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Transitioning to Low Carbon Living: A Review of Environmental Psychology and Associated Literature



Authors	Léan V. O'Brien & Yoshihisa Kashima
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- originality
- methodology
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Executive Summary

This literature review is a project document produced for the CRC Low Carbon Living project "Transformation to Low Carbon Living: Social psychology of low carbon behavioural practice". The purpose of this project is twofold. First, it will develop an integrative understanding of how psychological factors interact with contextual factors present at multiple levels of analysis to reinforce cultures of high or low carbon behaviour. Second, it will produce a tool to identify underlying motivational readiness to switch from high to low carbon behaviours, which can be used when designing and targeting interventions.

The low carbon behaviours examined in the Transformation to Low Carbon Living project are a subset of pro-environmental behaviours, that is, behaviours that are positive for the environment. To support the project, this literature review represents an assessment of and reflection on this broader field of pro-environmental research and consequently, when reviewing literature the term "pro-environmental" is often used. However the examples used almost exclusively refer to low carbon behaviours and when discussing the implications of the literature for our project we speak in terms of low carbon behaviour.

As discussed in the introduction, the low carbon behaviours focused on in this review are private behaviours in the home and personal travel that can limit greenhouse gas emissions. These include home modifications to increase energy efficiency (e.g. double glazed windows) and consistent behavioural choices that limit how much energy is used (e.g. switching off lights and using public transport or a bicycle for private travel). Such private, discretionary behaviours are an integral part of a societal culture of low carbon living. However a range of factors must be considered to understand and facilitate when and how people will transition to this kind of lifestyle.

Part 1 outlines the Reasoned Action Approach (RAA), which then serves as a framework that we use to guide our assessment of the wide range of factors examined in environmental psychological research. The key factors involved in the theory are attitudes, perceived norms, perceived control, and actual control. The RAA is the dominant way of understanding behaviour change in both social and environmental psychology, and it provides a parsimonious basis for identifying the different factors that affect behavioural intention. However there are many factors (psychological and non-psychological) that complement the components of the RAA. Part 2 examines a range of psychological factors (e.g. values, goals) that influence attitudes and perceived norms. It also notes that within a context there may be conflicting factors motivating different behaviours (e.g. positive attitude towards the environment, negative attitude towards spending more than absolutely necessary on appliances). This is part of the reason why it is possible for people to have pro-environmental attitudes but still not enact pro-environmental behaviours.

Part 3 addresses how context can reinforce behavioural intentions that are not pro-environmental. It begins by briefly commenting on the nature of context (personal, social, institutional and physical features) and several ways that context can affect behaviour are outlined. Key aspects of the way that contexts shape behaviour are then examined in some detail. First, the dynamic relationships between the choices people make in different contexts is explored in terms of "spill over" effects, which can either prompt people to generalise pro-environmental behaviour from one context to another, or to reduce pro-environmentalism in one context when new efforts are being made in another. Second, we present an analysis of the way that habitual behaviour automates choices in response to contextual cues, thereby limiting people's perceived and actual control. Third, we review a selection of literature that covers multiple ways in which context can be difficult to modify. This literature covers several different aspects of context, including infrastructure, resources required to modify infrastructure and social relationships grounded in particular contexts (e.g. families and the family home).

Part 3 ends with a consideration of two theoretical approaches that complement the RAA via their focus on context and the insights they provide for the level of actual control people have over their behaviour at different times. Social practice theory is presented as an approach that provides rich insight into how and why patterns of behaviour persist in society. It identifies that routines of behaviour occur with parallel shared social meanings and involve the use of material equipment and infrastructure that support and reinforce the routine. Together these elements make up a practice that is reproduced as an uncontested default and reinforced by multiple other practices that all bundle together to produce the structure of society. While this perspective does not lend itself to clear models of behaviour change, it provides an invaluable tool for understanding the nature of a person's engagement with a context. This is particularly valuable when designing interventions to aid transitions from disinterest to low carbon intentions and then low carbon behaviour. To understand how these shifts can occur at a cultural level, a selectionist approach to cultural dynamics is then presented. It describes a general framework for considering cultural dynamics involving the emergence, establishment and transformation of behavioural practices in society. In closing comments for this part we identify our agenda to integrate social practice theory and cultural dynamics with the RAA and related psychological concepts to produce a coherent and comprehensive theoretical framework for transitions to low carbon living.

Part 4 concludes with notes on intervention strategies. It identifies the many different strategies that interventions may use (e.g. information, social influence and structural changes) and reports literature showing that using a combination of different strategies is the best approach to take. It also notes that interventions must be tailored for the particular population and behaviour(s) being targeted. Finally, Part 4 considers general insights for behaviour change taken from social practice theory and a general selectionist approach to cultural dynamics. We note that as well as integration with psychological theory, empirical research is needed to develop these insights into specific models of low carbon behaviour change.

The review closes with conclusions about directions for future research. The appropriateness of the RAA is affirmed as a starting point, and goals, social identity and social influence are identified as particularly valuable psychological factors that should also be considered. It is also concluded that social practice approaches should be taken to understand the way that people engage with the context, with cultural dynamics being used to understand processes at a macro level. This is expected to be fruitful in terms of understanding how much actual control people have over acting on their behavioural intentions and identifying nexus for interventions to initiate a change from high to low carbon practices.

Introduction

The aim of this review is to identify how and when people may be ready to transition to low carbon living despite not currently living a low carbon lifestyle. The literature reviewed here is deliberately arranged in a way designed to first establish how psychological factors motivate behaviour and then appreciate how dynamic relationships between the psychological, social and physical world pattern behaviour in consistent self-organized and self-sustaining ways, which are nonetheless susceptible to change.

Low carbon living is considered here in terms of private behaviours in the home and personal travel. Private individuals with a low carbon lifestyle will undertake a series of curtailment behaviours to limit the amount of energy required and wasted in their daily lives, while simultaneously living in homes with energy efficient infrastructure. Examples of curtailment in the home and personal travel include wearing seasonal clothing rather than using a heater/air-conditioner and using public transport rather than driving to work. In contrast, efficiency behaviours primarily involve making changes to infrastructure and energy sources so that the energy required to meet household demands are as low as possible. Examples of energy efficient infrastructure in the home include features of home construction (e.g. high-quality installation in walls and ceiling conserves heating and cooling) as well as equipment used within the home (e.g. energy and water efficient dishwashers and washing machines). An energy efficient car can also be construed as a piece of infrastructure related to a private individual's lifestyle.

Table 1 provides a rough taxonomy of low carbon behaviours structured in terms of Stern's (2000) categorization of environmentally significant behaviours (i.e. low carbon behaviours that have a positive impact on the environment). As the home and personal travel sections are the focus of the Transformation to Low Carbon Living project, extensive examples are given for low carbon behaviour in these contexts. These examples are based on the description of a 'green' Australian household provided by Pears (2011) and the CSIRO Home energy Saving Handbook (Wright, Osman, & Ashworth, 2009) as well as shortlists of behavioural practices recommended in the United Kingdom (DEFRA, 2008) and the United States (Gardner & Stern, 2008). The Transformation to Low Carbon Living project will examine a range of these behaviours in Australian homes in general, as well as in Australian households participating in the CRC LCL living labs scheme (where direct measurement of energy bills and quality of infrastructure is available).

In Part 1 of this review we present the Reasoned Action Approach (RAA; Fishbein & Ajzen, 2010) as a starting point for understanding low carbon readiness. This approach provides the dominant framework for behaviour change in social psychology and has been used extensively in research on environmental behaviour. We provide a preliminary critique of the approach to frame the subsequent sections. In Part 2, we consider research providing a range of additional concepts that extend and nuance the model of behaviour provided by the RAA. Literature is drawn from the field of environmental psychology and focuses on pro-environmental behaviour, which, as noted in the Executive Summary, refers to a wide range of behaviours that are good for the environment. Pro-environmental behaviour includes the specific low carbon behaviours that we are interested in and in this review the examples are typically focused on low carbon living. However some other pro-environmental behaviours are referred to for the purposes of understanding and illustrating the kind of effects that this field of research has identified. In Part 3, inspiration is drawn from social practice theory and a general selectionist approach to cultural dynamics to help understand the way psychological factors dynamically interact with a range of other factors to create and break established patterns of behaviour in society. Finally, in Part 4 we discuss the design of interventions. In closing we consider how the literature reviewed can inform future research into the transition to low carbon living.

The ideas presented in this review here are broad and can be extended to the other domains of life identified in Table 1 (i.e. work and community). However, this should not be done without careful consideration and further research. The literature reviewed and much of the thinking involved has a focus on the private elements of low carbon living. While we expect there would be important implications for behaviour in other domains of life, past research has shown that patterns of attitudes, norms and values involved in engaging in behaviour across different contexts can be different (Stern, 2000).

Table 1: Taxonomy of Environmentally Significant Behaviours

Broad domain	Context of behaviour	Type of behaviour	Examples
1. Private Sphere Behaviours	a. Household	i. Infrastructure E	High quality insulation in walls and ceiling; double glazing on windows; heavy draught-free curtains; weather-strips or caulk to seal draughts in windows and doors; compact fluorescent or LED bulbs; reverse cycle heating/cooling system; solar hot water system; white goods with high energy star ratings; Efficient LCD or LED TV instead of a plasma TV or cathode ray tube TV; small energy efficient car; water efficient shower heads; dual flush toilet; low-flow and aerating taps.
		ii. Energy Source E	Photovoltaic solar panels, gas, using Green Power for energy bills.
		iii. Use of Infrastructure/Energy Use C	Wear seasonal clothing to keep warm/cool; open doors and windows to cool home when the weather is going to get hot later; use curtains, awnings, shutters, blinds and/or vegetation for shade; adjust heater/cooler thermostat to minimum comfortable setting; heat/cool for only part of the day; only heat/cool the rooms of your home that are used; for clothes washing use the cold wash setting; only run dishwasher when it is fully loaded; keep showering time to around 4 minutes; switch off appliances at the powerpoint or powerboard instead of leaving them on standby; get frequent car tune-ups; check and correct car tire pressure; use low-rolling resistance car tires.
		iv. Recurrent Purchase C	Grocery Shopping for food that is locally in season and avoids beef and processed foods.
		v. Waste management E	Shop and plan meals to minimise food waste; compost food waste; recycle all food packaging and other packaging that can be recycled.
		vi. Leisure Activities C	Switch off television when not using it, plan activities based around local physical and social activity rather than travel and resource use.
	b. Workplace (including School)	i. Low Carbon Industry Practice E	Using low carbon goods and services for the activities directly relevant for the business
		ii. Low Carbon Workplace Practice	<i>Workplace equivalent of 1.a.i to 1.a.v</i>
	c. Transportation	i. Transportation between household and workplace E	Avoid driving a car for most travel (e.g. public transport, small motorbike, bike or walk); when driving, use a "smooth" driving style that avoids sudden or surging acceleration and sudden stops; when driving, combine multiple errand trips to one when driving, carpool with others; choose travel destinations that avoid air trips; carbon off-set air trips.
		ii. Transportation for other purposes E	<i>Other purposes equivalent of c.ii.</i>
2. Public Sphere	a. Community	i. Citizenship E	Voting, conversations about low carbon living (green talk)
		ii. Activism E	Demonstration

Note: **E** Refers to likely preponderance of efficiency behaviours and **C** refers to likely preponderance of curtailment behaviours.

Part 1: The Reasoned Action Approach (RAA)

In 1975, Fishbein and Ajzen posited the theory of reasoned action (TRA) based on the core tenant that people form intentions to perform behaviours under volitional control, and that these intentions are driven by a series of beliefs and evaluations. In 1991, Ajzen suggested that most behaviours that are of social significance are not under volitional control. This is because many behaviours consist of not only bodily and motor actions that are typically under volitional control, but also outcomes of those actions which are often beyond the actor's control. He extended TRA to behaviours that are not under volitional control, and postulated a reformulated theory called the theory of planned behaviour (TPB), which reduces to TRA when behaviour is under volitional control (referred to as "actual control"). More recently, Fishbein and Ajzen (2010) integrated TRA and TPB with the subsequent two decades of relevant research, and summarised them in the framework called the Reasoned Approach. We will provide a brief description of this recent integration to structure our review.

A brief description of the Reasoned Action Approach (RAA)

The RAA sets out basic psychological processes underlying the performance of specific behaviour. It is a general theory of social behaviour and postulates that people form intentions to perform a behaviour, which then drive the actual performance of the behaviour.

