
Book Section:
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How Design Influences Habits?

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Introduction

Habit is significant in the context of approaching sustainability, as many environmentally-relevant behaviours are habits which are recurrent, stable and persistent (Kurz et al., 2015). A better understanding of the process of habits formation and change is considered vital when designing interventions to change behaviour (Tang and Bhamra, 2008; 2012; Bhamra and Lilley, 2015; Darnton, et al., 2011).

Habitual aspects of the behaviour have been approached from two different academic disciplines: social psychology and sociology. From a social psychological perspective, habits are regarded as a driver of behaviours and a barrier to more sustainable alternatives, which intercede between intentions and behaviour and determine behavioural outcomes (Jackson, 2005). From a sociological perspective, habits are regarded as routine practices which consist of several interconnected elements enabling practices collectively shared across time and space in society. Levels of resource and energy consumption are the outcome of technical systems and routine practices arising from the on-going interactions between individuals and the structures of the social world (Shove, 2003). Psychologists posit that the individual is central to a rational decision-making and behaviour change, while sociologists decentralise the individuals, and put the practices themselves at the centre of the enquiry (Darnton *et al*., 2011).

Recognising the associations between behaviours and their negative environmental impacts, several attempts have been made in design to explore the feasibility and role that designers can play to influence sustainable decision-making, behaviours and lifestyles (Jelsma and Knot, 2002, Rodriguez and Boks, 2005; Ingram et al. 2007; Tang and Bhamra, 2008; Hielscher et al., 2009; Bhamra et al. 2011). Two nascent research fields of design have emerged and are concerned with the application of theories and models rooted in the social sciences to understand behaviours and habits and design products, services and systems that promote more sustainable consumption. One is 'Design for Sustainable Behaviour' (DfSB) that draws on social-psychological theories, a range of design strategies have been developed to evoke and steer the cognitive, behavioural or unconscious reaction to sustainability in the individual (Tang, 2010; Tang and Bhamra, 2012; Zachrisson and Boks 2012; Hanratty, 2015). The other approach, resting on the social practice theory, Practice-oriented Design focuses on the social and systemic nature of consumption, the accomplishment of everyday practices and the roles of conventions and conceptions

of normality in shaping interactions with technology towards more sustainable practices (Ingram et al., 2007; Hielscher, 2011; Scott et al. 2012; Kuijer, 2014; Kuijer and Bakker, C. 2015).

This chapter explores how design alters or interjects change in habits to encourage more sustainable consumption. It begins by introducing the role of habit in the context of approaching sustainability and two different conceptualisations of habit, coming from both social psychology and sociology. Then it outlines two sub-categories of design, Design for Sustainable Behaviour and Practice-oriented Design, which draw on the theories from psychology and sociology respectively for bringing about habit change resulting in environmental improvements. This is followed by a number of design opportunities, strategies and their application that elucidate the two theoretical propositions. Implications are finally drawn out for designers to address habits on multiple levels and create interventions that can bring about pro-environmental habits on multiple levels.

The importance of habit

Changing behaviour is thought to have a considerable environmental impact (IPCC, 2007; Kurz et al., 2015). For example, household energy use is responsible for 29% of the UK end-user carbon dioxide emissions (DECC, 2015) and consumer behaviours alone can affect household energy use by a factor of 2–3 in technically identical houses (Gill et al. 2010). Growing attention is paid to reducing the impact of consumer behaviours as a response to environmental problems (IPCC, 2007). Focusing on technology transfer, innovations deal with energy efficiency improvements and renewable energy technology. Focusing on individuals and attitudes, policymakers have favoured information-based campaigns to seeking the active participation of consumers in pro-environmental behaviour change. However, progress has been unsatisfactory so far. The "rebound effects", for example, offsets the beneficial effects of the technological improvements that result from the behavioural or other systemic responses (Druckman, et al., 2011), and the "value-action gap" (Blake, 1999) obstructs the translation from the pro-environmental intention of individuals into actual action that requires lifestyle change (Jackson, 2005). Although information-based campaigns are successful in raising people's awareness about environmental problems as well as their intentions to act environmental friendly, their actions do not reflect their concerns (Energy Saving Trust, 2006). Few interventions have successfully created the long-term behavioural shift needed for energy consumption reduction.

