary disease (COPD).**
- vii. **More general information on how to create and maintain a healthier home, available in the waiting rooms of medical facilities**
- viii. **Use of sports and leisure centres to encourage the 'piggybacking' of more efficient heating systems onto bathroom upgrades.** This thesis has shown how amongst this more affluent group of owner-occupiers, new bathrooms were frequently associated with facilitating sports activities, and with providing more accessible showering and toilet facilities amongst empty nesters specifically.

Domestic instability was shown to stimulate a high number of home-improvement projects, as owner-occupiers sought to adapt a new home to their needs. However, with a view to further house moves, these projects were implemented with reference to a short time horizon, discouraging investment in measures with long payback periods. The measures most commonly affected were Solar PV and Solid Wall Insulation. In this study, one of the biggest drivers of domestic instability was the current geographical catchment area system for allocating pupils to state schools. Young families described moving into properties close to their preferred state school and then undertaking home improvements to adapt these properties to their needs. However, these improvement were undertaken with a four or five year time horizon in mind, as these young families anticipate moving on from the catchment

area of a good primary school to that of a good secondary school. This shows how certain low carbon investments, in this case those with long payback periods and whose value is not captured in the resale value of the property, are challenged by policies in other spheres. Collaborative strategies between education services and housing services may include:

- ix. **Developing parents' competences regarding the positive influence of a healthy retrofitted home on educational attainment (Howden-Chapman et al. 2007; Thomson et al. 2013; Garrett et al. 2014).** The concern expressed by young owner-occupiers for obtaining a high-quality education for their children, could link to home improvements such as extension or thermal upgrades of existing fabric to provide study spaces.
- x. **Minimising the impact of educational policies and provision on domestic instability.** The findings of thesis show that in some areas, the geographic catchment areas for schools utilised in the UK, combined with demand for places in state education, cause high levels of domestic instability. This is a good example of how policies and provision within the education sector can have unintended consequences for adjacent policy areas such as housing.

9.2.4 Devolution

Greater integration between health education and housing could be achieved through the devolution of powers to city level under the Cities and Local Government Devolution Bill 2015-16. For example, both housing and a greater integration between health and social care service are key provisions in the Greater Manchester Agreement. This devolution of powers could, as previously described by Pearce (2014), allow local policy makers to develop contextually appropriate collaborations between departments. Policies could be designed to address problems that are locally specific or predominant (e.g. respiratory illness aggravated by damp housing) and have the co-benefit of reduced carbon dioxide emissions (Pearce 2014). Local priorities are likely to be informed by a range of factors including, the age and style of housing available locally, levels of affluence and demographics of the city's inhabitants. For example, a city with high proportion of solid wall properties may choose to focus on building up local supply chains and making appropriate training and funding available to support high quality insulation of these properties whilst maintaining the character of the neighbourhood. Meanwhile, a city with an aging population may focus on

home improvements that support independent living and low cost, low maintenance energy sources.

9.2.5 Brexit

The impact of the proposed exit of the UK from the European Union, following the referendum on 23rd June 2016, on climate, environment, and energy legislation in the UK remains moot (Watts 2018). The extent to which existing legislation and standards underpinned by EU Directives will be reviewed and renegotiated will depend on whether the UK remains in the European Economic Area (EEA (Blackman 2015; Harvey 2016; Jacobs 2016; Nelsen 2016)). However, a review of climate change and energy policy could provide an opportunity to renew focus on reducing CO₂ emissions from housing and adopt a more innovative policy approach.

This could include adopting an approach to encouraging greater numbers of low carbon retrofits that specifically addresses both material conditions in the UK such as the age of the housing stock, as well as structural conditions such as residential instability. Leaving the EU will also allow the UK to set its own tax rates on construction products, providing the opportunity to return the VAT charged on solar panels and other renewables to 5%, making these technologies a more attractive option for investors (RIBA 2016b). Furthermore, the transfer of the responsibilities of DECC to BEIS (Vaughan 2016a), could be just the first stage of a more structural approach to recognise that other government departments and areas of policy are influenced and underpinned by the UK's fossil fuel and domestic energy consumption.

However, the protracted negotiations regarding an appropriate deal with the EU following the referendum raised fears of a possible slump in the UK economy due to a reduction in import and export of goods, including construction related products (Blackman 2016; RIBA 2016a, b). Furthermore, while environmental standards put in place by the EU were seen to be a stable basis for investment, national policy is subject regular change with successive governments (Cary and Metternich 2013). This is likely to affect the construction industry and its willingness to invest (Miller 2016; Vaughan 2016b) in the kind of training described as necessary for the further dissemination of low carbon retrofit technologies in Section 9.2.2. Therefore, if progress in this training and dissemination is to continue, the industry will need long-term reassurances and potentially some financial support from national government

(RIBA 2016b).

This chapter has discussed the implications of the findings of this research for practice theory understandings of low carbon retrofit as well as policies to encourage higher rates of retrofit. The concluding Chapter of this thesis (Chapter 10) will discuss the contribution this thesis makes to existing knowledge as well as considering directions for future research.

Chapter 10: Conclusion

10.0 Aims, questions and methods

This thesis has sought to explore the explanatory power of a nexus approach to practices when applied to owner-occupier low carbon retrofit, and in particular the connective power of teleology. In doing so, the thesis aimed to contribute to addressing gaps in current practice theory understandings of large and complex phenomena such as retrofit; the variations that arise between practices; and the tractability of practice. More specifically, this involved addressing the following three research questions. Firstly, what are the teleological structures supporting renovation and retrofit measures respectively (RQ 1)? Secondly, how do different elements of practice (i.e. teleological influences, home improvement measures and associated competences or expertise) connect to one another (RQ 2)? Finally, what are the implications of these findings for encouraging higher rates of owner-occupier low carbon retrofit (RQ 3)?

In response to these research questions, data was collected from a sample of 31 owner-occupiers who had recently undertaken home improvements in the City of Bristol (UK), a city which has relatively well-developed infrastructure to support low carbon retrofit. This sample was purposively selected to include a range of home improvements including both amenity measures and retrofit measures in order to understand the connections that resulted in some home improvements including low-carbon measures, while others did not. Data was collected using walk through tours and in-depth interviews, which were carefully designed to begin with the home improvement measure. The interview then proceeded by following up on the participants' responses to trace the connections between this measure and other related practices. During analysis, all of the elements of practice the participants discussed (namely teleo-affective structures, competences, and materials) and the relationships between elements were coded. This enabled the researcher to identify practices linked together by common teleological constellations as well as analysing the relationships

between elements to determine the nature of these relationships, how they are formed, and how they linked practices together into a wider nexus of practices.