Defining "behaviour"

According to the RAA, behaviour can be analysed in terms of four elements – action, target, context, and time. For instance, "installing solar panels" specifies action and target; "installing solar panels for my house" specifies action, target, and context; "installing solar panels for my house next month" specifies all four elements. Depending on how many of the elements are specified, behaviour is described at different levels of generality. The RAA's fundamental principle, the *principle of compatibility*, is that to predict a behaviour described at a certain level of generality, the measure of intention has to be described at the exact same level of generality. To predict whether someone will install solar panels, his intention to install solar panels can be measured. However, to predict whether someone will install solar panels for her house next month, her intention to install solar panels for her house next month must be measured. Furthermore, behaviour may be a *single act* that specifies one act (e.g., installing solar panels), or a *behavioural category* (e.g., making your house environmentally friendly), which includes a category of multiple acts (e.g., installing solar panels and high quality insulation, as well as sealing draughts etc.). In this review, we generally use the term "behaviour" to refer to both single acts and behavioural categories since they are both included in the scope of the RAA. However, later in Part 1, we will discuss how the classification *behavioural category* must be carefully and meaningfully defined before the RAA can be used at this more abstract level of analysis.

RAA Components

The RAA postulates four classes of variables that contribute to the prediction of intentions and behaviours (see Figure 1).

- i. *Attitude towards the behaviour.* An attitude is a disposition to respond to something in a favourable or unfavourable way. Attitudes towards the behaviour are postulated to derive from (i) beliefs about the outcomes that the behaviour will produce (behavioural beliefs) and (ii) evaluations of that outcome as being positive or negative (evaluations).
- ii. *Perceived norm.* A perceived norm is a psychological sense of social pressure to perform the behaviour. Perceived norm derives from (i) what the actor thinks other people say the actor should do (injunctive normative beliefs) what other people do (descriptive normative beliefs), and (ii) the actor's motivation to comply or identify with the sources of the normative pressures (motivation to comply or identify).
- iii. *Perceived behavioural control.* Perceived behavioural control is an assessment of what the behaviour requires and the extent to which the actor believes she can control the performance of the behaviour. It derives from (i) beliefs about the tangible and intangible supports and resources that would facilitate or hinder performing the behaviour in light of the barriers and obstacles that undermine its performance, and (ii) the extent to which these sources can exert the power required.
- iv. *Actual behavioural control.* Actual behavioural control is not a psychological factor. It is included in the model to highlight that behaviour involves the actor's interaction with a physical and social environment that may prevent the behaviour in both anticipated and unanticipated ways.

In summary, the RAA posits that attitudes, perceived norms, and perceived behavioural control are respectively based on behavioural, normative, and control *beliefs*, combined with *evaluations* or *motivational implications* of those beliefs appropriately construed to link them to intentions. For behavioural beliefs, they are evaluations of the outcomes that are

believed to follow from the behaviour; for normative beliefs, they are motivations to comply with or identify with the sources of pressures that are believed to exist in their social environment; and for control beliefs, they are evaluations about the extent to which those sources are believed to help or hinder the performance of the behaviour.

The relative weightings of attitudes, perceived norms, and perceived control are not fixed, with Fishbein and Ajzen (2010) explicitly noting that they may vary with the person and/or situation. The various components are also not necessarily consciously experienced, even immediately prior to or during the behaviour, although they are posited to have a higher level of activation in the brain at the time of forming the intention. Although it is possible that intentions are formed at the time of performing behaviour, intentions are typically assumed to be formed at t_1 , prior to t_2 , the time at which they are to be activated and enacted to perform the behaviour. The intention at t_1 (prior intention) is assumed to be committed to a memory system (called a prospective memory; see Brandimonte, Einstein, & McDaniel, 1996), and retrieved at t_2 and activated as *intention in action* (Searle, 1980), which controls the enactment of the action.

Note that a lack of actual behavioural control refers to the objective reality of an actor's inability to realise their intention. If actual control is lacking, then even if the actors perceive that they have control over the performance of their actions (i.e., high perceived behavioural control), their intentions cannot be carried out or even if they are carried out, their intended outcome will not eventuate (in the case of diminished actual control, impact of the outcome will be diminished). The inclusion of actual control in the TPB is not so much an empirical proposition as an analytical necessity (see Kashima, 2015). However, *perceived* behavioural control is a psychological factor and empirical investigation has found that it can moderate the relationship between intentions and behaviour (i.e. whether or not intentions lead to behaviour can depend on whether people perceive they have behavioural control). Armitage and Conner (2001) reported that this relationship was present in nine of the 19 studies that investigated it.

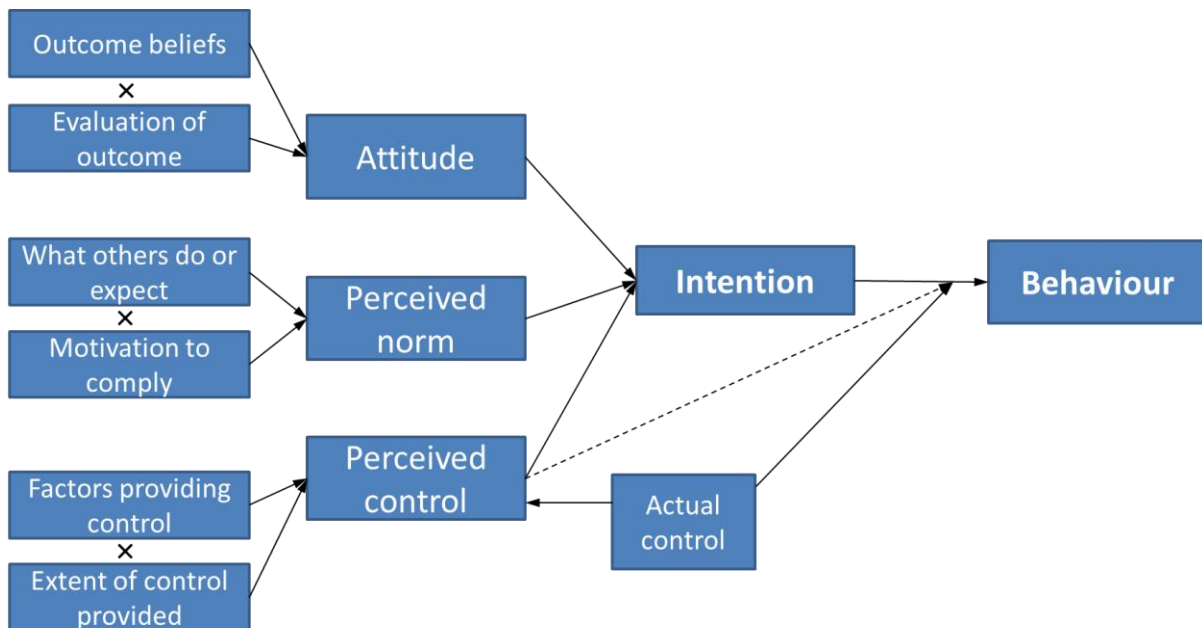


Figure 1: The Reasoned Action Approach – simplified model.

Further detail on the nature and source of perceived norms

Injunctive and descriptive normative beliefs

The RAA's conceptualisation of perceived norms attempts to incorporate Cialdini and colleagues' theory of normative conduct (Cialdini, Kallgren, & Reno, 1991; Cialdini, Reno, & Kallgren, 1990). They include norms based on social approval of a behaviour and disapproval of non-compliance (injunctive norms), but also common patterns of behaviour (descriptive norms). Cialdini and colleagues have shown that these different qualities can affect the extent to which people comply with messages about littering in public settings (Cialdini et al., 1991; Cialdini et al., 1990). Although the evidence is mixed, it appears that injunctive norms about what should be done are undermined by perceived descriptive

norms about what is actually done (e.g. Keizer, Lindenberg, & Steg, 2008; McDonald, Fielding, & Louis, 2013; Smith et al., 2012). It is when both types of norms act in tandem that their effects appear to be strongest (e.g., Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007).

Sources of influence motivating compliance with norms

Fishbein and Ajzen (2010) note that motivation to comply with sources of social influence may stem from different types of social power (French & Raven, 1959). Two of these forms identify instrumental ways that norms can influence people: people may be motivated to comply by the promise of reward, and by the threat of punishment. The three remaining types involve a more relational type of power, which motivates compliance based on a person's beliefs about the social position of the person or organisation. When a person or organisation represents qualities that others want to emulate the norms espoused by them become a point of reference for behaviour, creating "referent" influence. Alternatively, certified experts are recognised to have specialised knowledge, skills or abilities and hence have influence within the scope of their expertise. Both referents and experts motivate compliance to the extent that they are seen to legitimately be what they appear to be. People in other social positions, such as a parent or administrator, may also hold special influence to the extent that their position is seen to be legitimately held.

Environmental research using the RAA

Although the RAA was formulated in 2010, its primary precursor, the TPB, has been applied to many domains of life, including pro-environmental behaviour, and behaviours relevant for reducing greenhouse gas emissions. Here we treat research that used TRA or TPB under the broad rubric of the RAA. This body of research has examined a range of pro-environmental behaviours including household recycling (Kaiser & Gutscher, 2003), household composting (Mannetti, Pierro, & Livi, 2004; Taylor & Todd, 1995) and use of energy-saving light bulbs, unbleached paper, water and meat consumption (Harland, Staats, & Wilke, 1999), as well as mode of travel (Sebastian Bamberg & Schmidt, 2003; Harland et al., 1999; Heath & Gifford, 2002; Verplanken, Aarts, Knippenberg, & Moonen, 1998).

We reviewed 74 papers published in the last 20 years that used the RAA (see Appendix 1). Overall, they showed strong support for the RAA. More than 80% of studies showed some support for the psychological factors proposed. In addition, while not all psychological factors were significant in each study, when tested, attitude, perceived norm and perceived control significantly predicted behavioural intention and/or behaviour about 80% of the time. Although it was far more common for papers to examine behavioural intentions (63 papers) instead of actual behaviour (11 papers), results were similar across both kinds of research. Likewise, no strong patterns of significance and non-significance emerged when papers were organised in terms of the different kinds of pro-environmental behaviour being examined. These findings are comparable to published reviews assessing the effectiveness of the RAA in other fields of study including health behaviour, job behaviour, and voting participation (see Ajzen, 2011; Armitage & Conner, 2001; Sheeran, 2002; Webb & Sheeran, 2006). The successful application of the RAA in many diverse studies underlines why it is the dominant approach for understanding behaviour and behaviour change in social psychology.

In the domain of environmental behaviour, intentions have been identified as one of the strongest predictors of behaviours, if not *the* strongest (see Hines, Hungerford, and Tomera's 1987 meta-analytic review of environmental behaviours since 1971, and Bamberg and Möser's 2007 meta-analytic review after Hines et al). Indeed, Bamberg and Möser found that intentions mediated the effects of all other social psychological variables that they examined. In light of the importance of intentions in environmental behaviour, our critical appraisal of the RAA focuses on the limitations surrounding the prediction of intentions and behaviour.

Limitations of the RAA for understanding transitions to low carbon living

Despite the general success of the RAA, there have been a number of critical comments, some constructively critical (Manstead, 2011) and others rather sharp, including a call to "retire" it (Sniehotta, Pesseau, & Araújo-Soares, 2014). While the research discussed above evidences the benefit of using the RAA to examine pro-environmental behaviour, we believe some criticism is warranted. The key purpose of the project motivating this review, as well as the CRC for Low Carbon Living as a whole, is to help facilitate a societal transition to low carbon living. The RAA has several limitations that need to be addressed before it can be used for this endeavour.

Heterogeneity limits direct application

At a first glance it may seem that the RAA can simply be applied to understand how attitudes, perceived norms and perceived control predict behavioural intention and thereafter low carbon behaviour. However, the category "low carbon

behaviours" is not the kind of category that the RAA is designed to address. While the RAA can predict both single acts and behavioural categories, the term "behavioural category" refers to homogenous sets of single acts that all occur within the same rubric of space and time and are all focussed on achieving the same outcome. Practically speaking, low carbon behaviours include actions that fall across a large number of diverse behavioural categories. This point can be illustrated by referring again to Table 1.

The distinction between curtailment and its efficiency is particularly clear, both operationally and experientially (e.g. one-off installation of insulation vs careful selection of goods during weekly grocery shop) and is marked in the table explicitly. However curtailment versus efficiency is only one dimension of variation across different low carbon behaviours. Scanning the entries in Table 1 below, it is obvious that each category of behaviours contains heterogeneity even at the lowest level of description (i.e., i, ii, iii...). At this level the behaviour grouped together still contains a number of different acts involving different targets (e.g. travel from home to work, have nice food to eat) and contexts (e.g. transportation device, home and work). Even if we constrain the scope to private sphere behaviours (i.e. 1.a household and 1.c transportation, the focus of our project), the actions involved still contain multiple behavioural categories that are very different from each other.