These failures are not surprising. Information-based interventions informed by "rational choice model" in psychological research have increased people's knowledge and intentions to act in environmental friendly ways but the rather linear model of persuasion has some significant limitations to bridging the intention - behaviour gap. One of many reasons for such a gap is that those who have developed strong habits are less likely to attend to new information (Jackson, 2005).

Much of the recent literature relating to environmental behaviour notes that many everyday behaviours are habits and carried out with very little conscious deliberation (Jackson, 2005; Steg and Vlek, 2009; Kurz et al., 2015). One empirical study in

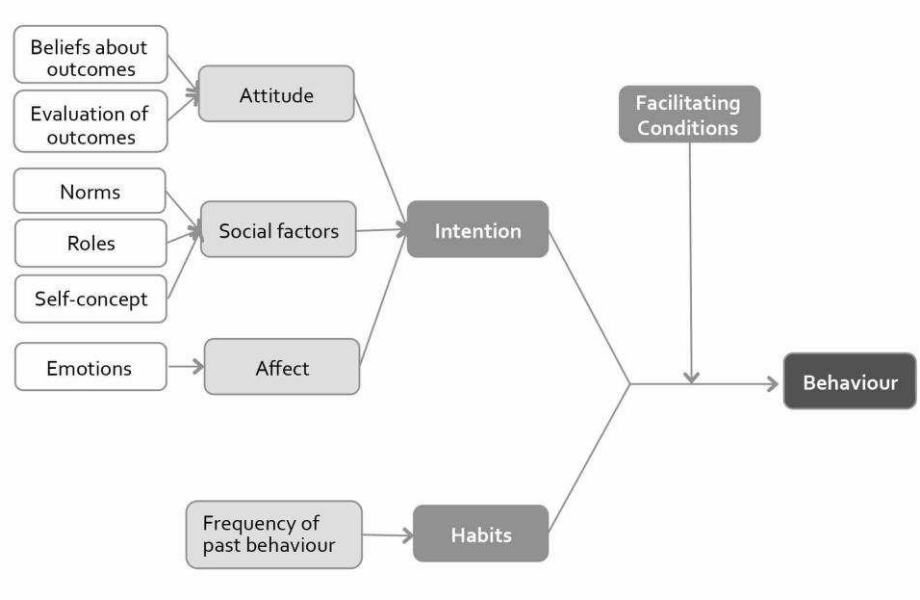
psychology estimates that 45% of respondents' daily behaviours are repeated at around the same time and in the same place (Wood et al., 2002). Research in neuroscience estimates that as much as 95% of our behaviours depend on deliberative and automatic thinking (Baumeister et al., 1998). Habit is significant in the context of approaching sustainability, as many environmentally-relevant behaviours are habitual in nature (Kurz et al., 2015). It is frequently repeated behaviours, e.g. how people interact with technologies to heat or cool their homes, cook their meals, wash their dishes and clothes, as well as entertain themselves and communicate with others that determine the actual impact on the environment, particularly domestic energy consumption (Steg and Vlek, 2009). Such behaviours ingrained in everyday life tend to be in competition with the rational aspect of behaviour, therefore, less ruled by interventions along rational lines (i.e. reliant on the provision of information and incentives) (Jackson, 2005; Darnton et al., 2011). To influence these behaviours effectively, it requires a better understanding of habitual behaviour, the processes of habit formation and change. Furthermore, rather than to consider either single technologies or behaviours in isolation (Jelsma, 2006), a holistic vision is required to bring together diverse technical, social and behavioural elements to facilitate the environmental improvements.

Understanding habit

This section introduces two different perspectives on habit, reflecting two different academic disciplines of social psychology and sociology. The purpose of this section is to offer a brief overview of these extensive debates and draw out some important implications for understanding and influencing the habitual behaviours.

Habit as a factor in behaviour

Within social psychology, habit is studied as an individual psychological construct. Triandis (1977) proposes an integrated model of Interpersonal Behaviour and features habit as a factor influencing behaviour. Given the fact that it includes habitual dimension of human behaviour, Theory of Interpersonal Behaviour (TIB) has been particularly widely applied in relation to Design for Sustainable Behaviour (discussed later in this chapter) (Tang 2010; Tang and Bhamra, 2012; Wilson, 2013). In this model, intention is an antecedent to behaviour, which is affected by attitudes, social factors and emotions. Habits, running parallel to intentions, play equally important role in determining end behaviour. The facilitating conditions moderate both the intention-behaviour and habit-behaviour relationships, which either enable or impede behaviour (Triandis, 1977). Although Triandis' Theory of Interpersonal Behaviour presents "dual processes" of behaviour that behaviour result either from intentions involving thoughtful deliberation or from habits based on the frequency of past behaviour, there has been little attention paid to the process of habit formation and change (Chatterton, 2011).