As previously discussed in Chapter 9, these findings have implications not only for the way that low carbon retrofit is theorised and studied in research, but also the policy strategies that could be employed to encourage more widespread adoption of low carbon retrofit measures.

10.1 Contribution to knowledge

10.1.1 Teleological structures supporting renovation and retrofit measures

In recent years, several studies have advocated that to understand the influences on low carbon retrofit measures, they must be understood within the context of home improvement practices more broadly or even within the context of all practices related to dwelling (for example Maller et al. 2012; Wilson et al. 2015). This thesis has taken this principle further to reveal how low carbon retrofit can be understood within the much wider context of the nexus of practices that make up social life, as described by Schatzki (2016). By applying this theoretical approach to low-carbon housing renovations this study has conceptualised the home as a spatial intersection in a wider nexus of practices, identifying how apparently unconnected practices, and components of practices, can influence each other through temporal, spatial, material, jurisdictional and teleological connections. One example of such a link is that of the practice of allocating pupils to state funded schools on the basis of geographical catchment areas. This, in turn, influenced participants' home buying practices, and consequently, their home improvement practices, leading to an increase in some types of home improvement with relatively short-term benefits, whilst discouraging others, which represented more long-term investments.

More specifically, this research enhances our conceptual and empirical understanding of the links between home improvements and other practices in social life, that are seemingly temporally and spatially dispersed, through the identification of 12 teleological constellations

1. Managing Risk
2. Fulfilling Values
3. Thinking Long Term

4. Improving or Maintaining Environmental Conditions
5. Supporting Existing or Desired Lifestyle
6. Making the most of something
7. Responding to a Crisis
8. Accommodating a Changing Family
9. Managing Costs
10. Facilitating Activities
11. Exercising Hospitality
12. Considering Appearance

The identification and examination of these 12 teleological constellations makes a theoretical contribution to literature on the nexus of practices by exploring the connective power of teleology between practices. In doing so, this thesis adds an alternative dimension through which to understand the relationships that connect practices together to make up the nexus of social life. Furthermore, this adds significant insights into the explanatory power of a nexus of practices approach to understanding why different households or owner-occupiers might undertake low carbon retrofit (for example Balcombe et al. 2013; Organ et al. 2013a; Achtnicht and Madlener 2014; Wilson et al. 2015). For example, this research has identified that those adopting retrofit measures more commonly reported performing practices connected to the teleological constellation associated with responding to a crisis, than those who did not. By balancing the sample of participants between young families and empty nesters, this study also sought to disentangle these influences from those associated with households in different stages of their lifecycle. In doing so these findings also revealed that accommodating a changing family and responding to a crisis were more commonly cited as an influence on young families' home improvements, independent of whether or not these households were adopting low carbon measures. Therefore, this represents a common influence that could encourage all households of young families and is not discrete to either retrofits or renovations.

Furthermore, examination of the connections between practices and elements of practices has revealed that home improvement projects, and even individual home improvement measures, typically link together multiple teleological constellations. To add further complexity to understanding such projects, these teleological constellations were comprised of multiple practices and bundles of practices. Therefore, practitioners adopting a wide variety of different practices and material improvements may all be addressing the same

teleological influence. Existing practice theory based studies have shown that both amenity renovations and low carbon retrofits are underpinned by many of the same influences (Maller et al. 2012; Wilson et al. 2015). This thesis builds on these findings, showing how attempts to encourage low carbon retrofit could focus on strengthening the links between current and desired practices within the same teleological constellation.

Beyond contributing to the existing literature on how home improvement practices might vary depending on the owner-occupier, this research also analysed teleological structures by home improvement measure. This analysis revealed that whilst renovation measures were more often associated with *managing costs*, *facilitating activities*, *accommodating a changing family* and *exercising hospitality*, low carbon retrofit measures were more commonly discussed in association with concerns *considering appearance*. This indicates that by employing the home improvement measure as the unit of analysis, rather than the individual, an alternative approach to inducing wider adoption of low carbon measures could be developed. While existing practice theory based studies have advocated moving away from the individual as the unit of analysis, many of these studies (see for example Maller et al. 2012; Gram-Hanssen 2014a) still rely on comparing the meanings or teleological influences associated with home improvement from one individual to another. In contrast, the analysis adopted in this thesis permits the individual to be temporarily removed from the analysis. This produces findings that offer the opportunity to plan strategies to encourage retrofit around the influences associated with the home improvements measures, rather than the influences associated with the individual.

Whilst this research has focussed on developing the relatively under-studied teleological connections between practices, the findings also emphasize the importance of understanding temporal links between these practices. These temporal links support previous findings by Wilson et al. (2013) that these home improvement projects should be viewed as a process which evolves over time. More specifically, several participants described how the practices involved in remedying an immediate crisis associated with failure of part of the building fabric or services, either prior to, or during a home improvement project, subsequently led to further home improvement practices. However, beyond supporting these existing findings, understanding the temporal links between different home improvement practices also provided insight into the strategies participants adopted in order to realise their renovation or retrofit projects. For example, when adopting home improvements associated with conflicting teleological constellations that included *managing costs*, owner-occupiers

employed strategies acquired through previous practices to allow them to resolve these conflicts. These strategies included DIY; taking on project management; adjusting expectations of quality or carefully timing the home improvements in order to manage costs. However, in the case of retrofit measures, such as solar PV and cavity wall insulation, participants did not feel capable of adopting adaptive strategies. Therefore, the conflicting teleological forces could not be resolved. For example, in the case of Solar PV owner-occupiers did not have the expertise to employ DIY or take on the project management themselves in order to reduce the labour costs, therefore, the tension between *fulfilling their environmental values* and *managing costs* could not be resolved and the measure was abandoned.

10.1.2 Relationships between teleological structures, home improvement measures and sources of knowledge

As discussed above, participants usually relate material objects, in this case home improvement measures, to at least one teleological constellation. This relationship is most often described as being based on practices that this material object affords (Gibson 1986) and more recently by Reckwitz (2017) as an affective relationship. However, this research has shown that in the case of many low carbon retrofit measures such as Air Source Heat Pumps (ASHPs); solar thermal; cavity wall insulation; and solid wall insulation (SWI) these material objects are not always linked by owner-occupiers to an appropriate teleological constellation, resulting in some individuals experiencing affective relationships with these technologies whilst many others do not. This implies that further investigation of Reckwitz' (2017) practice theory of affect could help to explain the variation in practices between individuals. Furthermore, with affective relationships thought to be influenced by previous experiences or interactions with materials, a temporal examination of how such affective relationships are formed could provide insights into steering individuals' relationships to low carbon retrofit measures.