The limitation that the RAA can only be generally applied to homogenous behavioural categories is also true of most of the contemporary theories of behaviour change (e.g., Michie & Johnston, 2012; Michie, van Stralen, & West, 2011). Thus, the specificity limitation of the RAA (and similar theories) prompts the question: *How can a broad range of heterogeneous acts be predicted and explained, so that an intervention for behavioural change that targets a heterogeneous behavioural category can be designed and implemented?*

RAA components are incomplete predictors of behavioural intention

The second limitation concerns constraints on the RAA's scope to predict and explain specific behavioural intentions. Notwithstanding its impressive capacity to achieve this end, RAA's capacity to predict behavioural intention is far from perfect (i.e. there are still substantial amounts of unexplained variances left in intention). When we examined the literature, we found that when predicting intentions to perform pro-environmental behaviours, in a substantial minority of cases, one or more of attitudes, perceived norms, and perceived control failed to predict behavioural intention or actual behaviour. In fact, only 49 of the 74 papers showed support for all psychological factors articulated by the RAA. Likewise, Armitage and Connor (2001) reported that attitudes, norms, and perceived control individually correlated with intention at .49, .34, and .43, respectively, and collectively with multiple R at .63, leaving substantial unexplained variance (approximately 60%) even taking some measurement error into consideration. While research methods play an important role in the success or failure of the RAA (see Ajzen & Fishbein, 1980; Fishbein & Ajzen, 2010, for extensive discussions about the use of this approach), or any theory for that matter, this pattern of results highlights that the useful framework provided by the RAA should not be taken as a complete guide to understanding intention.

We can conclude that although the RAA captures a very large portion of relevant psychological mechanisms, people's minds are more complex, subtle, and flexible than its components imply. Hence, the psychological factors that drive the formation of behavioural intention are likely broader than those provided in the RAA. The RAA attempts to accommodate this complexity by suggesting that these broader factors are *Background Factors*, namely, individual, social, and informational factors that influence outcome, normative, and control beliefs, as well as other relevant components in Figure 1 (see Fishbein & Ajzen, 2010). According to the RAA, the effects of such distal factors should be mediated by the more proximal mechanisms postulated by the theory. However, past research has sometimes found that psychological factors other than those specified in the RAA can help in explaining intentions and behaviours over and above the RAA components (i.e. the effects of distal factors are not fully mediated by the RAA components). This raises the question: *What background and psychological factors besides those in the RAA are important for predicting intentions (and thereby behaviour)?*

The intention-behaviour relationship is under-specified

The third limitation concerns RAA's ability to predict behaviour. Although intentions substantially predict future behaviours when they are compatible in the sense described above (see section on defining behaviour), the intention-behaviour relationship is far from perfectly described or predicted. This problem is well recognised in the domain of environmental behaviour (Kormos & Gifford, 2014). Sheeran's (2002) meta-analysis of the RAA reported an average intention-behaviour correlation of .53. Similarly, Webb and Sheeran's (2006) meta-analysis reported that interventions aimed at changing intentions could indeed produce relevant behavioural changes but the correlation between intervention and behaviour change was only .21, and intention change only partially mediated behaviour change (i.e. statistical analysis indicated intention is only one causal factor for behaviour change). The RAA offers two primary reasons why measured intentions imperfectly predict behaviour: a lack of intention stability and a lack of actual control.

Intention stability refers to a potential change of intention from the time of its measurement to the time of behaviour. The prior intention (intention at t_1) may change over time and the intention in action (intention at t_2) may differ from the former. Consequently, although the connection between intention and action holds, the measured prior intention does not match

the behaviour that ultimately occurs. Consistent with this idea, Conner, Sheeran, Norman and Armitage (2000; see Sheeran, 2002, for a review), found that an index of intention stability moderated the intention-behaviour relation (i.e. accounted for whether the relationship was present or not). Indeed, many of the factors that affect the strength or presence of the intention-behaviour relation (i.e. moderators) identified in the literature (e.g., Sheeran, 2002; Rhodes & Dickau, 2013) can be interpreted in terms of intention stability. For instance, strong intentions predict behaviours better than weak intentions (e.g., Bagozzi & Yi, 1989); attitudinally determined intentions predict behaviours better than normatively determined intentions (e.g., Sheeran, Norman, & Orbell, 1999); those whose personal identity includes the performance of a given behaviour (e.g., I am a physically active person) show a stronger intention-behaviour relation (e.g., intention to exercise and actual exercise) than those who do not have this personal identity (e.g., Kendzierski & Whitaker, 1997). These moderating factors seem to tap intention stability (Sheeran, 2002) and to an extent can be used to better specify when intention will lead to behaviour. In addition, those who have conflicting intentions (e.g., I intend to attend classes vs. I intend to go to a bar) tend to have a weaker intention-behaviour relation than those who do not (e.g., Abraham et al., 1999). This raises the issue of how people come to have multiple intentions and how different intentions dominate, which is an issue that we discuss further in Part 2.

In addition to the issue of intention stability, actual control is an important limiting factor on the conversion of intention into behaviour. As described above, actual control is included as a component in the RAA but it is not a psychological factor nor really a component designed for empirical testing. Instead its role is to identify within the TPB that a variety of factors will limit or remove a person's ability to act on their intention. This is an important qualification but it does not provide any guidance about how actual control might be limited within and across contexts, which is a serious limitation for practical applications of the approach.

Thus, although intention stability can be elucidated to some degree with additional measures, both it and actual control require a theoretical specification of when and why they will occur. This leads to the question: *how do we theorize actual control and intention stability in a theoretically coherent and practically useful way.*

Considering the questions that arise from RAA's limitations

Our analysis of RAA's limitations gave rise to three questions and these inform the remainder of this review. To recapitulate:

1. *How can a broad range of heterogeneous acts be predicted and explained, so that an intervention for behavioural change that targets a heterogeneous behavioural category can be designed and implemented?*
2. *What background and psychological factors besides those in the RAA are important for predicting intentions (and thereby behaviour)?*
3. *How do we theorize actual control and intention stability in a theoretically coherent and practically useful way, so that intentions and other factors that can predict the heterogeneous behavioural category?*

The first question has prompted this review to be relatively exhaustive in the kind of pro-environmental research that it reports. Because low carbon behaviours involve a breadth of behavioural categories it is important to consider a wide range of literature before drawing conclusions about how behaviour change in different domains occur. As stated above, this review principally examines behaviours in the household and private travel spheres, however even with this limitation a wide variety of behaviours are examined in the literature reviewed. Actually tabulating the results of different studies in terms of the behavioural categories they examine is beyond the scope of this review, however research of this kind is reported and specific behaviours are repeatedly referred to throughout the review. Part 2 also more specifically addresses this limitation by considering psychological factors that predict pro-environmental behaviour and are not limited by the principle of compatibility and that may cover the breadth of behavioural categories we need to consider in the transition to low carbon living. The second question is also addressed directly in Part 2, which covers a wide array of factors that complement the RAA.

We then begin to address the third question in Part 3. Our approach is to analyse *context* by examining evidence for how psychological factors operate to drive the different kinds of environmental behaviours that exist in different contexts. We further suggest that social practice approaches (e.g., Shove, Pantzar, & Watson, 2012) and a general selectionist approach to cultural dynamics (see Kashima, 2008, for a broad review) may be helpful to understand and analyse the way that features of the context can be expected to influence and interact with psychological factors to predict behaviour.

Part 2: Additional Psychological Factors used in Environmental Psychology

Additional factors used in environmental psychology may influence intentions because they simulate the factors identified in the RAA (i.e. mediation), however they have also been shown to directly influence intentions in addition to the RAA factors (for broad reviews of recent literature on environmental psychology, see R. Gifford, 2014; Kashima & Margetts, 2014). Here we present a range of different additional factors in terms of those that pertain to (i) beliefs, (ii) evaluations and (iii) identity. While the factors that concern beliefs and evaluations are conceptually similar to the RAA and typically influence behaviour by indirectly influencing RAA components, those considered in the identity section bring some new perspectives on motivation for action. Part 2 closes with a discussion of how there can be conflicting motivations competing for dominance when a person chooses how to behave in context.

Belief-based factors that predict pro-environmental behaviour

Information

Information affects beliefs, and a variety of information sources can influence behavioural, normative, and control beliefs. While, there is some evidence to suggest that more detailed knowledge about the environment leads to stronger environmental behavioural intentions, other studies have shown that being well informed is not predictive of positive attitudes towards environmental behaviours, which is also called "environmental concern" (e.g. Abrahamse, Steg, Vlek, & Rothengatter, 2007).

Judgmental biases

The somewhat puzzling mix of findings for the role of information may be explained by the fact that beliefs are not necessarily objective facts, and they are acquired in a biased way. That is, not only do people judge the things they "know" in terms of whether those things are good or bad, they also tend to accept or reject the truth of information in a way that is subject to a series of biases (see Kahneman, 2003; Kahneman, Knetsch, & Thaler, 1991). For example, humans have difficulty making probabilistic judgements about risk. We are heavily influenced by past events and tend to accept information that is consistent with things that we already hold to be true. We are also disposed to accept and remember information that favours both our own interests and those of the people we care about. Finally, we are often willing to form beliefs based on the views of the people we trust without fully understanding the details of why that view is being espoused. Consequently, it is possible to strongly espouse an attitude without having particularly detailed beliefs about the evidence and processes that make the attitude correct. For further details about potential biases in the domain of climate change and carbon emissions, see Newell and Pitman (2010) and (Kahan, 2015).

Mental models

Across the lifespan, people create and recreate elaborate belief structures or mental models about how the world works (e.g., Kashima & Margetts, 2014; Vandenbosch & Higgins, 1996). Such mental models about the environment often find their sources in people's culture, and a mental model that is commonly held in a population may be called a folk theory (Kashima & Margetts, 2014). It identifies important objects and causal relationships between them as a generalised guide for behaviour. Mental models and folk theories can inform beliefs relevant for a wide range of behavioural intentions.

In the domain of environmental behaviour, a prominent research instrument called the new ecological paradigm (Dunlap, Van Liere, Mertig, & Jones, 2000) can be understood in this way. In the 1960s and 1970s there was a movement in the United States to place some constraints on consumerism and introduce more pro-environmental behaviours (Carson, 1963). To investigate the structure and prevalence of this change in worldview, Dunlap and colleagues (Dunlap & Van Liere, 1978) developed a measure called the new environmental paradigm, and more recently revised and named it the new ecological paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000). The new NEP contains eight items positing a new ecological paradigm with the underpinning messages that environmental resources have limits, too much interference with nature produces negative consequences and humans are not intrinsically better than other forms of life. These ideas stand in contrast to those in an additional seven items that present an older paradigm where the natural environment is seen as a resilient resource that can be effectively used and controlled through human technology and ingenuity. Thus, the NEP can be construed as representing two contrasting mental models about human-nature relationships (Kashima & Margetts, 2014; also see Kashima, Paladino, & Margetts, 2014, for other approaches to mental models of human-nature relationships).

The NEP is the dominant way of measuring generalised environmental attitudes (Steg & Vlek, 2009). Higher environmental concern as measured by the NEP is associated with actual environmental behaviour; however, relationships are not generally strong (e.g., Poortinga, Steg, & Vlek, 2004; Schultz & Zelezny, 1998; Vining & Ebreo, 1992). Since its development, the NEP continues to hold relevance as a measure of competing folk theories about

humans' relationship with the rest of the environment, although extensive variation in the exact methods of measurement have limited meta-analysis of results (Hawcroft & Milfont, 2010). In addition, whereas the new and old ecological paradigms may provide broad mental models about the human-nature relationships, in the last ten years or so the issue of climate change, and its mitigation and adaptation to it, has come to dominate global dialogue about the natural environment (Hulme, 2009).

The shift to a focus on climate change does not invalidate the NEP measure or the ideas it contains. However modern environmental concern is now particularly focused on (i) human impact on global climate systems, (ii) the need to revise sources and applications of energy, and (iii) consequences of climate change and adaptation to it. New measures are needed to capture and examine how folk theories around these ideas are developing (for some developments see Heath & Gifford, 2006; Kahan, 2015). In the context of transition to low carbon living, mental models for private sphere low carbon behaviours require a series of beliefs about energy use, electrical goods, home infrastructure and travel that are consistent with current recommendations on these topics (Wright et al., 2009). For private citizens to engage in public sphere low carbon behaviours, they may also need to have a more abstract set of beliefs about the human causes of climate change and effective ways to manage it. These more abstract beliefs provide a broader framework for household behaviours because they link private behaviours with a global phenomenon, potentially creating mental models of climate change causation that include the role of private individuals.

Evaluation-based factors that predict pro-environmental behaviour

As part of negotiating a complex world, people tend to have systematic patterns in the way that they evaluate the information they accept to be true. These patterns are shaped by values, goals, internalised norms, and ideologies, which can be more or less pro-environmental in nature, and they can affect the evaluation, and motivational implications, of beliefs.