< INSERT Figure 1: Triandis' Theory of Interpersonal Behaviour (TIB)>

There is still no agreement upon how habits should be conceptualized and operationalized in social psychology, but there is a consensus that habits are formed through repetition (how often the action is repeated in a consistent context) and reinforcement (the strength and frequency of the positive reinforcement received) (Jackson, 2005). Firstly, a goal intention must already be in place and achieved (Gollwitzer, 1999). People must be "pre-motivated" to create habits (Darnton et al., 2011). Barbopoulos (2012) identifies why people are doing what they are doing based on the prioritisation of three goal frames (Lindenberg and Steg, 2007) and breaks the high level goals into seven related sub-goals (Barbopoulos, 2012; 2017) (Table 1). Lindenberg and Steg (2007) suggest that in the environmental context, normative goal frames imply acting pro-environmentally, while gain and hedonic goal frames often hinder the action in an environmentally sound manner. Therefore, pro-environmental behaviour may be stimulated by strengthening normative goals or by making gain and hedonic goals less incompatible with normative goals and behaviour change. Hanratty (2015) applies the Goal-framing Theory (GFT) as the theoretical basis for understanding behavioural motivation for reducing domestic energy use through digital media.

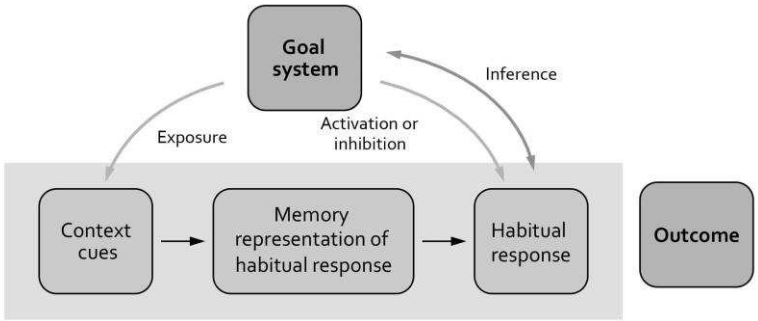
Goal Frame	**Sub Goal**	**Motive**
Gain	Value for money	To get value for money, pay a reasonable price, avoid wasting money
Gain	Quality	To get something of high quality and reliability, meeting one's highest expectations
Gain	Safety	To feel safe, calm and prepared for the unforeseen
Hedonic	Stimulation	To get something exciting, stimulating or unique, avoiding dullness

Hedonic	Convenience	To get something pleasant and comfortable, avoiding hassle and discomfort
Normative	Social Acceptance	Acceptance To make a good impression, identifying with peers, conforming to expectations
Normative	Ethics	To act according to moral principles and obligations, avoiding guilt

<INSERT Table 1: The three high-order goals in Goal-framing Theory and seven related sub-goals (GFT) (Barbopoulos, 2012; 2017)>

The satisfactory accomplishment of a goal reinforces subsequent performances of the same behaviour (Jackson, 2005; Schwanen et al., 2012). As behaviours are repeated in recurring contexts and strengthened through interval rewards, they then begin to proceed more efficiently with less thought. When people gradually learn associations between an action and a given context, the behavioural control transfers to cues in the context which triggers an automatic response: a habit (Lally et al., 2010). Once habits form, the perception of the context activates the associated response in memory (Wood and Rünger, 2016). Rewards for habit performance have, by this time, become relatively unimportant, although these may be important initially to promote the learning of context-response associations (Wood and Rünger, 2016). Habits are, therefore, measured by frequency of action (Triandis, 1977), but also by the cognitive processes that develop through frequency and association of the contextual cues and actions (Lalley et al., 2010; Steg and Vlek, 2009), as defined by Orbell and Verplanken (2010), habits are built on three pillars: repetition, automaticity and a stable context. Given an explicit goal that is incompatible with a habit, recent work from Wood and Rünger (2016) has identified three ways in which habits interface with goal to guide behaviour (Figure 2) through:

- repetition and exposure to a given context (illustrated by the arrows from goal system to context cues and habitual response);
- activation or inhibition of the habitual response, and
- inferences about the probable causes of habit responding (reflected by the double-headed arrow between habitual response and goal system).