Beyond these relationships with practitioners, the focus on connections between practices and elements of practice adopted by this research also revealed a number of associations between home improvement measures. These connections between materials, whether spatial, jurisdictional or teleological, contribute to the existing literature by providing insight into how adoption of home improvements can hang together in bundles of practices. Furthermore, this research identifies how such intersections provide potential routes through

which low carbon retrofit measures can become ‘piggy-backed’ onto more mainstream home improvements or even how material objects can act as an intersection between practices (Blue and Spurling 2017). For example, solar PV can be piggybacked onto measures such as loft conversion due to a spatio-material intersection between these two measures. Meanwhile, windows sit at the intersection of multiple teleological influences including improving *environmental conditions*, *considering appearance*, and *managing cost*. Investigating home improvement measures as material intersections between practices has shown how this approach could provide multiple ways in which owner-occupiers could be induced to adopt such measures. However, it has also revealed where these measures sit at the intersection of conflicting practices. Research on conflicts between practices has largely focussed on how they compete for time, however, these findings suggest that further research is needed, on how such conflicts are resolved by owner-occupiers, even if only provisionally.

Finally, this research found that in contrast to this array of relationships between material objects and teleological constellations, there is a lack of commonly understood relationships between home improvement measures and specific sources of competences or advice. Contrary to much of the existing research that examines which types of sources are considered trustworthy or competent, this research found instead, a series of practices that owner-occupiers implement to access and evaluate sources of expertise. Furthermore, owner-occupiers who adopted retrofit measures generally accessed a wider range of sources, indicating that adopting retrofit measures requires participants to move beyond the sources of information commonly utilised to research renovation measures. These findings support further investigation of the temporal links between practices and the work of Alkemeyer and Buschmann (2017) on how practitioners develop competences through previous practices. For example, by facilitating practices such as obtaining multiple quotes or visiting examples of recent work, that generates these competences rather than delivering ‘ready made’ information.

Furthermore this research highlighted the non-linearity of the relationships discussed by participants between sources of expertise and teleological constellations. It also revealed how teleological influences, such as *managing cost* actively informed the selection of sources of knowledge, and therefore the kind of information and advice received. As discussed in Chapter 8, and shown in Figure 8.1, builders were often selected on the basis of cost, and

went on to provide much of the advice relating to the home improvement including advice on subsequent costs. The teleological constellations informing the selection of expertise such as builders, architects, and suppliers are likely to have wide ranging implications, as these practitioners are well-connected to many other sources of specialist expertise. Given the lack of common associations between home improvement measures and sources of specialist expertise, it is likely that owner-occupiers rely on well-connected professionals such as architects, builders and suppliers to help them access the competences that support the adoption of low carbon retrofit measures.

10.1.3 Implications of understanding how home improvements fit within the wider nexus of practice for inducing adoption of low carbon retrofit measures

In their work examining DIY home improvements, Peng (2012) reports that lack of trust in contractors resulting from poor access to sufficient quotes often leads homeowners to DIY. The findings of this thesis support this assertion that trust is established through practices such as obtaining and comparing multiple quotes and that these practices are commonly understood among young families in particular. By understanding the influence that prior practices have on the evolving competences of the practitioner, this research brings the concept of subjectivation, previously discussed by Alkemeyer and Buschmann (2017) to bear on the field of low carbon retrofit. Therefore, unlike previous studies, this research would indicate that policy interventions that aim to increase owner-occupier competences around low carbon retrofit and their awareness of where to access specialist expertise, should focus on facilitating the practices through which such competences evolve. For example, by supporting the development of appropriate expertise amongst local SMEs, making multiple quotes and examples of previous workmanship or products easier to access. This is particularly important amongst those measures that are currently not commonly related to teleological constellations or material arrangements by participants such as Air Source Heat Pumps or Solid Wall Insulation.

Similarly, in contrast to much of the existing literature, which draws attention to the need for trusted sources of information to be provided, this thesis has identified that information cannot be 'pre-packaged' as credible. To become trustworthy, the practices through which trust is established must be facilitated. In this case, this could be through the development of sufficient numbers of local suppliers of specialist low carbon retrofit measures, to allow participants to obtain multiple quotes and visit local examples of previous workmanship.

Similarly, there may also be opportunities to learn from the affective relationships and enthusiasm retrofitters develop for renewable energy technologies, through having generation data they can analyse and act on.

Despite attempts to develop owner-occupier abilities to access specialist retrofit expertise directly, the important influence that tradesmen have on home improvement projects, as previously identified by Killip (2013a), is likely to persist in certain situations. This research identified that professionals likely to be involved in dealing with newly discovered defects, including tradesmen, but also surveyors, architects, suppliers and building inspectors, potentially provide a jurisdictional intersection (as described by Blue and Spurling 2017) with retrofit measures that could be included as home improvement projects expand to address these defects.

The jurisdictional intersections identified by this study could also be used to take advantage of the connections between material improvements to incorporate both retrofit and renovation measures into packages delivered by the same supplier. For example, analysis of the connections between measures has revealed opportunities for new boilers; new windows; loft insulation, and solar PV to be 'piggy-backed' onto measures such as extensions and loft conversions. Meanwhile understanding that retrofit measures such as new boilers and heating systems; solar PV; and new windows, appear to have well-developed associations with a range of teleological constellations, that vary between owner-occupiers, could provide multiple ways of promoting these measures to different individuals. Furthermore, the understanding of how these home improvements fit into a much wider nexus of practices revealed by this research, provides insight into interventions that could encourage adoption of low carbon retrofit measures, that are apparently unconnected to home improvements.

10.1.4 Theoretical contribution

Through investigation of the research questions addressed above in Sections 10.1.1 – 3, this thesis has shown how a nexus approach to practices has the explanatory power to make significant contributions to current understandings of owner-occupier low carbon retrofit. Detailed analysis of the relationships between the elements of study common to both ABC and Practice Theory approaches, namely: teleological influences, sources of knowledge, and home improvement measures, have shown that they are not linear. As discussed in Chapters

7 and 8, the adoption of a cost-saving home improvement measure is not the inevitable outcome of a concern with managing costs that arise from information provided by a builder, as suggested by an ABC perspective. Instead, these relationships are often cyclical and mutually sustaining, as conceptualised by practice theory approaches. Furthermore, by moving away from the individual as the sole unit of analysis, this thesis has shown how the prevalence of different teleological influences is more varied depending on the home improvement measure, than on the individuals concerned. Both of these findings indicate that the non-linear, flat ontology (Shove and Pantzar 2005; Nicolini 2017) of practice theory is a more appropriate conceptualisation of the relationships at work in owner-occupier adoption of low carbon retrofit measures than the linear, individualistic ABC models of psychology.