Values

Values are generalised ideas about what is desirable. Schwartz (1994) regards values as global life goals, and has cross culturally identified a set of universal values that may guide people's behaviour across or within contexts. These values can be typed in terms of openness to change (stimulation, self-direction, and hedonism), self-transcendence (universalism, benevolence), self-enhancement (achievement, power and again hedonism) and conservation (security, conformity, tradition). Several studies have found that self-transcendent values, particularly universalism, are associated with pro-environmental behaviour (e.g., Stern & Dietz, 1994) and endorsement of the new environmental paradigm (Schultz & Zelezny, 1999). Universalism emphasises that human life and happiness is grounded in interdependence between all people and nature. It holds that equitable treatment that protects all life from harm is fundamentally positive. In contrast, people who hold more self-enhancement values tend to see the environment more as a resource available for consumption (Kaiser & Byrka, 2011; Milfont & Gouveia, 2006; Nilsson, von Borgstede, & Biel, 2004; Nordlund & Garvill, 2002).

Schwartz's universal values have also been modified and re-classified to explore the influence of more specific values in the context of the environment. Here, biospheric (e.g. unity with nature, protecting the environment) and altruistic (e.g. peace, social justice) dimensions have been found to be positively associated with pro-environmental behaviour, while egoistic (e.g. social power, wealth) and hedonistic (e.g. pleasure, enjoying life) dimensions have been negatively associated (De Groot & Steg, 2007; Stern, Dietz, & Kalof, 1993; van der Werff, Steg, & Keizer, 2013). The research on universal values resonates with other research on political, economic, and technological values, as well as ideologies. For instance, people who value free market principles and maximising wealth are less concerned about environmental behaviour and view technology as the solution to environmental problems (Heath & Gifford, 2006). It is worth noting that people who eschew this kind of approach to hold more post-materialist values (e.g., self-improvement) are more likely to hold a level of wealth. This means they do not have to worry about meeting their basic needs. Within the context of climate change, Kahan and his colleagues' work has repeatedly found that conservative political ideologies that emphasize the maintenance of social hierarchy tend to be related to lower levels of environmentalism in the USA (Kahan et al., 2012) and also in Australia (Guy, Kashima, Walker, & O'Neill, 2014).

Thus, a range of research converges to produce a consistent pattern of results where generalised and relative endorsement of one kind of value over another can be used to predict endorsement and/or enactment of a broad range of pro-environmental tendencies. However, while the pattern is consistent, it is not very strong (Nordlund & Garvill, 2003). This is called the "Values-Action gap" because even though people with pro-environmental values are more *likely* to engage in pro-environmental behaviour, it is still the case that a great many of them do not act on these values (Blake, 1999).

Goals and motivational readiness

Goals are more specific and action-oriented than values, and as such have a greater chance of motivating a narrower, but still a fairly broad range of environmental behaviours. A goal represents a desire for an outcome that a person has some level of commitment to achieving and some sort of judgement about the likelihood that they can achieve it (for a recent theoretical integration of goal research, see Kruglanski, Chernikova, Rosenzweig, & Kopetz, 2014; Kruglanski et al., 2002). The important additional characteristic of having a goal is that the beliefs involved include the proviso to *personally act* in ways designed to meet that desire. As is noted in Part 4 below, interventions sometimes try to stimulate goal creation by asking people to write out or make a public commitment to act in a pro-environmental way. Without an internalised commitment to personal action, a person does not hold a goal and only has what Kruglanski et al. (2014) term “motivational readiness”. Motivational readiness will morph into a goal when there is a sufficient level of desire. Importantly, increased expectancy that the desire will be satisfied reduces the level of intensity necessary for a desire to become a goal. Values and mental models inform the environmental goals that Kashima et al. (2014) called environmental strivings; personal goals and commitments to improve or maintain the healthy state of the natural environment. Environmental strivings have been found to motivate a range of behaviours (e.g., engaging in discussions about environmental policies, shopping for environmentally friendly groceries, reduced driving) that are perceived to help attain the pro-environmental goals.

Internalised norms

The RAA focuses on perceived norms derived in context from others with whom a person is motivated to comply or identify with. However, it is possible to feel a sense of pressure to behave in a certain way based on *personal norms* that have previously been internalised by the individual. Personal norms are experienced as a sense of moral obligation to act. Schwartz’s (1973, 1977) moral norm-activation theory of altruism holds that personal moral norms are activated when people (a) see threats to others, (b) see a way to personally act to avert those consequences and (c) assume responsibility to act. It has been successfully applied to several pro-environmental behaviours including recycling and reducing household energy use (see John Stanley Black, 1978; J Stanley Black, Stern, & Elworth, 1985; Guagnano, Stern, & Dietz, 1995; Schultz & Zelezny, 1999; Widegren, 1998), reduced car use (Abrahamse, Steg, Gifford, & Vlek, 2009), and water conservation (Corral-Verdugo & Frías-Armenta, 2006).

Stern and colleagues have iterated on this and other work to develop an integrative value-belief-norm (VBN) theory of environmentalism. VBN theory links Schwartz’s value theory and norm-activation theory with work on NEP beliefs to propose a causal chain of five psychological factors that predict pro-environmental behaviour: values (especially altruistic ones) guide the adoption of NEP beliefs, which raises awareness of environmental threat and increased likelihood of assuming personal responsibility to act. This formulation has received empirical support (Stern, Dietz, & Guagnano, 1995). However, when reviewing its efficacy, Steg and Vlek (2009) noted that VBN theory has been demonstrated most successfully with behaviours that do not require much more than the expression of an attitude (e.g. policy support), while the RAA is more robust in predicting more difficult behaviours such as reducing car use. This is not surprising, given that the VBN is focussed on the attitudinal pathway, whereas the RAA also considers pressure from others and perceived behavioural control.

Factors related to environmental identity

Environmental identity (see Clayton, 2003, 2012) is broadly defined as a psychological connection between oneself and the nonhuman natural environment (e.g., Clayton, 2003; Mayer & Frantz, 2004; Schultz, 2002; Stets & Biga, 2003). Broadly speaking, self-definition creates a sense of immediacy that is important for initiating behaviour. Personal identities like “I am a recycler” make it more important for a person to actually behave in line with their attitudes (e.g., Barata & Castro, 2013). Strongly held personal goals such as environmental strivings (Kashima et al., 2014) constitute part of environmental identity. People can also have social identities wherein they define themselves in terms of important group characteristics that they share with others as “environmentally friendly” (e.g., Whitmarsh & O’Neill, 2010). Importantly, environmental identity has been found to contribute to intentions to perform a variety of environmentally significant behaviour over and beyond the RAA components (e.g., Sparks & Shepherd, 1992; Sparks, Shepherd, & Frewer, 1995; Terry, Hogg, & White, 1999; Whitmarsh & O’Neill, 2010).

Social identity and social influence

When people define themselves in terms of a group that values pro-environmental behaviour then the social norms of the group are internalised and provide a guide for their group member behaviour. For example, Terry et al. (1999) found that when people strongly identified with their friends and peers in the community then their household recycling intentions were influenced by whether or not those community group members thought that recycling was important. Social identification with a group also means that the group has strong referent influence over a person’s motivations. For example, Nigbur et al. (2010) found that neighbourhood identification accentuated compliance with an injunctive neighbourhood norm regarding curb side recycling.

It is possible for an opinion or behaviour to become the defining characteristic of a social group. The social identity of environmental activists is a primary example (Fielding, McDonald, & Louis, 2008). In the context of climate change, Bliuc

and colleagues (2015) have shown that climate change believers and climate change sceptics in the United States now tend to think and act as competing social groups, each seeking to make their perception of reality the dominant one. They found that three "group consciousness" characteristics predicted support for political action and donation behaviour: identification with one's own social movement, a sense of intergroup efficacy and anger towards the opposing group. As Bliuc and colleagues argue, this structure of group beliefs fuels intergroup antagonism, which is likely to simply polarise people's views farther. They recommend that instead of expressing anger climate change believers may be better served to use a social influence strategy that subtly undermines the efficacy of the sceptic group (e.g. "there has been an undeniable policy shift") coupled with a focus on finding new ways to communicate with sceptics including developing shared future scenarios and finding joint goals that decrease conflict. As Kahan (2015) points out, antagonism between climate change believers and sceptics obfuscates many shared beliefs and values that people on both sides have about how to manage the environment.

Place attachment

It is worth noting that the physical spaces that define contexts can inspire their own set of psychological factors. While it is sometimes simply conceived as a precursor or close correlate, place attachment can also be construed as an environmental identity that understands self in terms of connection to a particular part of the nonhuman natural environment (Clayton, 2003; Knez, 2005). Place attachment involves an emotional connection to place (e.g., Brown, Perkins, & Brown, 2003) and can inspire action to protect threatened environment; however, it can also lead to resistance if the pro-environmental behaviour recommended would dramatically change the nature or symbolic meaning of the physical environment (Devine-Wright & Howes, 2010; Uzzell, Pol, & Badenas, 2002; Vaske & Kobrin, 2001). While most place attachment research has focused on large districts, Gifford (2014) points out that a person's household can be the most important physical setting.

Emotion

One of the potential reasons why environmental identity contributes to intentions over and beyond the RAA components may be emotions (e.g., Triandis, 1979). An emotion (e.g., anger, happiness, love, hate) is a subjective experience that involves a physiological response and typically also some kind of behavioural or expressive response (Hockenbury & Hockenbury, 2007). Our emotions are connected to our reasoning and are powerful motivators for behaviour (Holland, Aarts, & Langendam, 2006).

Fishbein and Ajzen (2010) maintain that moods and emotions are likely to influence intentions and behaviours as background factors mediated through the RAA components. However, there are several studies that point to the importance of specific emotions in the context of environmental behaviour. As discussed earlier, Bliuc and colleagues' (2015) work indicates that emotions play a role in pro-environmental behaviour. Likewise, processes involving the assumption of environmental responsibility have been found to involve a sense of guilt (Ferguson & Branscombe, 2010) and a Swedish study found that recycling behaviour was associated with worry, hope, and joy (Ojala, 2008). Dittmar's (1992) theory that material possessions have instrumental, symbolic and emotional functions has also received support, and in one study, Steg (2005) found that car use is more strongly associated with symbolic and emotional dimensions than with instrumental ones. Similarly, Hine et al. (2007) showed that positive affect towards personal possessions that are high pollutants is associated with less willingness to change to another device.

Different psychological factors can be complementary or in conflict

Although the psychological factors we have discussed tend to cluster together in terms of whether or not they are pro-environmental, people will have many other meaningful clusters of psychological factors that may also be relevant in context. When such multiple motivational sources are complementary they can be expected to strengthen behavioural intention and the likelihood that an action will occur (e.g., Kruglanski et al., 2002). However, it is practically inevitable for people to have sets of psychological factors that are inconsistent with each other and therefore in conflict at least some of the time. Such conflicting motivational sources can undermine pro-environmental motivations (see Stroebe, Van Koningsbruggen, Papies, & Aarts, 2013, on eating; on general theory, see Kruglanski et al., 2002).

Lindenberg's (2001a, 2001b, 2006) goal-framing theory highlights the dynamic processes occurring between complementary and conflicting goals. He posits that people use preferencing principles for choosing between competing goals. Goal frames prioritise goals of a similar type and de-prioritise goals of a competing type, with three different types specified: hedonic "feel better right now", gain "maximise resources" and normative "act appropriately". The theory posits that the hedonic goal frame acts as the default. In the context of environmental behaviour, Lindenberg and Steg (2007) suggest that both the hedonic and gain goal frames tend to motivate pro-environmental behaviours, whereas the normative goal frame tends towards pro-environmental behaviours.

In line with this, Richetin et al.'s (2012) work highlights competing goals. They conducted a qualitative study to identify separate goals associated with reducing resource consumption and with not reducing resource consumption. The most

common goals expressed as motivating reduced energy consumption were (i) to save, protect and respect nature, (ii) to better the future and well-being of future generations, and (iii) to improve quality of life. In contrast, the most common goals expressed as motivating no change in energy consumption were (i) to maintain actual lifestyle and an easy life, and (ii) to seek immediate pleasure. These reasons not to engage in pro-environmental behaviour are hedonic in the Lindenberg and Steg (2007) sense that they are focussed on short-term low-effort pleasure. In addition, Richetin et al. reported two additional reasons for not reducing consumption, which are directly linked to the issue of resources. One was “trust in resources”, that is, there will be sufficient resources even if one does not save energy – perhaps indicating overconfidence in Lindenberg’s gain goal-frame. The second was the desire to spend one’s limited time on other things – arguably indicating a strong desire to regard time as a significant resource to be protected, again linked to Lindenberg’s gain goal-frame.

In converging research, the human interdependence paradigm (Garling, Biel, & Gustafsson, 2002) identifies that the problem of climate change highlights a social dilemma between the individual goal of gaining and protecting one’s resources and hedonic pleasures and the collective goal of sustaining humanity and the natural environment as a whole (see Gifford & Gifford 2000; Gifford 2007, chapter 14; Milinski, Sommerfeld, Krambeck, Reed, & Marotzke, 2008). Since the hedonic goal is said to be the default this begs the question of how a normative goal in favour of the commons might win out. However, work on the evolution of morality posits that internalising unselfish codes of conduct is in part a genetically and culturally evolved adaptation to collective living (e.g., Greene, 2013; Singer, 1981). Hence the normative goal-frame is a true contender to motivate people to perform pro-environmental behaviours, and thereby tip the balance of the social dilemma in favour of the commons, which benefits the collective.