<INSERT Figure 2: Schematic of three ways in which habits interface with deliberate goal pursuit (Wood and Rünger, 2016)>

As Jager (2003) pointed out, before the behaviour becomes habitual, it is influenced by the same factors that interact with the cognitive processes and contextual cues (Zachrisson Daae, 2014; Wood and Neal, in press). According to Prochaska et al., (1992)'s transtheoretical model (TTM), the creation of durable behaviour is assumed to go through five stages; precontemplation, contemplation, preparation, action, and maintenance. The TTM distinguishes between people who have not yet decided to change their behaviour, those who intend to, and those who are already changing and sustaining the behaviour. The rationale behind this model is that individuals at the same stage should face the same types of problems and barriers, and thus can be helped by the same type of interventions (Nisbet and Gick, 2008). Liking the stages to potential strategies, the TTM specifies ten processes how behaviour change might occur and be promoted by cognitive, affective, and behavioural strategies so that people might move through the stages (Prochaska et al., 1992). The TTM has been widely used in health intervention research, most recently in Design for Healthy Behaviour (Ludden and Hekkert, 2014) where a framework for stage-matched design interventions is proposed for healthy behaviour change, and people's water conservation behaviour (Sherrod, 1999, cited in Nisbet and Gick 2008), where the model accurately predicts people in stages of change related to water usage. Theory of acquisition of cognitive skills developed by Anderson (1982) echoes a similar sequence of stages in TTM, which have been integrated in Tang's (2010) Design behaviour intervention model (DBIM) for Design for Sustainable Behaviour.

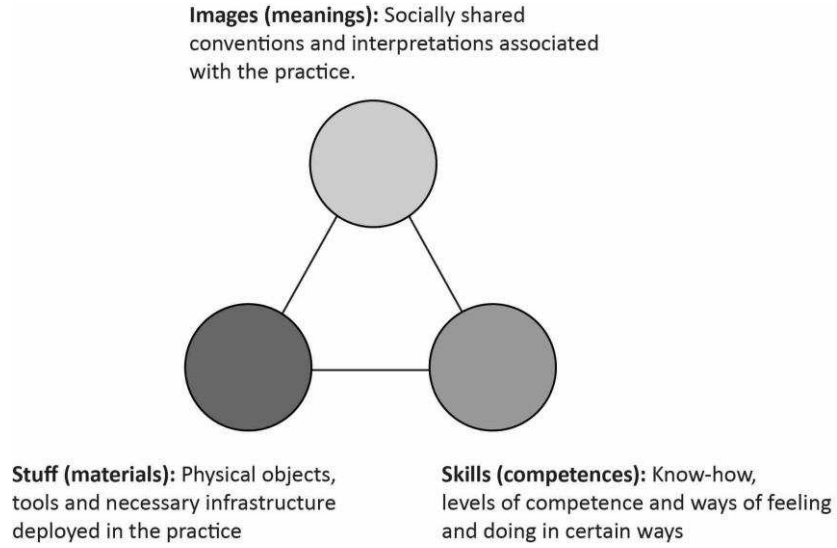
Lindenberg and Steg's (2007) Goal-framing Theory and Wood and Rünger's (2016) framework for Habit Formation augmented with Prochaska et al.'s (1992) transtheoretical model TTM will be the model of understanding taken forward within this Chapter. It allows designers to give weight to the motivation to change and the habit formation and change.

Habits as routine practices

Sociologists have developed an alternative theoretical account of what psychologists term habitual behaviour. Social practice theory as a school of thought with mostly sociological roots in the writings of Bourdieu (1977) and is increasingly influential in current thinking about human behaviour, particularly in the context of energy consumption, transport and waste. In this approach, habits are understood as ways of doing, routine practices, arising from the interactions between individuals and the structures of the social world. They are social and collective rather than individualised processes, organised around shared practical understanding that individuals carry. Therefore, habits are not the product of a series of factors (as it is understood in social psychology), but as routine practices, they are the emergent outcome of elements in the social world (Darnton et al., 2011). Practices are defined as 'a routinized type of behaviour which consists of several interconnected elements: "forms of bodily activities, forms of mental activities, 'things' and their use, a background knowledge in the form of understanding, know-how, states of emotion and motivational knowledge" (Reckwitz, 2002, p.249). The role of people is to be the carriers of practices that operate social practices (Reckwitz, 2002). The purpose of this approach is to understand social change by considering behaviours in regards to their material, social and cultural contexts (Piscicelli *et al*., 2015).