However, this thesis has also shown that by focussing on these relationships between elements of practice, a nexus approach to practices can also overcome many of the criticisms of practice theory interpretations of owner-occupier housing retrofit. These relationships, as well as the *teleological*, *jurisdictional* and *material* intersections, between practices identified in this thesis, contribute to addressing gaps in practice theory understandings of complex and spatially dispersed phenomena. Furthermore, a greater understanding of how teleological influences manifest themselves differently between individuals and practices, and how this may arise as a result of competences and associations established through previous practices (Sahakian and Wilhite 2013; Alkemeyer and Buschmann 2017), has given insight into how variations between practices arise. By understanding and recognising how these variations and unequal capacities to act arise through practice, appropriate points of intervention to encourage desirable practices are also revealed, making practice theory more tractable and practicable to policy-makers. The large degree of variation in this nexus of practices does not imply that policymakers should seek to intervene in all practices, or the relationships that bind them together into bundles and constellations. Rather, that such an approach allows those relationships, that are both conducive to encouraging desirable practices (e.g. that connect a desirable practice with an established practice), and represent 'roads well travelled' by many owner-occupiers, can be identified as points where an intervention could be successful or impactful.

However, in addition to employing the spatio-material and jurisdictional connections discussed in previous research (Shove et al. 2012; Schatzki 2016; Blue and Spurling 2017), this thesis also explored the connective power of teleology. The teleological constellations of practices - constellations of practices that share the same ends - identified in this thesis,

provides an additional dimension through which to examine the nexus of practices that make up large and complex phenomena. Other practice theorists are less unequivocal than Schatzki about the teleological nature of practices (Kemmis et al. 2012), therefore, it could be argued that teleological constellations exclude relevant practices on this basis. Furthermore, it should be noted that the teleological influences identified in this thesis reflect the 'ends' of owner-occupiers. As identified by Schatzki (1996), industries, including the construction industry are subject to teleological distributions between participants in different positions. Therefore, it is probable that tradesmen would describe a different, but highly interconnected series of teleological constellations. Nonetheless, teleological constellations provide a means of conceptualising relationships between practices that are otherwise temporally and spatially dispersed. Furthermore, although teleology implies that practices have goals, it is not necessary that participants are consciously aware of these goals (Okrent 2000; Schatzki 2002); the 'ends' and why they matter to the participants, are not necessarily rational (Schatzki et al. 2001); and changes in teleological constellations can result from many smaller changes in the practices that comprise them and how they relate to one another (Schatzki 2016). Therefore, teleological constellations bring intelligibility to the nexus of practices, while avoiding the individualism, stability, and rationality implied by many ABC approaches.

10.1.5 Methodological contribution

Many of these insights have been facilitated by a methodological approach that focussed on a) the home improvement measures themselves as the point of departure for interviews; and b) the relationships between measures and other elements of practice as the focus of the analysis. This method of analysis was made possible by employing the matrix query facility available in qualitative data analysis programme NVivo, to identify common relationships between different elements of practice directly, rather than comparing between the narratives of individuals.

The result of this process was not only the identification of teleological influences that vary according to the home improvement measure, rather than the individual, but also policy recommendations that are specific to home improvement measures. As a construction professional, the author asserts that this approach is more appropriate to the organisation of specialisms within the construction industry. These specialisms are primarily focussed around provision of particular home improvement measures (e.g. plumbers, electricians, plasterers), rather than serving very specific groups of clients. Therefore organising recommendations

according to the home improvement measures involved is more likely to align with specialist jurisdictions within the construction industry, and therefore, more successfully mobilise the expertise of construction professionals to encourage higher rates of retrofit.

10.1.6 Policy Contribution

This thesis has identified an important role for construction professionals such as tradesmen in encouraging higher rates of low carbon retrofit. Examining the connections between practices has shown how professionals such as plumbers can act as jurisdictional intersections between amenity and low carbon retrofit measures. Furthermore, owner-occupiers describe how they used multiple quotes to collect ideas and suggestions about home improvements, in addition to information about cost. This suggests that tradesmen can have a significant impact even at very early stages of home improvements and that builders' concerns that making suggestions will put clients off hiring them (EST 2011) are certainly not universally true. However, if the construction industry is to invest the relevant skills and training to facilitate low carbon retrofit, it is likely to need some long-term assurance from national government of the stability of energy and climate policy extending beyond the proposed UK exit from the European Union.

Furthermore, this thesis emphasises the importance of examining the detailed and complex relationships between practices. This suggests a role for the state in steering public engagement in sustainable practices through intervening in selected appropriate relationships, rather than the current focus on large infrastructure projects such as the decarbonisation of the energy supply through investment in nuclear power (Cowell and Devine-Wright 2018). However, while this approach advocates a focus on the micro-relations between practices, as this analysis has revealed this has far-reaching consequences for policies across ministerial departments. Applying the concept of teleological constellations to owner-occupier home improvement, has shown how practices that are otherwise unrelated to home improvements can contradict or challenge attempts to increase the rate of low carbon retrofit, highlighting the need for a coordinated and consistent approach across policy areas.

10.2 Limitations of study

The in-depth accounts of home improvement projects from this small but carefully selected group of participants evidence how these projects are connected to the wider nexus of practices that make up these participants' social life, but care is required to generalise to a wider population. This is partly due to the priority given to gaining a smaller number of highly detailed accounts in place of a larger number of participants providing more cursory information. However, it is also the product of a highly focussed sampling strategy targeting owner-occupiers, who had the capacity to undertake home improvements, and were at particular stages of their lifecycle, and above average affluence. Therefore, it is highly likely, that if this research design were to be replicated with participants of a different demographic, the connections between practices or even the structure of the wider nexus of practices could be different. Similarly, if this research were undertaken on a similar demographic of participants in a different city, it is likely that differences in housing stock, geography and availability of resources would result in different relationships and connections between practices and bundles of practices. However, whilst the detailed connections between practices and between teleological constellations may vary, the overall structure of the nexus and the teleological constellations it comprises are likely to be broadly consistent.

Furthermore, limited access to private homes and research participants meant that whilst interviews were complemented by walk-through tours where possible, data collected was largely based on self-reporting by owner-occupiers, after or towards completion of their home improvement projects. Therefore, these accounts may be subject to some biases in terms of participants omitting or forgetting aspects of their home improvement process from their accounts.

Finally, this research focuses on understanding home improvement projects within the wider context of a nexus of practices rather than understanding specific practices or relationships in detail, for which studies focussing explicitly on these practices or relationships would be required. Similarly, some of the less well-known home improvement measures are under-represented in this sample, and therefore to get a better understanding of where these measures do, or could, fit within a larger teleological constellation would again require a study focussed more specifically on these material improvements.