Broad goal-frames may also help explain why financial incentives can have limited success in creating long-term adoption of pro-environmental behaviour (Shipworth, 2000). The goals identified by Richetin et al. (2012) as motivating pro-environmental behaviour were more consistent with altruistic values, preserving the commons and acting appropriately. Social influence that focuses on maximising resources and instrumental gains is not well aligned with these psychological factors, which could make their reinforcement less likely.

However, in our view, these general findings should not be taken as a prompt to exclusively devise strategies that try to activate normative goal frames in favour of preserving the commons. Such strategies are an important part of stimulating a transition to low carbon living but an alternative approach is to change people’s circumstances so that pro-environmental behaviour is also in line with the hedonic and gain goal frames. Addressing this question requires a consideration of the role of context in environmental behaviour generally and low carbon behaviours in particular.

Part 3: The Complexity of Context

Context is used in a very abstract sense in psychology because its details are difficult to generalise and they include many features that are not directly studied in psychology. When it is used, the term can include physical, institutional, social and personal features of the situation. Hence, saying that something is context-dependent is by itself equivalent to using the adage “it depends on the circumstances”. From the perspective of the RAA, context is one of the four elements that specify behaviour, and typically includes a class of relatively enduring social or physical settings in which an act towards a target takes place (e.g., my household, at my workplace, at the University, etc.). We will use the term context more broadly than the RAA to include not only those social or physical settings, but also including a temporal dimension. This is more in line with the broader use of the term context in psychology generally.

In this part we first briefly summarise some broad ways that context can shape behaviour. We then consider three aspects of contexts in more detail: (i) they are dynamically related to each other (ii) they are central to the development and maintenance of habits, and (iii) they are difficult to modify. Part 3 then concludes by presenting and discussing theoretical concepts from social practice theory and a general selectionist approach to cultural dynamics. These theories provide some direction on how to characterise context in a theoretically coherent and practically useful way and in doing so they can be used to identify limits on how much actual control people have in context.

Ways that context affects behaviour

Context can affect behaviour in different ways. The summary list below is adapted from work by Steg and Vlek (2009):

- i. Context can drive behaviour. Contextual factors can cue a behaviour or increase perceived behavioural control over achieving a behaviour. For example, the introduction of recycling facilities both prompts consideration of recycling and makes that behaviour more easily achievable. Contexts also often set a default for “standard behaviour” (e.g. prominent elevators and hidden stairs in buildings) which people are likely to passively accept even if they express support for alternatives (see Pichert & Katsikopoulos 2008).
- ii. Context can remove actual control over the behaviour. For example, without the necessary infrastructure and services it is impossible to use public transport instead of a car (e.g., Bamberg & Schmidt, 1999; Fujii & Kitamura, 2004).
- iii. Context can be necessary but not sufficient to produce behaviour. For example, having an adequate meeting place may be essential to coordinating pro-environmental behaviour in the neighbourhood but pro-environmental psychological factors must also be present amongst neighbours (see also Stern, 1999).
- iv. Context can set the default for how to think about behaviour in general. For example, technology is generally designed to be convenient and “labour-saving”, so much so that modern electrical equipment such as televisions and computers are designed to be on standby at all times. This kind of design prompts people to expect instant gratification when they interact with their technology and makes the reduction of energy consumption counter-intuitive.

Stated more simply and narrowly from the RAA perspective, context can play a significant role in the formation of intentions and intention-behaviour relation. Our discussion of this role addresses two main issues: context as a potential source of *intention stability* and context as a critical determinant of *actual control* in the RAA. First however we discuss a phenomenon called “spillover”, which amounts to a fifth, indirect, way that context can affect behaviour.

Spillover and the inconsistent pursuit of goals across contexts

Spillover is a phenomenon wherein an actor’s performance of one behaviour has a knock-on effect on the performance of another behaviour, typically across contexts. Hence, it involves indirect and dynamic relationships surrounding whether people choose to behave consistently or inconsistently across contexts. When one pro-environmental behaviour induces another pro-environmental behaviour, it is called *positive* spillover; when one pro-environmental behaviour induces another environmentally damaging behaviour, it is called *negative* spillover (Thøgersen, 2004; Thøgersen & Crompton, 2009; Thøgersen & Ölander, 2003; for a recent review see Truelove, Carrico, Weber, Raimi, & Vandenberg, 2014).

In the domain of environmental behaviour, much of the evidence reported in the literature has documented positive spillover, for instance, moving from recycling to organic food purchase in the late 90s in Denmark (Thøgersen & Ölander, 2003). For an overview, Truelove et al.’s (2014) review documents a number of instances of positive spillover. However, although it may be over-interpreted, there is some suggestion that negative spillover also occurs. For instance, Tiefenbeck, Staake, Roth, and Sachs (2013) reported that a decrease in water use resulted in an increase in energy

consumption, (c.f. Truelove et al., 2014). In economics, negative spillover is often discussed in terms of *rebound effects*. For instance in the domain of energy use, an increased energy efficiency can reduce energy cost, which then may push up the consumption of energy (see Hertwich, 2005, for a broad overview).

Psychologically, goal theoretic perspectives suggest that, when two behaviours are seen to serve the same goal, depending on how the relationship between the behaviours is construed, a positive or negative spillover may occur. According to Fishbach, Dhar, and Zhang (2006), when one behaviour is seen as complementary to the other, so that both behaviours complement each other to achieve the goal, performing one behaviour is likely to prompt the enactment of the other (positive spillover). However, if one behaviour is seen to substitute the other, so that performing one or the other is sufficient to achieve the goal, performing one behaviour can hinder the enactment of the other (negative spillover). Similarly, Whitmarsh and O'Neill (2010) suggested that environmental identity may mediate positive spillover. This is because performing a pro-environmental behaviour may strengthen the actor's identity as an environmentally friendly person, which then may motivate another pro-environmental behaviour. More generally, it is possible that global psychological factors such as environmental identity, pro-environmental goals and values may mediate positive spillover via similar mechanisms.

Negative spillover may also be explained in terms of moral licensing, involving thoughts like "now that I have done something good for the environment, I deserve to take a break and indulge a bit" (e.g., Monin & Miller, 2001; see Miller & Effron, 2010, for a recent review). This type of mental accounting can result in rebound effects for the way resources are used to perform pro-environmental behaviours (Herring & Sorrell, 2008). For example, a virtuous choice to invest in home insulation may be used to justify less effort in curtailment, potentially neutralising the environmental benefit of having a more efficient home (Gifford, 2014). Although Gillingham, Kotchen, Rapson, and Wagner (2013) admonish that the rebound effect is overplayed, interventions targeting a specific behaviour can produce negative unintended side effects and this reminds us of the need to conceptualise behaviours not in isolation, but as an interconnected network.

The phenomenon of spillover highlights the importance of understanding how multiple contexts across space and time are related to each other. The RAA focuses on a single act or a homogeneous behavioural category, and therefore interventions tend to target a single act or a homogeneous behavioural category. The RAA provides a powerful framework for doing so and, as we have noted, its utility has been shown in past research. Yet, when approaching heterogeneous and yet inter-related behaviours that fall under the broad rubric of low carbon living, the RAA is not designed to deal with the critical problem of negative spillover, nor how positive spillover might create beneficial flow-on effects (for example, from workplace interventions to the household). What is needed is a way of understanding the diversity of low carbon behaviours and also a way to identify any consistencies across behaviours. Later in Part 3 we consider theoretical approaches that may be integrated with the RAA to achieve this kind of understanding. However, we first consider in detail some of the ways that context affects intention stability and limits actual control.

Stability of intention within a context and the role of habit

Context can affect the stability of intention. For instance, intentions may change over time because various events and other activities that occur in the context may interfere, and the actor may forget to retrieve the prior intentions at the right time, failing to convert the prior intention into the intention in action. Alternatively, the actor may move from one context to another, affecting beliefs and evaluations stipulated as relevant by the RAA framework, and thus leading different prior intentions to be accessed. Such destabilising effects may appear random, but when they are based on a person's pre-existing habits then they can be readily identified and understood. Wood and Neal (2007) theorised that habit can drive behaviour by virtue of a context-behaviour association established by repeated performances of a specific behaviour in that particular context. As our discussion in this section explores, the extent to which a habit-context match is present is important for understanding whether intention is likely to be converted into behaviour.

Defining habits

Aarts, Verplanken, and Van Knippenberg (1998) argued that habits involve a series of context-specific inter-connected behaviours that have been proven over time to achieve a contextual goal. As the behaviours in context are found to achieve the goal, a mental representation forms about how to behave in that context and it then automatically activates when a person enters that context and registers situational cues about how to engage with the context (Verplanken, 2005). According to these models, even if a behaviour is intentionally performed in pursuit of a conscious goal at the outset, after it is repeated in a certain context, the behaviour becomes automated. The strength of cues and the integrity of the mental representation may vary however, and it is better to think of habit as a continuum with behaviour being more or less habitual (Moors & de Houwer, 2006; for measurement see Klöckner & Oppedal, 2011 and Aarts & Dijksterhuis, 2000). When strong habits are formed, habitual behaviour is automatically performed upon entering the same context.

The stabilising potential of habits

In line with the view that habits are automatic responses to contextual cues, Ouellette and Wood's (1998) meta-analysis found that, when contexts remained the same, past behaviour predicted future behaviour without any mediation by intentions (i.e. experience of intention was *not* needed to explain the relationship). In contrast, the effect of past behaviour on future behaviour was mediated by intentions when contexts had changed from the past so that the future behaviour was performed in a different context (i.e. experience of intention was needed to explain the relationship). Neal, Wood, Wu, and Kurlander (2011) also showed the same pattern in field experiments.

Thus, depending on the combination of pre-established habits and intentions, context can have somewhat different effects on behaviour. Table 2 presents the effects of habit and intention on intended behaviour as a function of contextual variation. If the actor forms a prior intention to perform a routinized behaviour in the same context as before (1), there is no conflict between habit and intention, and the intended behaviour is likely to follow. However, if the actor's prior intention is to perform a behaviour routinized in one context in a different context (2), the intention needs to be remembered, activated, and carried because the habitual behaviour is unlikely to be triggered by the cues in the old context.

Table 2: Behavioural outcomes under different conditions of context and intention

		Intention	
		Perform habitual behaviour	Perform new behaviour
Context where habit was acquired	Same	(1) <i>Habitual and intended behaviour</i>	(3) <i>Habitual behaviour</i>
	Different	(2) <i>Intended behaviour</i>	(4) <i>Intended behaviour</i>

In contrast, if intentions are to perform new behaviour, which differs from the habitual old routine, one way to "break the habit" is to change the context (4). Here in a new different context, there are no contextual cues to trigger the routinized behaviour, and therefore intention is more likely to drive the new behaviour. However, the old habit can interfere with the performance of a new intended behaviour *if the actor stays in the same context* (3) (e.g., one's house; Binder & Boldero, 2012). There are potentially several reasons why this may happen. First, habit may be simply too strong for the actor to enact his or her prior intention, and the routine behaviour may be automatically performed without his or her awareness. This is likely to occur especially when the actor does not have sufficient "cognitive resources" to retrieve and activate the prior intention (e.g. when ability to focus on carrying out intentions is impaired by factors like fatigue or distractions). Second, habitual behaviour may not simply interfere as a default but as a source of conflicting motivation. While it may not always be consciously activated, the habit was most likely established in the first place because it was satisfying in some way. In this case, depending on the habit strength, the actor may succumb to the temptation of habitual familiar behaviour. In line with this reasoning, Danner, Aarts, and de Vries (2008) found that habits interfered with intention only when habits were strong (i.e., repeatedly performed in the past and the context remained the same).

Although breaking the old habits in the same context is difficult, it is not impossible. Research has found that implementation intentions (e.g., Gollwitzer, 1999; Gollwitzer & Sheeran, 2006), i.e. prior intentions to perform desired behaviour when certain context is encountered, can combat old habits and increase the likelihood of people performing behaviours that they think are more desirable. Gollwitzer and Sheeran's (2006) meta-analysis has found a wide range of behaviours from health behaviours to environmental behaviour can be changed by implementation intention. Most directly relevant, Bamberg's (2002a; 2002b) field studies have found that inducing students to form implementation intentions to purchase organic food and to use public transport (i.e., bus) indeed increased them performing those behaviours, and notably having small financial incentives did not make a difference to this effect. However, despite the consistent power of implementation intention in breaking habits, it is not a panacea. Other processes in the context where the behaviour must be "implemented" can thwart implementation intentions; social processes in particular may interfere (e.g., Gollwitzer, Sheeran, Michalski, & Seifert, 2009; Nickerson & Rogers, 2010)

Contexts have a structure that can be difficult to modify

As the sites of actual engagement with the world, contexts guide and structure behaviour. In this way, context determines *actual control* over the behaviour and there may be a number of unexpected obstacles to performing an

intended behaviour in the intended context. For example, despite an actor's intention to purchase solar panels, she may find that the communication device is out of order, the provider of the panels is out of stock, or the panels cannot be purchased within the available budget. In addition, people in rented accommodation have limited control over their built environment, while those in mortgaged homes may not be able to afford the initial financial outlay for solar power. Finally, where a limited resource is used to fuel behaviour across a range of contexts, a person's assessment of their perceived behavioural control may take into account extra-contextual demands (for example whether money should be spent on home insulation or a school holiday program).