Instead of targeting individual behaviour, practice theory takes social practice as a unit of analysis for understanding consumption but also a unit of intervention for a greater reduction in consumption (Pettersen, 2015). The focus shifts from the individual to the practice itself, such as bathing, laundering and cooking. This leads away from intervening in decisions and contextual cueing of the habit towards reflecting upon what shape actions. Taking Shove et al.'s (2008) definition of practice, the units of doing are shaped through non-linear interconnected elements of materials, meanings and competences (Figure 3):

• Stuff (materials): Physical objects, tools and necessary infrastructure deployed in the practice.
• Images (meanings): Socially shared conventions and interpretations associated with the practice.
• Skills (competences): Know-how, levels of competence and ways of feeling and doing in certain ways.



<INSERST Figure 3: Shove's Three Element model>

The elements are dynamically related to each other and the dynamic interplay of the elements is continually reproduced, maintained, stabilized, challenged and eliminated through the reiterative performance (Warde, 2005). They commingle at a particular historical moment that allows particular activities to take hold as routine practices (Kurz et al., 2015). A practice can thus not be reduced to the elements. These three elements are not factors, determining behavioural outcomes, and the individual, in turn, is not the originator of the behaviour, but the carrier of the practice (Darnton, et al., 2011). Showering, for example, is more than piped hot water. Different elements must be integrated into the physical performances, and practice is considered as entity or nexus of activity, rather than as performance or the carrying out of a practice (Pettersen, 2015). To understand showering, a practice perspective would explore questions like: why daily showing has become a "necessity" for the most people in the UK, while historically personal hygiene routines typically involved a weekly bath (meaning: the importance of daily freshness to fit in with everyday society) how showering has been co-evolved with the provision of requisite material infrastructure and technology (staff); how it has been done and fits into the temporal organisation of daily life (skills: being able to run the boiler and get water to a desired temperature at

the right times).

The Three Elements Model also offers a diagnostic tool for mapping interdependency and interaction among practices. Practices may be closely related through sharing elements – e.g. meaning, stuff (Gram-Hanssen, 2011) and interact with each other in different ways: they may be complementary, or substitute other practices, or cluster together in complexes (Ropke, 2009). Networks of practices built on the connected and integrated elements can be identified at the level of "lifestyles" (Spaararen et al., 2006, in Scott et al., 2011). Intervening in habits as routines thus involves the reconfiguration of elements and links to a new configuration that works. The routinized, social, systemic but dynamic nature of practice does, however, open up new possibilities of designing behaviour change interventions, which in turn implies the need for holistic and collaborative approaches to the boundless consumption. Attempts have been made to investigate how practice theory can inform the design process to deal with sustainability issues in practice-oriented design, which is discussed later in the chapter.

Behaviour and Practice

Psychology and sociology offer two distinct accounts of environmentally (un)sustainable practices and implications for bringing about change. A psychological analysis of laundry would focus on the way in which an individual washes clothes, reasons to launder, the barriers and drivers for reducing the environmental impact of such a habit. The central challenge for changing habits as behaviours is that relapse occurs when old habits continue to be activated automatically by recurring environmental cues (Wood and Rünger, 2016). Interventions to mindfully breaking automatic engagement in laundry might alert individuals to the importance of water and detergent conservation or make it impossible to use the detergent more than necessary (e.g. designing package where only right amount pours out). By contrast, a practice perspective would focus on a mapping of the elements that comprise laundry practices in a particular time period, and the relations between these elements and other practices (e.g. washing clothes after a workout). Instead of aiming at the motivational factors driving behaviour and contextual cues triggering habitual responses, practice-based interventions would target at rearranging the technical systems and infrastructures (e.g. a washing machine, systems of hot water provision), practical skills and symbolic elements and their integration in laundry practices.