10.3 Directions for future research

Future research, involving owner-occupiers from a variety of demographic backgrounds, housing types, and cities could help to further our understanding regarding of how elements of practice between practices and bundles of practices might vary between different owner-occupiers, depending on the home improvement measures involved. This could inform how policy seeks to facilitate practices that in turn support low carbon housing retrofit. However, collecting data of sufficient depth to reveal these relationships amongst such a large population would be a significant undertaking.

Conversely, by focussing on how home improvement practices fit within a wider nexus of practices, this research has identified many important relationships and connections between practices and bundles of practices that invite more focussed and detailed investigation. For example, future research could focus on how conflicts at intersections such as *considering appearance*, *improving environmental conditions* and *managing costs* are resolved, even if only provisionally, by owner-occupiers in order to support and induce adoption of low carbon retrofit measures. Alternatively, longitudinal studies could explore how competences or affective relationships with certain home improvement measures develop over time and those practices that facilitate this. Equipped with an appropriate understanding of when and how such relationships are likely to be formed, policy makers could support the performance of these practices on a much wider scale, leading to more widespread adoption of low carbon retrofit measures. In particular, future research could focus on less widespread technologies such as ASHP, solar thermal, or SWI that were less well represented in this study in order to understand and identify potential ways in which competences of these measures, or relationships with more mainstream home improvement measures could be forged.

In depth, longitudinal studies of home improvement projects could also provide future studies with greater opportunity to investigate how this process interacts with the wider nexus of practices over time. Furthermore, through participant observation at meetings with professionals such as architects and suppliers, as well as ethnographical research as construction unfolds on site, understanding of the home improvement process can be developed beyond owner-occupiers' accounts. This more observational or ethnographical approach would allow a more detailed examination of the home improvement process, free

of any post-hoc rationalisation or unconscious editing of accounts from participants, from which research based on interviews can suffer.

Whether through this ethnographic approach or not, the findings discussed in this thesis reveal the important role that the expertise of construction professionals plays in forging connections between practices, indicating that this, so far largely unexplored area of research, warrants further investigation.

10.4 Concluding comments

This thesis has sought to understand low carbon housing retrofit, not only within the context of home improvement, but also within the wider nexus of practices that make up social life. In doing so, this research has identified a number of teleological constellations that connect home improvement measures to seemingly spatially and temporally dispersed practices. The understanding of these constellations, and the relationships between the bundles of practices that comprise them, is essential if we are to understand which practices support the adoption of low carbon retrofit measures and how the performance of such practices can best be facilitated. An understanding of how connections and competences which develop through the performance of practice, can inform policy interventions that create environments in which such performances can be nurtured. In this way, these connections and competences can potentially become much more widespread amongst owner-occupiers.

Policies that encourage more affluent owner-occupiers to invest their own funds in low carbon retrofit measures are extremely important against the current policy background and the context of austerity. With the majority of previous policies focussing on providing free or heavily subsidised low carbon retrofit measures to the most vulnerable households, the UK Government's Green Deal was the first incentive scheme to encourage more affluent or 'mainstream' households to adopt these measures, albeit with little success. This implies that the existing focus on financial incentives and providing a list of 'trusted' or accredited installers is not sufficient to encourage the widespread adoption of low carbon retrofit measures. Moments of change in overarching policy structure, such as those afforded by the UK withdrawal from the EU, or devolution within the UK, provide an opportunity to consider alternative ways in which environmental, and more specifically energy efficiency policy, could induce mainstream owner-occupiers to adopt low carbon retrofit measures. This study,

whose findings include but are not limited to, alternative teleological constellations with which the adoption of low carbon retrofit measures are connected, and practices, that allow owner-occupiers to develop relationships of trust in construction professionals, can offer valuable insights to these alternative policy approaches.

Given the persistent low rate of housing construction in the UK and the increasing demand for housing, identifying policy approaches that successfully increase the rate at which existing houses are rendered more energy efficient is essential if the carbon dioxide emissions of the dwelling stock is to be reduced. With these buildings accounting for 25% of UK carbon dioxide emissions, this is vital in order to meet the UK's legal obligations to reduce carbon dioxide emission targets and our moral obligation to address global climate change.

APPENDICES

Appendix A | Information Sheet and Postal Survey

Have you made improvements to your home in the last five years?



What have been your experiences? Between June and August 2016, I will be undertaking research with homeowners to understand their reasons for making home improvements. This research aims to understand homeowners' own perspectives on their home-improvement decisions, with a view to applying this understanding to the improvement of information and advice given to homeowners during the home-improvement process.

- Tara Hipwood, PhD Candidate

What types of home improvements are eligible?

I am interested in speaking to homeowners who have or are in the process of undertaking any number of a wide range of home improvements. These may include highly visible improvements such as extensions or more subtle improvements such as loft conversions or installation of energy saving or retrofit measures such as cavity wall insulation.

What would be your role as a participant?

Participation in this study will involve taking part in an interview lasting 1-1.5 hours. During this interview you will be asked about the home improvements you have made, including the outcomes you thought they would achieve and the sources of information and advice you used when planning and making these improvements. Completion and return of the enclosed questionnaire prior to the interview will allow me to prepare and structure the interview effectively to minimise the amount of interview time required from participants.

The interview can be scheduled at an exact time that is most convenient to you. It is preferred that the interview takes place in your own home, as this is perhaps the most appropriate setting to discuss your home improvements. However, if you wish to take part in the research but do not wish the interview to take place in your home, please get in touch and we

can discuss alternative arrangements.

What would be your rights as a participant?

Participation in the study is entirely voluntary and you would retain the right to withdraw from the study at any point, without the need to give justification. You would also retain the right to refuse to answer any question, should you choose to do so.

How will your data be protected?

The information participants provide during the course of this study will be processed in accordance with the Data Protection Act 1998. Any information you provide will be anonymised accordingly to ensure participants cannot be identified from the research results or published research papers. Data will be stored electronically under a unique code. The key showing which code relates to each participant will be kept within a secure location at the university. Data may be retained for use in future projects of a similar nature by the researcher, therefore, any identifying features will be removed from interview transcripts to protect your anonymity in the event of further analysis of this data.



Should you wish to take part in this study please complete the enclosed questionnaire and return it to the address below.