Newton and Meyer's (2012, 2013) research highlighted the importance of infrastructure as a defining feature of context that acts as a determinant of behaviour. Together with attitudinal and other individual difference characteristics, Newton and Meyer (2012) examined three concentric circles of context as determinants of consumption: household (e.g., household income, size, car access), dwelling (e.g., type, tenure, number of bedrooms, energy and water efficiency), and location in Melbourne, Victoria (e.g., near CBD, suburban, outer-suburban). Not only did they find that different areas of consumption have different determinants, they also showed that contextual factors had far greater effects on most areas of consumption than did individual differences (see Table 3 for relative amount of consumption explained by different types of variables).

Table 3: Effect sizes explained by context and individual difference variables for each consumption domain (R^2 from Newton & Meyer, 2012, Table 6, η^2 from Newton & Meyer, 2013, Table 13)

	Water	Energy	Appliance	Carbon-intensive personal travel	Housing space
<i>Context</i>					
Location	5.1	7.4	5.9	21.1	3.3
Dwelling	28.5	11.3	8.7	26.8	36.6
Household	24.3	35.2	54.6	36.1	55.6
<i>Individual</i>					
Global Attitudes	2.1	5.4	5.2	12.6	2.6
Demographics	5.9	7.1	4.3	8.5	13.9
<i>Attitudinal Segments</i>					
Three subgroups	0.2	0.6	2.4	1.1	0.1

When Newton and Meyers (2013) used attitudinal variables to segment the sample, they identified three different profiles. Committed greens (33.5%) were most pro-environmental in their attitudinal outlook to the extent that they are willing to pay more for the environment; material greens (40.3%) had positive attitudes towards the environment, but were not willing to pay for it; and enviro-sceptics (26.3%) were sceptical about the necessity for pro-environmental choices. Although comparisons of these subgroups' actual consumption behaviours showed statistically significant differences, the effect sizes were very modest indeed, varying from 0.1 to 2.4%. Taken together, these results highlight that when behaviour is construed to include actual outcomes of individual actions as in Ajzen (1991) and the RAA, 'context' in the sense of infrastructure for action plays a role critical for the transition to low carbon living.

Stern and colleagues' work to include context in psychological research on pro-environmental behaviour is instructive when considering the difficulty of modifying contexts. Their work primarily focuses on decisions to engage in pro-environmental behaviours as the contextual demand for resources varies. Their work is conducted with a framework they have developed called ABC theory (Stern, 2000), which provides that behaviour (B) is a product of interactions between attitudinal variables (A) and contextual variables (C). Here contextual factors are conceived as either impeding or facilitating the expression of an attitude through behaviour by requiring either more or less resources from people (e.g. effort, time, money) to enact the behaviour. Black et al. (1985) found evidence supporting ABC theory when examining the extent to which attitudinal variables predicted household energy conservation, showing that the relationship weakened as the cost of conservation method increased (see also Corraliza & Berenguer, 2000; Guagnano et al., 1995; Lüdemann, 1998). Similar results have been found for the way quality of public transport and the availability of sustainable goods can affect pro-environmental behaviour (see Santos, 2008; van Diepen & Voogd, 2001; Vining & Ebreo, 1992).

Many constraints on actual control stem from the issue of resources. Although it is rarely explicitly stated in psychology, the above analysis suggests that people use a variety of different resource currencies to engage with the physical,

institutional, social and personal features of the context they move through in the course of their daily lives. In the broader interdisciplinary field of environmental research, the five capitals framework (Bebbington, 1999) is often used for analysing the resources available and necessary for developing sustainability strategies, disaster management and community capacity building (Nelson, Adger, & Brown, 2007; Reddy, Reddy, Galab, Soussan, & Springate-Baginski, 2004; Sayer et al., 2007). The resources or "capitals" identified in this framework are financial, social (including institutional), human (including personal capabilities), built (including technological infrastructure) and the natural environment (including its restorative capacity for cognitive functioning, productivity, mood and vitality; Kaplan, 1995). In addition, the amount of time a person has to perform essential and non-essential behaviours can be understood as a resource (Lokhorst, Werner, Staats, van Dijk, & Gale, 2013), and innovative behaviours themselves can be considered to be a resource (Beretti, Figuières, & Grolleau, 2013).

Context in the sense of infrastructure is a necessary and relatively stable condition for action. However, a focus on infrastructure – particularly the institutional, technological, and built environment – may underestimate the importance of other relatively less stable and more flexible aspects of context. A hint at this is provided in Newton and Meyers' (2012) work, discussed above, where household context consistently explained a large part of Melburnians' actual consumption. They found that household context mattered in terms of an individual respondent's infrastructure (e.g., household income, registered vehicles owned), but also in terms established social relationships that defined the *social context* of consumption, including whether or not other adults were present and whether they had children. Far from simply signifying the number of people consuming energy in different households, these social factors structure complex relationships surrounding both perceived consumption requirements and decisions about how to consume. Difficulties in modifying these requirements and decisions go directly to the question of how to stimulate pro-environmental intentions within households en masse as well as how to provide the right conditions for this intention to convert into action.

Generally, there is awareness in environmental psychology that psychological insights should be integrated with knowledge in other disciplines so that models of how the context will affect behaviour are sufficiently detailed. For example, Steg and Vlek (2009) advise that research to understand context should be conducted in dialogue with architects, urban planners, industrial designers and technologists whose professions' focus on human interaction with the physical world. While Gifford (2006, 2008), taking a macro approach, proposes a general model of social dilemmas that includes consideration of weather, extent and accessibility of resources, regulatory policies, pricing and technological developments. Focusing more on climate change mitigation and adaptation, and mindful of the social dimension, Kurz, Gardner, Verplanken and Abraham (2015) make a compelling case for the social practice approach. This approach is widely applicable for low carbon behaviour, and is discussed below.

Social practice theory can help address the limitations of the RAA

In our view, social practice theory gives a useful perspective for analysing the particularly social aspect of context while acknowledging the way that it is deeply structured in terms of space and time. It examines in detail the way serially reproducing networks of behaviour within and across contexts (called "bundles") represent and maintain a shared social and physical reality that gives structure to society (see Shove, Pantzar, & Watson, 2012 for a broad overview). From this perspective, Shove (2010) criticised psychological and economic approaches to behaviour change in the climate change mitigation and adaptation domain, though note there are also commentaries on Shove's portrayal of psychology by Whitmarsh, O'Neill, and Lorenzoni (2011) and Boldero and Binder (2013). A well-rounded review of the practice theory perspective and psychological research on habits can be found in Kurz et al. (2015).

Definitions of practice

While there is some disagreement within the literature, a particularly clear formulation of social practice theory defines a *practice* as a routinized set of behaviours that encompass (i) the capacity to perform physical actions or procedures located in space and time (competence), (ii) things that are used (material), and (iii) mental activities, including knowledge, emotion and motivation (meaning; Shove, Pantzar, & Watson, 2012; Southerton, 2003). In this way, social practices are sustained by material, psychological, social, and cultural elements. They are also imbued with a sense of normality, even inevitability; however, social practice researchers emphasise that practices only survive as long as they are enacted (Warde, 2005).

Importantly, the mental activities referred to here as an element of a practice are not those that are specific to an individual, but rather the consensualised understandings and symbols shared amongst people. These consensualised mental activities may not be the only ones occurring, but they are the ones that allow us to have common mental models across different people and experience the intersubjectivity of a shared reality (for a discussion see Reckwitz, 2002). They are also central to maintaining a "community of practice" that structures different people's enactment of practices (Shove et al., 2012; Southerton, 2003; Shove, 2012; Wenger, 1998), including power and prestige relationships maintained by the presence of the practice (Hargreaves, 2011). It is also worth noting that the design of the material objects and resources that are used as part of a practice will shape and facilitate the physical actions and procedures involved in the social practice. For example, electricity and water infrastructure are designed for constant unlimited

demand (see Moss, 2000; Van Vliet, Shove, & Chappells, 2005) and are not well equipped for contributions by private citizens to the commons.

Kurz et al. (2015) discuss the bodily cleansing as an example of a practice. They identify the three elements of practice. Bodily cleansing typically involves a particular set of actions and competences to execute them (e.g., a variety of actions associated with daily showering in morning or evening), involves the use of materials and infrastructure such as showerheads and hot water systems, and signifies commonly held ideas and meanings about bodily “freshness”. In addition, when we reflect on the practice of bodily cleansing we can from our own experiences see how it is directly interconnected with other practices like shopping, house-cleaning, having people to stay at your house, relaxing sore muscles, and getting ready for a special occasion, as well as a whole raft of practices surrounding the installation of showers and baths in homes.

Practices are the unit of interest in a social practice perspective and individuals are seen as “carriers” for the practice. The way that the individuals enact and negotiate different practices is no more important than the design of the physical infrastructure and equipment being used, nor the location of the practice in time and place. The way that specific practices occur and bundle together and the antecedents to and consequences of their reproduction and dissolution are the focal points of enquiry (Shove, 2010; Reckwitz, 2002).

Intersection with psychological approaches to behaviour

Social practice as construed in the social practice approach have much in common with behaviour as defined in the RAA (contra Shove, 2010; Shove et al., 2012; for counterpoints to Shove, see Boldero & Binder, 2013; Whitmarsh, O’Neill, & Lorenzoni, 2011; Wilson & Chatterton, 2011). In particular, the social practice approach clearly parallels psychological research on habits (e.g., Kurz et al., 2015). If behaviour is reconceptualised as a culturally shared meaningful unit of action or a series of actions that an individual can carry out intentionally or habitually (see Triandis, 1979), behaviour does not only follow from choice and decision making, but also follow from context via habit. Both intentions and habits are profoundly under social influence, which is not only felt as external “social pressures”, but also as internalized personal norms or even as attitudes or perceived control.

To be sure, the automatic character of habits means that there is a widespread view that habit implies a mechanistic association between contextual cues and behaviour, such that behaviours inflexibly follow when cues are present. However, habits form and dissipate all the time and psychological approaches also allow us to theorise context and behaviours as being psychologically represented in distributed representational systems such as distributed connectionist networks (e.g., McClelland, Rumelhart, & the PDP Research Group, 1986; see Kashima, Woolcock, & Kashima, 2000, on context). Viewed in this way, the context-behaviour relationship becomes flexible and potentially influenced by a variety of other relevant information. Our discussions about psychological representations of context and behaviours are based on these more dynamic conceptions of the mind. Thus construed, it seems to us the primary concern of some practice theorists that “[a] language of driving factors does not capture the extent to which forms of practical knowledge, meaning and competence are themselves forged and reproduced through the process of doing” (Shove et al., 2012, p. 144) largely dissipates.

The value of placing more emphasis on infrastructure

What is striking about social practice approaches is that they prompt an exhaustive consideration of the role of context, and the way that multiple behaviours are linked across time and space. In particular, the way that it puts the same focus on competence and materials as it does on meanings means that it is better placed to identify the way that the *material and technological infrastructure* reinforces behaviours, regardless of individuals’ stated attitudes and intentions. Relatedly, by taking a longer view of how a context comes to be, the social practice approach makes it possible to see how a non-habitual behaviour for one person is frequently contained within the routinized behaviours of many others. For example, when a person buys a fridge for the first time their behaviour is not habitual, but the shop in which the fridge is bought and the whole manufacturing and supply chain providing stock to the shop is governed by many interdependent routines, and these routines are largely not focussed on the reduction of household consumption. Similarly, the fridge-purchaser’s learned understandings about what fridges are for is formed from many past instance of routine fridge use, where energy efficiency has probably been construed in terms of not leaving the door open too long when browsing for something to eat. Thus, the behaviour of buying the most energy efficient fridge that supports the most extensive curtailment behaviour may not be the most prevalent fridge-buying practice.

Developing a perspective on behavioural practice and behavioural context

In this section, we present a preliminary integration of the RAA and social practice perspectives in order to provide a theoretical framework to analyse low carbon behaviours and help design intervention strategies for transition to low carbon living. As a focal point of departure, we use the term *behavioural practice* to refer to a culturally shared set of actions that people in a population regard as a coherent behaviour. We suggest that its psychological representation

includes (1) typical consequences as well as social and cultural implications (broadly speaking, meaning) of enacting this behaviour, (2) typical resources required to perform it, and (3) typical cues that act as prompts to activate it. Depending on the level of enculturation and acquisition, different actors may have different degrees of skills and competences to perform a given behavioural practice, and it can be activated intentionally or non-intentionally (or habitually), and may be (though not always) intentionally regulated or even stopped in interaction with the dynamically changing physical and social context.