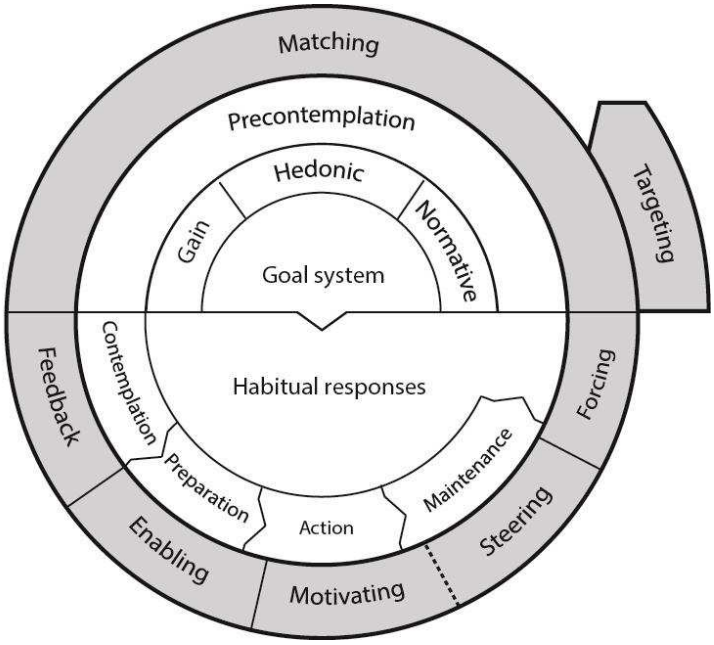
Implications for Design

This section firstly introduces design strategies aimed at changing habits drawn on social psychological models and illustrates these with examples of where they have been applied. Then it discusses the feasibility of design to foster absolute reductions by intervening in everyday practices and the conditions for the practice-based interventions.

Designing Habit-Based Interventions

Social psychological models have been predominantly applied in promoting more sustainable behaviour through design (Tang, 2010; Zachrisson Daae, 2015; Coskun et al., 2015). Design for Sustainable Behaviour (DfSB) is a field in sustainable design concerned with the application of behavioural theory to understand users, and behaviour changing strategies to design products, services and systems that encourage more sustainable use (Bhamra and Lilley, 2015). DfSB approaches take individual behaviour as the focal unit of analysis and intervention (Shove et al., 2008; Scott et al., 2012; Kuijer and Bakker, 2015). Drawn from Wood and Rünger's (2016) Framework for Habit Formation, Lindenberg and Steg's (2007) Goal-framing Theory (GFT) and Prochaska et al.,'s (1992) Transtheoretical Model (TTM). The following section presents a model for design for habit-based interventions.

As highlighted earlier, before a habit is formed, "behaviour change interventions encourage the formation of habits when people repeat an action sufficiently often in a stable context to form cognitive associations between context cues and the response" (Wood and Neal, in press, p5). As an evolution of Tang's (2010) work, a Design for Positive Habit Model (Figure 4), therefore, illustrates the factors that promote and impede habit formation and design strategies are highlighted to correspond to the stages in change for the purpose of encouraging habit change in the context of sustainable consumption. Steven categories of design strategies are outlined that change the environment around the person to disrupt the contextual cueing of the habit based on levels of motivational readiness along the process of change. Table 2 illustrates each design strategy with examples of where they have been applied.



<INSERT Figure 4: Design for Positive Habit Model>

Focusing on people without intention to change at the "precontemplation" stage in TTM, design strategies for goal matching respond to goal frames so as to leverage people's decision process and motivate people to expose themselves to performance contexts (Wood and Rünger, 2016). For the habits that are not necessarily promoted by goal-directed learning, five types of design strategies have been proposed with five

different design aims: feedback, enabling, motivating, steering and forcing. These strategies spreading over multiple stages in TTM might help to develop the interventions that address the problems and barriers faced by individuals at the same stage and influence movement at different stages. Finally, design strategies aimed at targeting moments of change support interventions that can capitalise on the specific discontinuity or habit triggers altered through a life change - such as moving house, changing job, having a child or retiring from work. These life events provide windows of opportunity in which to deliver interventions that eliminate (or increase) exposure to the cues that automatically trigger unsustainable (or sustainable) habit performance. There is increasing evidence that interventions delivered at these "moments of change" can be more effective than if delivered at another time, since people may be more able or willing to do things differently (Darnton et al., 2011; Wood and Neal, in press). Therefore, this type of intervention might not be dependent on individual's levels of pre-motivation.