This research forms part of a three-year doctoral programme funded and subject to Research Ethics Committee of the School of Planning and Geography at Cardiff University. Should you have any queries regarding this research, please do not hesitate to contact me:

Tara Hipwood, PhD Candidate,
School of Planning and Geography,
Glamorgan Building, King Edward VII Avenue, Cardiff, CF10 3WA

Tel: 07787175644

E-mail: HipwoodT@cardiff.ac.uk

Office Code: _____

Home Improvement Questionnaire

Tara Hipwood, School of Planning and Geography, Cardiff University.
email: HipwoodT@cardiff.ac.uk, Tel: 07787175644



It would be greatly appreciated if you would complete and return the following questionnaire regarding your household, the property itself and the improvements that have been made. Should you have any queries or concerns regarding this research, please get in touch using the contact details above.

YOUR HOUSEHOLD

1) Approximately how long have you lived in this property? _____ years

2) In which of these ways do you occupy this dwelling? (please tick one box only)

- | | |
|---|--|
| <input type="checkbox"/> Own it outright | <input type="checkbox"/> Rent it from private landlord |
| <input type="checkbox"/> Buying it with the help of a mortgage or loan | <input type="checkbox"/> Rent it from registered social landlord (RSL) |
| <input type="checkbox"/> Pay part rent and part mortgage (shared ownership) | <input type="checkbox"/> Live here rent-free |

3) Approximately what is your combined household's total weekly income from all sources, before income tax and NI contributions? (please tick one box only)

- | | | |
|---|---------------------------------------|---|
| <input type="checkbox"/> Less than £100 | <input type="checkbox"/> £300 to £399 | <input type="checkbox"/> £700 to £999 |
| <input type="checkbox"/> £100 to £199 | <input type="checkbox"/> £400 to £499 | <input type="checkbox"/> £1,000 to £1,499 |
| <input type="checkbox"/> £200 to £299 | <input type="checkbox"/> £500 to £699 | <input type="checkbox"/> £1,500 or more |

4) How many people living at the property fall within each of the following age ranges?

Age Range	No. of people	Age Range	No. of people
0-4 years	_____ people	35-44	_____ people
5-10	_____ people	45-54	_____ people
11-15	_____ people	55-64	_____ people
16-18	_____ people	65-74	_____ people
18-24	_____ people	75 & over	_____ people
25-34	_____ people		

5) Which ONE of the following best describes your household? (please tick one box only)

- | | |
|--|--|
| <input type="checkbox"/> Married or co-habiting couple with no children | <input type="checkbox"/> Lone parent with dependent children |
| <input type="checkbox"/> Married or co-habiting couple with dependent children | <input type="checkbox"/> Lone parent with non-dependent children |
| <input type="checkbox"/> Married or co-habiting couple with non-dependent children | <input type="checkbox"/> Student houseshare |
| <input type="checkbox"/> One Person household | <input type="checkbox"/> Non-student houseshare |
| <input type="checkbox"/> Other (please specify) _____ | |

Please return, using the enclosed self-addressed envelope, to: Tara Hipwood, School of Planning and Geography, Glamorgan Building, King Edward VII Avenue, CF10 3WA

6) Do you have any non-dependent children who do not reside at this dwelling?

☐ Yes

☐ No

DWELLING CHARACTERISTICS

7) Approximately when was this property built? (please tick one box only)

☐ pre 1919

☐ 1981–1990

☐ 1919–1944

☐ post 1990

☐ 1945–1964

☐ Don't know

☐ 1965–1980

8) Which of the following accommodation types best describes the property?

☐ Semi-detached

☐ Detached

☐ Terraced (including end terrace)

☐ Bungalow

☐ Flat

☐ Other _____

HOME IMPROVEMENTS

9) Which of the following home improvements are you aware of having been undertaken in the dwelling, either by yourself or by previous occupants? (please tick all boxes that apply).

If known, please also provide a rough indication of what year these were undertaken.

	Year		Year
<input type="checkbox"/> Extension	<input type="text"/>	<input type="checkbox"/> Cavity wall insulation	<input type="text"/>
<input type="checkbox"/> Loft conversion	<input type="text"/>	<input type="checkbox"/> Adding/removing walls	<input type="text"/>
<input type="checkbox"/> Loft Insulation	<input type="text"/>	<input type="checkbox"/> Conservatory	<input type="text"/>
<input type="checkbox"/> New windows	<input type="text"/>	<input type="checkbox"/> New roof	<input type="text"/>
<input type="checkbox"/> Installation of renewables (e.g. solar panels)	<input type="text"/>	<input type="checkbox"/> Installation of roof lights/dormer window	<input type="text"/>
<input type="checkbox"/> Re-rendering facade	<input type="text"/>	<input type="checkbox"/> External/Internal wall insulation	<input type="text"/>
<input type="checkbox"/> New bathroom	<input type="text"/>	<input type="checkbox"/> New boiler/heating system	<input type="text"/>
<input type="checkbox"/> New fitted kitchen	<input type="text"/>	<input type="checkbox"/> Replacement of fixtures and fittings	<input type="text"/>

Other improvements (please specify):

10) Which sources of information did you access to assist you with these home improvements? *If you have undertaken any of the previously mentioned home improvements in the last 5 years, please list these improvements in the left hand column, and in the right hand column, identify the sources of information and advice you accessed to assist you with these improvements.*

Alterations undertaken in last 5 years	Sources of information/advice
Alteration 1	
Alteration 2	
Alteration 3	
Alteration 4	
Alteration 5	

Please continue on reverse of this sheet if necessary.

11) Who undertook these improvements?

- ☐ I did it myself
 ☐ Hired Professional Tradesmen/consultants
 ☐ Other (please specify):

FURTHER PARTICIPATION IN THIS RESEARCH

Please confirm if you would be willing to participate in this research by taking part in a single, 1-1.5 hour interview to discuss any home improvements you have undertaken recently, your reasons for undertaking these improvements and the sources of advice and information you used during the home improvement process.

12) Would you be willing to participate in this research by taking part in an interview?

- ☐ Yes
 ☐ No

If you answered yes, please provide your contact details below, or alternatively contact the researcher directly by email at HipwoodT@cardiff.ac.uk or by telephone at 07787175644.

Tel. _____ Email: _____

Thank you very much for taking the time to complete this questionnaire!