Behavioural practices differ in the extent to which their performance depends on the performance of other behavioural practices. We call *contextual behavioural practices* those other behavioural practices that facilitate or hinder the performance of a *focal behavioural practice*. We call *behavioural context* the totality of those contextual behavioural practices that are relevant for the performance of the focal behavioural practice.

Table 4: Behavioural Practices and Behavioural Context

Behavioural Practice	Focal	A given behavioural practice under consideration
	Contextual	Behavioural practices that facilitate or hinder the performance of a focal behavioural practice
Behavioural Context	Personal	Contextual behavioural practices performed by the focal actor
	Social	Contextual behavioural practices performed by other private actors (individuals, businesses)
	Institutional	Contextual behavioural practices performed by other institutional actors (governments, providers of public goods and services, their employees)

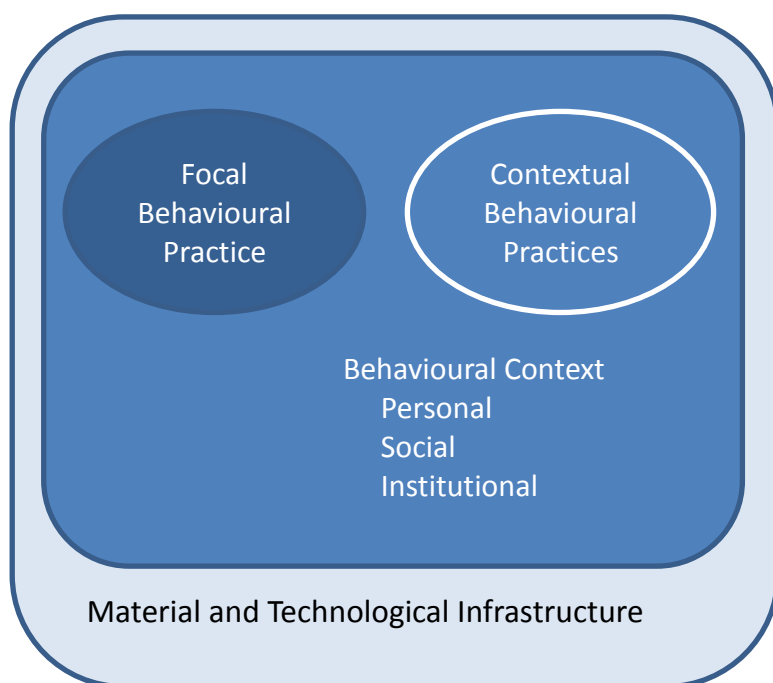


Figure 2: Schematic Depiction of Behavioural Practice and Behavioural Context

We distinguish three types of behavioural context depending on the actor that typically enacts contextual behavioural practices. One type is *personal behavioural context*, which includes contextual behavioural practices performed by the actor who engages in the focal behavioural practice. For instance, to save energy for air conditioning, the actor may need to activate a different clothes purchasing practice (e.g., lighter summer clothes without ties – “cool biz” in Japan) or

to activate a different appliance purchasing practice (i.e., purchase a more energy efficient air conditioner). A second type is *social behavioural context*, which includes other behavioural practices performed by other actors that the individual actor interacts with (e.g., other people living in the same household, those that manufacture, marketing and sell an energy efficient air conditioner). A third type is *institutional behavioural context*, which includes behavioural practices performed by institutions such as governments, other suppliers of public goods and services, and the like (e.g., provide stable electricity supplies; set, monitor, and enforce an energy standard). All of these practices and types of context are underpinned by material and technological infrastructure

Social practice theory offers a nuanced way to think about context and networks of contexts. Our preliminary integration with RAA provides the beginning of an analytical approach to understanding the forces constraining actual control in a context. However, these tools are still focused at the site of specific behaviours. As we have discussed, low carbon behaviours are heterogeneous and behavioural change in one context will not necessarily result in positive spillover into low carbon behaviour in other areas of the person's life. This creates a huge burden for multiple points of intervention to achieve a thorough transition to low carbon living. Alternatively, it prompts the need for a theoretical approach that links the detail of behavioural practices with a broader macro perspective on the generation, maintenance, and extinction of behavioural practices. This kind of perspective is needed to address questions like: How can the broad goal of reducing carbon emissions be achieved within a community? How can a wide range of high carbon practices be extinguished and alternative low carbon practices be cultivated? One potential framework is a general selectionist approach to cultural dynamics.

A general selectionist approach to cultural dynamics can help address the limitations of the RAA

A general selectionist approach to cultural dynamics postulates that cultural evolution follows the general mechanism of generation of variability, social transmission, and selective retention (e.g., Campbell, 1975; Dawkins, 1976; Cavalli-Sforza & Feldman, 1981; Boyd & Richerson, 1985; Sperber & Wilson, 1986; see Kashima, 2008, for a broad review).

- (i) *Generation of variability*, that is, a wide range of behavioural practices needs to be generated within a community.
- (ii) *Social transmission* (or diffusion) of behavioural practices need to occur within the community.
- (iii) *Adaptive* behavioural practices tend to be retained and become widespread in the community.

Adaptiveness is broadly conceived to include not only tangible financial or economic incentives, but also social reputations, status, and other social resources as well as congruence with broad values and goals widely held in the population. More to the point, this framework suggests that behavioural practices that are in line with the determinants of intentions (attitudes, perceived norms, and perceived control) and that also do not incur costs to other behavioural practices are more likely to be selected in than selected out.

From this perspective, it is no surprise that the emergence and retention of behavioural practices is difficult to predict. To begin, it is difficult to “predict” what innovative behavioural practices may be generated because there may be a variety of sources that can produce variants of behavioural practices. As Kashima (2014) noted, new behavioural practices may be transmitted from other communities, created by members of a community, or generated by errors in transmission. There are a variety of mechanisms by which newly generated behavioural practices are transmitted to various members of the community: from formal education and training programs to informal transmission via social networks. The social and physical circumstances that create selection biases (i.e., adaptiveness) are difficult to ascertain in every instance of the enactment of behavioural practices.

Agenda for future research

In his 2014 review of environmental psychology Gifford noted that what was needed was a theoretical framework that linked micro and meso accounts of behavior with a macro perspective. He identifies RAA as a meso perspective, abstract in some ways but incomplete and constrained to the site of specific behaviours. Our project agenda is to integrate RAA and related psychological concepts with the micro perspective of social practice theory and the macro perspective offered by a general selectionist approach to cultural dynamics. Our discussion of behavioural practice and behavioural context is the start of this work however this review does not include a full integration. Instead we present these literatures to highlight that social practice theory and a general selectionist approach to cultural dynamics intersect with RAA by elucidating the complexity of context at two very different scales. In doing so, their related but distinct insights about context and behaviour show great potential for addressing the limitations of the RAA identified in Part 1. Further notes from these theories are included in the second half of Part 4, which directly considers interventions to promote a transition to low carbon living.

Part 4: Notes for interventions

This final part of our review first covers the range of methods used in past interventions to promote pro-environmental behaviour (including low carbon behaviour). We then discuss some general directions for future research into ways of stimulating large-scale change at the societal level.

Types of interventions examined in past research

Information dissemination

Interventions focused on providing information about the necessity and benefits of pro-environmental behaviour are the most commonly used, in part because it is a simple and relatively inexpensive strategy. While new information can be essential for behaviour change, interventions that focus solely on information dissemination tend not to be successful and have been widely criticised as insufficient (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Kollmuss & Agyeman, 2002). With this qualification in mind, it has been found that information is most effective when it is tailored to the specific population being targeted. In addition, positively framed information that seeks to educate or show how to "solve" climate change produces better results than negatively framed information that is coercive or demands sacrifices (Abrahamse et al., 2007; R. Gifford & Comeau, 2011a; Rabinovich, Morton, & Birney, 2012). Information dissemination can also be useful to warn and explain about interventions that involve structural change, thereby increasing public acceptance (Gärling & Schuitema, 2007).

Social influence

The content and framing of messages used in information dissemination will communicate not only bald facts but also normative messages that people will be more or less motivated to comply with. In addition, a second communication strategy is called "modelling" wherein a person or a group of people perform the behaviour to demonstrate its benefits and provide an example upon which an injunctive norm can be based (Baca-Motes, Brown, Gneezy, Keenan, & Nelson, 2013). More simply, signs can be used to post simple injunctive messages (e.g., "turn off the lights" Sussman & Gifford, 2012). Finally, a block leader strategy will create leadership roles for people within a community to harness existing networks and communicate pro-environmental norms. In a recent meta-analysis comparing different kinds of pro-environmental interventions, Abrahamse (2007) found that social influence strategies were particularly effective, regardless of the type of behaviour being targeted, although the kind of population being targeted did affect the extent of behaviour change.

More recently, Abrahamse and Steg (2013) conducted a meta-analysis of empirical studies that employed different social influence strategies, and found that the interventions using social networks were the most effective (i.e., placing a leader within a local social network that champions a desired behaviour), followed by public commitment, modelling, group feedback, socially comparative feedback, and the use of social norms. Social influence strategies were most effective for employees, followed by students, farmers and hotel guests. These findings underline the utility of social influence strategies, and also the potential benefit of workplace interventions as employees appear to be most willing to comply with the social influence attempts. If pro-environmental behaviours encouraged in the workplace positively spillover to the employees' household and other behavioural practices, this intervention strategy may be an important avenue for future intervention research.

Consequence-based. Consequence-based strategies follow up on social influence by providing feedback about behaviour change or lack thereof (e.g. information, financial rewards or punishment). Information feedback may include comparative information relative to a benchmark and/or a comparison group (meaning that the consequences include judgement against injunctive or descriptive norms).

Threats. Pro-environmental proponents often favour a fear appeal as a way of motivating pro-environmental behaviour. However, research in the field of fear appeals indicates that while it can motivate action it can also lead people to minimise or ignore a problem (e.g., Finckenauer, 1982; Higbee, 1969; Johnson & Tversky, 1983; Weinstein, Grubb, & Vautier, 1986). Unless the threat of a natural disaster is imminent, the impact of climate change is abstract and located in an uncertain future. This reduces the likelihood that fear appeals will be successful.

Commitments. One of the actions that people are sometimes asked to take is to make a commitment to engage in pro-environmental behaviour. These may be made publically or simply written out by people for their private reflection. The commitment itself is generally focussed on specific behaviours and in addition to setting this goal it may include an implementation plan to circumvent established habits (Holland et al., 2006). A recent meta-analysis by Lokhorst, Werner, Staats, Dijk and Gale (2013) found that commitments do increase the likelihood of behaviour change in both the short and the long-term.

Structural change

Rather than appealing to people's minds', structural strategies change their environment. Examples include altering physical or technical infrastructure, changing legal and market-based regimes or integrating new services. Frequently a strategy will combine several different kinds of structural change, and successful large-scale structural interventions include road de-congestion and household recycling (with household composting services now being rolled out in many places in Europe). Structural changes interfere with the reproduction of established social practices, and while social practice theorists would caution against the over-generalisation of structural strategies from one context to another, psychological research has identified some consistencies across different structural interventions.

Structural changes alter relationships between different elements of the practice, ideally making pro-environmental behaviour the most convenient and lowest in cost (Steg & Vlek 2009). However as mentioned above, financial incentives by themselves are often insufficient for long-term behaviour change (Gärling & Loukopoulos, 2007). In terms of responding to different proposed policy-based structural strategies, people prefer positive incentives to change rather than penalties and their assessments are affected by perceptions of fairness and effectiveness (e.g., Poortinga, Steg, Vlek, & Wiersma, 2003; Steg, 2008). There is also evidence suggesting people respond more positively to politics focused on changing or providing new infrastructure and equipment rather than those that seek to force behaviour change through other means (R. Gifford, Steg, & Reser, 2011b; Steg, Dreijerink, & Abrahamse, 2006).

Given the human bias in favour of the status quo, it is not surprising that reactions to proposed policies will not necessarily be accurate and there are several reported incidences of policy support and pro-environmental attitudes increasing after a policy has been implemented (e.g., Convery, McDonnell, & Ferreira, 2007; Tretvik, 2003). In contrast, Kurz et al. (2015) warn that downstream interventions can be expensive, unwieldy and thwarted by the nature of larger structures and social practices.

Combination approaches

There is consensus in the literature that the most effective interventions will use combinations of multiple different behaviour change strategies (e.g., Gardner & Stern, 1996; Gifford 2014). In addition, a meta-analysis conducted by Osbaldiston and Schott (2012) found evidence that different intervention types can be particularly effective for different kinds of behaviour, and further that different combinations are also best for different kinds of behaviour. Highlighting the important role of mediating psychological factors, Osbaldiston notes that, although goal setting was not by itself the highest impact characteristic of interventions, it was nonetheless present in many effective combination-based strategies.