Additional information relating to Question 10:

Appendix B | Interview Guide

Interview Guide	
INTRODUCTORY COMMENTS	
Thank participant for returning questionnaire and agreeing to take part in this interview.	
Brief explanation: <i>"In the next hour or so, what I'd like to do is talk to you about the improvements you've made to your home and the sources of information you found useful when making those improvements. The purpose of the interview is to understand your perspective, so I want to assure you that there are no right or wrong answers."</i>	
Ask the participant if they have questions or queries about anything on the information sheet	
<p>Explain consent form:</p> <p><i>"Before we begin I just want to assure you that anything you say during the interview will be kept confidential and the results of the research will be anonymised. The ethical procedures at the university require me ask you to sign a consent form. It's nothing for you to worry about and it doesn't commit you to anything other than participation in the interview and the use of the information you provide for academic purposes. It just allows me to prove to our ethics committee that participants understood that this interview was part of a research project and that they took part of their own free will. If you change your mind within seven days after the interview you can still withdraw from the study and of course you still retain the right to refuse to answer any questions during the course of interview."</i></p>	
INITIAL QUESTIONS	
Additional clarifications based on questionnaire response:	
1) You mentioned that you had <u>[insert home improvement]</u>. Can you tell me more about that?	
<p>2) Where individual home improvements require further unpacking:</p> <ul style="list-style-type: none"> You mentioned you had <u>[insert home improvement]</u>. Can you tell me more about what that involved? So the <u>[insert home improvement]</u> included <u>[insert list of individual measures]...?</u> 	
3) Would you say any one of these measures was a priority for you?	

INTERMEDIATE QUESTIONS

4) Unpacking the relationships between measures and motivations:

a) Where the participant begins to discuss the measure itself:

- Why was *[insert measure]* important to you?

b) Where the participant begins to identify the benefits of the home improvement:

- How did *[insert measure]* help you to achieve *[insert benefit]*?
- Why was *[insert benefit]* important to you?
- What does *[insert benefit]* mean to you?

c) Where the participant begins talking directly about their motivations:

- How did *[insert measure]* help you to achieve *[insert motivation]*?
- Why was *[insert motivation]* important to you?
- What does *[insert motivation]* mean to you?

Additional prompts to elicit further details:

- That's interesting, could you tell me more?
- Could simply offer an encouraging, non-judgmental summary statement: So you would say, *[insert benefit]* is something that is important to you?"

Questions regarding sensitive or personal subject areas may be prefaced with:

- "I don't know if this is an appropriate question, but..."
- "Could I ask you..."

5) Questions about sources of information:

- Where did you find out about *[insert measure]*?
- Where did you learn that *[insert measure]* would *[insert benefit]*?
- What was your main source of information about this *[insert measure]*?
- How did you identify that *[source of information]*?

6) Considering comparisons with non-adopted measures:

- Did you investigate any other home improvements other than *[insert measure]*?
- Why was *[insert adopted measure]* more important to you than *[insert non-adopted measure]*?

FINAL QUESTIONS
7) Have any of the home improvements you have undertaken had any unintended outcomes or consequences, either positive or negative?
8) Now that you have adopted <i>[insert measures]</i> , has this changed your opinion about these measures?
9) What advice would you give to somebody looking for advice on undertaking home improvements?
10) Is there something that you might not have thought about before that occurred to you during this interview?
11) Is there something else you think I should know to understand your home improvement experience better?
12) Is there anything you would like to ask me?
13) Can I ask you why you offered to take part in the interview?
CLOSING COMMENTS
Thank the participant for taking part in the interview.
Ask the participant if they would be willing to give the researcher a brief tour of the rooms effected by their home improvements: <i>"I was wondering if you would be willing to give me a very brief tour of the rooms that have been effected by your home-improvements? Once again I am not here to judge or inspect the house, it would just increase my understanding some of the improvements we have talked about. It is to compliment the interview but is entirely in addition to the consent form you signed and there is no obligation to agree whatsoever."</i>
Following the tour (if applicable) thank the participants once again for their time.
Reiterate how this information will be used: <i>"The information you have provided will be used to develop a greater understanding of homeowner's perspectives on the benefits of home improvements. The research plans to identify how the information provided to homeowners, particularly with regards to energy efficiency measures, could be improved."</i>
Remind participants to get in touch should they have any queries: <i>"If you have any questions about the study, or if anything occurs to you after I have left, please do not hesitate to contact either by telephone or email."</i>

Appendix C | Policy Recommendations by Measure

i) New Boiler or heating system

New boilers or heating systems (such as wood-burning stoves) were one of the most commonly adopted home improvement measures as shown in Figure 5.2 (Chapter 5). However, whilst Approved Document Part L, sets minimum standards for the energy efficiency of domestic boilers (HM Government 2013) these only apply where boilers are already being replaced (Planning Portal 2017).

The replacement of boilers was most commonly described, by all groups of participants as being a response to a crisis as existing boilers broke down or were no longer fit for purpose, as previously reported by EST (2011); and Wilson et al. (2013) and expressed more commonly as an influence by young families. Addressing these issues was seen as urgent due to the potential risk to the building fabric or occupant safety.

Meanwhile, responding to a crisis was less of an influence on older participants, and the jurisdictional and material intersections between new bathrooms and new boilers or heating systems, could provide an alternative means to stimulate the replacement of older inefficient boilers. New bathrooms were frequently associated with facilitating sports activities by all groups of owner-occupiers, and with providing more accessible showering and toilet facilities amongst empty nesters specifically. Therefore, the adoption of energy efficient boilers could be encouraged in sports centres or medical facilities associated with mobility related illnesses to encourage more efficient heating systems to 'piggyback' onto bathroom projects.

ii) Solar Photovoltaic (PV) Panels

As identified in Chapter 7, Solar PV panels already have well-developed connections with different teleological constellations including fulfilling values and thinking long term which were equally prevalent influences across all groups of participants. For many of the

participants interviewed, the capital costs of solar PV panels were lower than anticipated, and the long-term financial savings associated with the Feed-In-Tariff (FIT) was an important influence in the adoption of this technology. However, as shown in Figure 5.2 (Chapter 5), young families are less likely to adopt renewables than empty nesters, due to the domestic instability associated with moving home in order to access the best state schools, discouraging the adoption of measures offering long-term benefits. Therefore, if the long-term financial benefits of solar PV are to encourage wider adoption of this measure amongst young families, relinquishing the current geographical catchment area system used to allocate pupils to state schools should be considered. This could reduce the high turnover in the housing market around desirable schools, increasing domestic stability and facilitating the adoption of measures for long-term benefits.