Design notes from past research on interventions

The importance of taking a combination-based approach to designing an intervention strategy is consistent with a social practice perspective on the complexity of behaviour. While design should be informed by past research, we also strongly recommend that the social practices surrounding the behaviour of interest are carefully mapped out and considered as part of the process of tailoring the intervention to the specific situation of interest. As part of this process, understanding the demographic characteristics of the population being targeted can help guide enquiry into the priorities and capabilities of the people who will be responding to the intervention (see Franzen, 2003; Grønhoj & Thøgersen, 2009; McCright & Dunlap, 2012).

In addition to the range of research already discussed, Gardner and Stern (1996, p.159) provide a helpful checklist of things to consider when designing an intervention. It is worth highlighting here Gardner and Stern's (1996) specification that interventions should be continually monitored and adjusted. Systematically evaluating the effects of the interventions during, immediately after and long after their introduction is extremely important for improving the design of interventions and making them worthwhile. In the past many interventions have received only cursory assessment and this is an area that needs attention in future work (for discussion, see Steg & Vlek, 2009).

Notes on different strategies for overcoming habits

Given that intended behaviour is most likely performed when habit and intention are in concert (i.e., (1) in Table 2), forming low carbon habits (i.e., making routine behaviours low carbon) is key to reducing carbon emissions. This raises the question of what behaviour change interventions will prompt citizens to voluntarily abandon their old high carbon behavioural practices (*target* practices) and adopt new, more desirable low carbon behavioural practices (*alternative* practices). Depending on the extent to which the target practice is under habit control, different types of interventions are likely to be effective; Table 2 is reproduced here to aid in our discussion of these options.

Table 2 [reproduced from Part 2]: Behavioural outcomes under different conditions of context and intention

		Intention	
		Perform habitual behaviour	Perform new behaviour
Context where habit was acquired	Same	(1) <i>Habitual and intended behaviour</i>	(3) <i>Habitual behaviour</i>
	Different	(2) <i>Intended behaviour</i>	(4) <i>Intended behaviour</i>

Behaviour change interventions to create low carbon habits will deal with four possible scenarios:

- i. To encourage younger citizens who have not formed high carbon habits to form intentions to perform low carbon behaviours, and to make those behaviours habitual (e.g., Hargreaves, 2011). That is, to start in cell (1) of Table 2 and stay in cell (1).
- ii. To encourage citizens who do not have high carbon habits and have moved into a new context (e.g., new immigrants who moved from countries where low carbon behaviours are routinized) to form low carbon intentions and to make those behaviours habitual. That is, to start in cell (2) of Table 2 and move to cell (1).
- iii. To encourage people to form intentions to perform low carbon behaviours *when they change their context* (e.g., moving in to a new house, new rental property, new office building), and to make those behaviours habitual. This involves moving from cell (4) to cell (1) in Table 2.
- iv. To encourage people to change their habitual high carbon behaviours to low carbon behaviours in the same context, and make those new low carbon behaviours habitual. This case involves moving from cell (3) to cell (1) in Table 2.

Scenarios (i) to (iii) should be less difficult to achieve than scenario (iv). Still, scenario (iv) is not impossible.

One way is to make use of implementation intentions to combat undesirable old habits (e.g. “when I leave a room, I intend to perform the alternative behaviour of turning off the light”). Nevertheless, as we discussed above, this is not a panacea, and may be interfered with by others in the context. However, given the structural and social influence power of other actors in a context, it may be possible to have *collective* implementation intentions, so that all actors involved in the context share the same implementation intentions and reinforce them in the context in multiple ways (e.g., we all turn off the light when we leave a room, we all do so if we find others have forgotten to do so, and we all enforce others to do so).

Insights on behaviour change from social practice theory and a general selectionist approach to cultural dynamics

Social practice theory (and our developing perspective on behavioural practice)

Another way to foster a transition to low carbon habits is to encourage people to *change their context* because a focal target behavioural practice is often maintained by (a) social practice elements (competence, materials, and meaning), and (b) contextual behavioural practices, which constitute the context of the target practices. In terms of changing social practice elements, changing the practice sustaining elements such as technological and infrastructural resources even by a small amount. According to Reckwitz (2002), when the elements that sustain a behavioural practice change, people are faced with an ambiguous, indeterminate situation, which they will resolve with pragmatic innovation, seeking to adopt an adapted or new alternative behavioural practice. The analysis in Table 2 suggests that the performance of this alternative is likely under intentional control. Consistent with this, Neal et al. (2001) found that getting right-handed regular popcorn eaters to eat popcorn with their left hand was sufficient to reduce the habitual popcorn eating.

Examining technological transitions, Berkhout, Smith, and Stirling (2004) suggest that new practices are likely to emerge and stabilise around technology that creates new knowledge, is salient or easily searchable amongst users and suppliers of technology, creates positive externalities, and forms new markets. Shifts from one set of technological equipment and infrastructure to another may be intended or unintended and will be strongly influenced by the relative availability of resources to perform a new set of practices versus the status quo.

When it comes to changing contextual behavioural practices different approaches are likely necessary depending on the type of contextual behavioural practices (i.e., who carries them out). If they are personal, the actor him or herself needs

to be encouraged to modify the relevant contextual behavioural practices. In this case, trying to change the target behavioural practice is unlikely to be sufficient, but a broader motivational readiness needs to be targeted, so that the focal actor recognizes and works out necessary changes in contextual behavioural practices. If the contextual behavioural practices are social, interventions need to involve broader social networks that connect others and the focal actor of the target practice, so that the relevant others are also encouraged to modify their practices. Finally, if the contextual behavioural practices are institutional, they need to be approached via public sphere behavioural practices such as political action.

Changing any aspect of the context, however, amounts to disrupting the routine target behavioural practice, and its repercussions are difficult to predict, as shown by the spillover literature. Encouraging one environmental behavioural practice may generate positive or negative spillover effects, and the net gain in carbon emissions reduction may be hard to predict. Similarly, from a social practice perspective, Schatzki (2013) acknowledges the difficulty in predicting alternative practices that emerge in response to intervention to dissolve an existing practice.

In the field of social practice theory, Schatzki's (2013) recommendations for the encouragement of pro-environmental practices include (i) piloting alternative physical contexts and exploring how behavioural procedures emerge in relation to them, (ii) making it easier to experiment with alternative pro-environmental practices, and (iii) publicising examples of people and communities engaged in pro-environmental practices. More generally, the emergence, stabilisation, or dissolution of a behavioural practice requires a deeper understanding of the mechanisms by which variants of behavioural practices are generated, transmitted, and retained for future use. One of the necessary steps would be to identify the elements involved in behavioural practices, and the interconnectedness among relevant behavioural practices. Once the structure of social practices has been mapped, the question becomes whether it is possible to reconfigure behavioural practices or the links among them, so as to enhance the transmissibility and adaptiveness of those behavioural practices that are more in line with the desired end, in the present case, the reduction of carbon emissions in a community. As Shove (2010) suggests, the ultimate goal is to dismantle 'obesogenic environments' in modern society, which reinforce consumption practices, which are also sustained by time use and mobility practices (Dixon & Broom, 2007), and to install 'envirogenic' environments that configure pro-environmental behaviour as the uncontroversial default.

Cultural dynamics

The recommendations derived from social practice theory, and our ongoing integration of its concepts with the RAA, are also generally in line with a general selectionist approach to cultural dynamics. This approach also gives perspective on how such transitions can be self-organized, so that cultural transitions may voluntarily and spontaneously occur. Wilson, Hayes, Biglan, and Embry (2014) have suggested that the basic selectionist theoretical framework for cultural dynamics can be applied to intentional culture change, that is, attempts to "evolve" a more desirable culture by intentionally intervening into socio-cultural processes. Wilson, Ostrom, and Cox (2013) argued that Nobel Laureate Elinor Ostrom's (1990) core design principles for self-management of common pool resources describes an ideal environment in which a community can develop a set of adaptive behavioural practices. The core principles below have been reproduced from Wilson et al. (2013, p.22) with slight modifications by replacing "group" with "community":

- (1) *Clearly defined boundaries.* The identity of the community and the boundaries of the shared resource are clearly delineated.
- (2) *Proportional equivalence between benefits and costs.* Members of the community must negotiate a system that rewards members for their contributions. High status or other disproportionate benefits must be earned. Unfair inequality poisons collective efforts.
- (3) *Collective-choice arrangements.* Community members must be able to create at least some of their own rules and make their own decisions by consensus. People hate being told what to do but will work hard for community goals that they have agreed upon.
- (4) *Monitoring.* Managing a commons is inherently vulnerable to free-riding and active exploitation. Unless these undermining strategies can be detected at relatively low cost by norm-abiding members of the community, the tragedy of the commons will occur (i.e. it will be exploited and not replenished).
- (5) *Graduated sanctions.* Transgressions need not require heavy-handed punishment, at least initially. Often gossip or a gentle reminder is sufficient, but more severe forms of punishment must also be waiting in the wings for use when necessary.
- (6) *Conflict resolution mechanisms.* It must be possible to resolve conflicts quickly and in ways that are perceived as fair by members of the community.
- (7) *Minimal recognition of rights to organize.* Communities must have the authority to conduct their own affairs. Externally imposed rules are unlikely to be adapted to local circumstances and violate principle 3.

- (8) *For communities that are part of larger social systems, there must be appropriate coordination among relevant communities.* Every sphere of activity has an optimal scale. Large scale governance requires finding the optimal scale for each sphere of activity and appropriately coordinating the activities. A related concept is subsidiarity, which assigns governance tasks by default to the lowest jurisdiction, unless this is explicitly determined to be ineffective.

Specific recommendations to achieve a cultural shift towards low carbon living are difficult to make without research. However, these insights provide a structure for conceptualising and investigating the conditions necessary for behaviour change at a societal level.

Next steps

As we outlined at the end of Part 3, our project will involve the integration of psychological research with social practice theory and a general selectionist approach to cultural dynamics. This will involve further conceptual integration and synthesis, but empirical examination is also essential to ascertain what the current high carbon and alternative low carbon behavioural practices are, what elements are involved in those practices, and what interconnections exist among them as well as with other behavioural practices.

Conclusions

Having reviewed the literature, it is possible to draw some conclusions about how to proceed with further research on the promotion of low carbon behaviours, and of low carbon behavioural practices in particular. These are briefly discussed here as touchstones upon which further theoretical and empirical enquiry can be built.

First, past research supports the continued use of the RAA as a robust framework around which to plan low carbon-oriented research. The central concepts in the RAA (intention and behaviour) can give a useful starting point to further develop a theory of behavioural practices in conjunction with the concepts of habit and context. General considerations about whether behaviours targeted for change are under habit or intentional control can guide broad strategies for behaviour change.

Second, the RAA should be supplemented by a variety of other concepts, both psychological and practical. Part 2 reviewed many different types of psychological factors associated with low carbon attitudes, and while this provides a nuanced picture of human psychology, to study every single one of them at once would likely produce diminishing returns. Based on the priority of promoting specific low carbon behaviours at the household level, examining goals pitched at an appropriate level of abstraction (e.g., reduction of greenhouse emissions) is probably more fruitful than examining personal norms since all these concepts can be expected to overlap as general motivators of a range of low carbon behaviours, and goals can be more easily understood as context specific and subject to revision. However, researchers should also explore the relevance of environmental identities as expressed in the form of social identities and other forms. These can dramatically impact on the success of social influences strategies and provide some insight into both available social resources and relevant communities of practice.

Third, the social practice approach can extend the RAA by shedding light on the heterogeneous contexts in which behaviours take place, and to fruitfully analyse actual control. It highlights the importance of non-psychological factors and the close relationship that they have with the way people understand and interact with the world. Further, the social practice approach highlights that the full weight and functional importance of shared mental models (or cultural meaning more generally) must be understood when seeking to introduce new understandings and behaviours into everyday contexts. Finally, the social practice approach directs attention to the material and technological resources as well as interconnections among practices as potential determinants of positive and negative spillover. As a preliminary attempt to integrate the social practice approach into the RAA, we have proposed the concepts of behavioural practice, behavioural context, and material and technological infrastructure.

Fourth, a selectionist theory of cultural dynamics can provide a broad theoretical framework within which the emergence, establishment, and dissolution of behavioural practices can be understood. While acknowledging the difficulty of predicting and managing the emergence and establishment of desirable behavioural practices, it points to some general strategies for managing the process. They include an empirical examination of the interconnections among behavioural practices, experimentation with the cultural dynamics that generate variants of behavioural practices, and the construction of the environment in which desired behavioural practices may evolve. Research investigating how positive spillover (e.g. from work to household) can be consistently generated will be an important aspect of developing this framework.

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Appendix 1: Reviewed papers that use the Reasoned Action Approach to promote pro-environmental behaviours

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