However, with the Feed-in-Tariff steadily reducing, associations with other influences may in future play a greater role in the adoption of solar PV. For example, greater attention could be paid to how concern for the environment intersects with other, teleological constellations such as managing risk and making the most of something. Potential risks to the fabric of the roof might be alleviated if owner-occupiers could develop their trust and competences of solar PV technology by accessing examples of similar properties in their local areas that had installed panels, potentially even by the same tradesmen. Greater understanding of solar PV technology amongst roofers and tradesmen more broadly could also help to alleviate owner-occupiers concerns regarding potential complications to the future repair and maintenance of the building fabric. With renovators depending on advice from builders more heavily than retrofitters (as shown in Chapter 7) tradesmen could also represent a jurisdictional intersection allowing solar PV panels to be ‘piggy-backed’ onto other home improvement projects, such as loft conversions. This would assist owner-occupiers in *making the most of* having the scaffolding in place, often one of the greatest expenses involved in the installation of solar PV panels. Finally, solar PV was by far the most common home improvement measure in which participants expressed a particular interest, especially with regard to energy generation profiles. Overlaying typical energy generation profiles of local PV installations, onto real-time energy consumption data soon to be made available by smartmeters, could stimulate further interest and competence amongst owner-occupiers.

iii) Solar Thermal Panels

No relationships were identified between solar thermal panels and any information sources or teleological constellation. This could be due to the fact that solar thermal panels were seldom discussed by participants and had been adopted by only three owner-occupiers interviewed. However, teleological constellations such as making the most of something could still encourage owner-occupiers to 'piggy-back' solar thermal onto other home improvements that require scaffolding (as discussed in association with solar PV panels above). With the withdrawal of the FiT, the relatively low capital costs associated with solar thermal panels when compared with solar PV panels, and the ability to store thermal energy more easily than electrical energy, could make solar thermal a more attractive option in the near future.

iv) New Windows

New windows were one of the most commonly adopted measures within the interview sample despite being associated with significant financial costs. This implies that the connections between windows and a wide range of other teleological constellations are sufficiently strong to recruit owner-occupiers despite the capital costs. However, these associations varied between different groups of owner-occupiers and therefore the way that policies and campaigns encourage people to adopt these measures must adapt to reflect these variations. For example, these findings suggest that whilst windows were associated with improving the indoor environment, an influence that was equally prevalent across all groups of participants, young families in particular would be encouraged and interested in installing new windows as part of a project to increase natural light in their homes. Meanwhile, whilst fulfilling values was also equally important across all groups of participants, those classed as renovators in this sample would be tempted to adopt replacement windows as part of a project to improve or address a concern specifically regarding the aesthetic value of their home. An exception to this would appear be those families living in Victorian properties where new windows were associated with damaging the character of the property, associated with *considering appearance*, leaving participants to make compromises between heritage, aesthetics, comfort and cost. This suggests that for families living in Victorian properties interventions should look to address the conflicts presented by replacement windows as described in Chapter 9.

v) Loft Insulation

Loft insulation was strongly connected with improving the indoor environment, which was cited equally across all groups of participants. Being more specifically associated with thermal comfort, and being a relatively low cost measure, loft insulation was considered by owner-occupiers to provide an improvement in comfort at good value for money. Almost all participants showed considerable knowledge of standards of loft insulation, however, it was owner-occupiers with a particular interest in energy efficiency who sought to surpass the normal standards for loft insulation.

Whilst retrofitters considered loft insulation as being associated with other measures such as loft conversion, renovators described how they had felt that through a spatial intersection between these two measures, they had been brought into conflict, indicating that different participants have different understandings of the combination of measures available to them. Retrofitters identified a wider range of sources of information regarding loft insulation and loft insulation standards, whilst renovators relied primarily on the advice of builders. This would indicate that builders, called in to do loft conversions or other associated measures such as a new roof could do significantly more to encourage the concurrent adoption of loft insulation.

vi) Cavity Wall Insulation

Interview participants did not commonly discuss Cavity Wall Insulation (CWI), but as a hidden or unfamiliar technology, those participants who did discuss it generally associated it with potential risks to the building fabric. This made it appealing only to those participants with a particular interest in energy efficiency. Furthermore, CWI was not associated with any other measures or sources of information, leaving participants unable to develop competences and adaptive strategies to overcome the non-financial costs and risks that this measure presents. Therefore, providing ways for owner-occupiers to perform practices to gauge the trustworthiness of this measure and the tradesmen who install it, such as greater access to local firms, and examples of local installations could help owner-occupiers to develop these competences.

vii) External Wall Insulation

Similarly, participants did not commonly associate External Wall Insulation (EWI) with any particular teleological influence, but when discussed by renovators it was associated

exclusively with financial cost. This would indicate that along with providing ways for owner-occupiers to develop greater competences regarding this measure, continuing to reduce the costs of installing EWI, by providing extra support for hard-to-treat homes as initiated by the ECO scheme, could increase the adoption of this measure.

Furthermore, EWI was not strongly associated with any sources of information and some adopters of EWI reported a shortage of installers and lack of expertise that could prevent owner-occupiers from accessing trustworthy sources of information. With EWI associated by some participants with re-rendering facades or installing windows, with the appropriate training, tradesmen involved in these improvements would be in a key position to influence the piggy-backing of EWI onto these measures.

viii) Solid Wall Insulation

Whilst Solid Wall Insulation (SWI) was associated by some participants with the non-financial costs of effort and disruption, other participants described how they had overcome these costs by taking advantage of the spatial intersection between SWI and a Damp Proof Course (DPC). This would indicate that specialists involved in the installation of DPCs, and other home improvements that involve the removal of the plaster, are in a key position to encourage the simultaneous adoption of SWI at a time when it would cause little additional disruption.

Perhaps a more significant concern discussed by participants regarding the adoption of SWI, is the association between this measure and damage to the character of the property. As discussed above in association with new windows and EWI, the constraints of the available products and cost associated with them create a material intersection between conflicting practices. Additional funding for the replication or removal and reinstatement of period features in hard-to-treat homes could help to address this conflict and encourage the installation of SWI.

Finally, as a measure with a relatively long-term payback period, SWI was seen as a significant financial risk for those households in a position of domestic instability. Therefore, any measures taken to reduce domestic instability such as the changes to the geographic catchment areas for schools discussed above in association with solar PV could also increase the adoption of SWI.

ix) Underfloor Insulation

Participants associated underfloor insulation with non-financial costs such as disruption and effort, in addition to time costs. However, those participants with a particular interest in energy efficiency described how they had found Do-it-Yourself (DIY) methods of installation that allowed them to overcome the disruption and effort associated with underfloor insulation. This would imply that if these methods could be shared with a wider range of owner-occupiers through DIY stores or other organisations and groups supporting DIY activities this could encourage the wider adoption of underfloor insulation.

x) Air/Ground Source Heat Pump (ASHP/GSHP)

There was very little discussion or awareness of Air or Ground Source Heat Pumps (ASHP or GSHP) amongst the interview participants, with no common connections with teleological constellations or sources of information described. This would imply that much more work is needed in facilitating practices that could increase competences of this measure amongst the wider population. Some retrofitters described how they had considered the adoption of ASHP, during the process of replacing their existing boiler or heating system, indicating that plumbers and other tradesmen involved in the installation or servicing of boilers are in an especially influential position to encourage the adoption of ASHP.

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