<table>
<tr><th colspan="2">Matching</th></tr>
<tr><td colspan="2">Aim: responding to goal frames, to leverage people's decision process and encourage people to exercise a different choice in practice through reconsciousness raising or friction reducing for environmental behaviours</td></tr>
<tr><td>How it works:
1. Responding to normative goals that often imply pro-environmental actions, interventions make the value of action outcomes visible, understandable and accessible to provoke reflection and to act on a social or personal norm;
2. Responding to gain and hedonic goals that often hinder pro-environmental actions, interventions provide desired functionality with less impact on environment so as to remove the barriers that reduce discouragement caused by the in-built friction for environmental behaviours</td><td>Example:
The use of interactive online displays shows historic and current consumption data, with relevant environmental or social comparisons and facilitates a self-appraisal of energy consumption.
Heat Me, an interactive app, persuades people to turn down the thermostat to 18˚C over a period of time. By acknowledging the most prominent home heating behaviours - the desire for periodic "heat boosts", it makes relatively easy for users to raise the temperature (i.e. 21˚C) for limited periods (Hanratty, 2015).</td></tr>
<tr><th colspan="2">Feedback</th></tr>
<tr><td colspan="2">Aim: to inform people clearly about what they are doing and to facilitate consumers to make environmentally responsible decisions through offering real-time feedback</td></tr>
<tr><td>How it works:
Obtrusive feedback provides tangible aural, visual, or tactile signs as reminders to inform people of resource use</td><td>Example:
Fridge alarm detects when the door has been left open for more than 60 seconds and reacts by sounding an alarm that is impossible to ignore, and subsequently trigger the user to close the fridge.</td></tr>
</table>

Enabling	
Aim: to support people in making the right choices and taking responsibility of theirs actions through providing consumers with options	
How it works: People are empowered to make a choice and the product enables sustainable use to take place	**Example:** Domestic Energy Display makes it easier for people see what is wasting the energy without forcing the people (Design Council 2006).
Motivating	
Aim: to inspire people to explore more sustainable usages through providing rewards to "prompt" good behaviour	
How it works: Interventions show people the consequences of actions through a variable (financial, emotional, social, physical) reward	**Example:** Flower Lamp "blooms" as a reward – changing its shape when power consumption has been low for some time. To make the lamp more beautiful, a change in behaviour is needed (Interactive Institute, 2004)
Steering	
Aim: to facilitate users to adopt pro-environmental habits through the prescriptions and/or constraints of use embedded in the design	
How it works: Interventions contain affordances and constraints which encourage people to adopt sustainable habits or reform existing unsustainable habits.	**Example:** The AWARE Puzzle Switch is an on/off button that encourages people to switch off the light by playing with people's built-in desire for order (The AWARE project, 2007)
Forcing	
Aim: to make it harder or impossible for people to act on undesired behaviours by introducing friction to existing context or removing cue of the habit so as to prevent relapse in the change.	
How it works: Interventions add friction to undesired automated responses or removing cue of the habit	**Example:** A speed bump forces the people to drive slowly.
Targeting Moments of Change	
Aim: to improve effectiveness of the interventions by targeting events in the life course	

How it works:	Example:
Habit-based interventions are designed to coincide with key events and other transitions in life course	TravelSmart programm delivers personalised travel planning advice (an intensive intervention) to people who have recently moved into an area (Sustrans 2008).

<INSERT Table 2: Design strategies and examples>

The Design for Positive Habit Model suggests that the relative stages of habitual formation dictate the individual's motivational readiness for change and receptiveness to interventions. It provides a framework for the design of interventions based on individual differences in environmental intentions and readiness to adopt new behaviours, as well as strategies to facilitate change. For example, to encourage water conservation consumption, people's contemplating this practice may need to be reminded. Eco Showerdrop (McDonough and Braungart, 2002) facilitates keeping track of the water used during a shower and sets off an alarm to when more than recommended water is used. People in the action stage may need the water company that often gives a small rebate for a reduction in water consumption on a weekly basis as rewards until they become new habits in the maintenance stage.

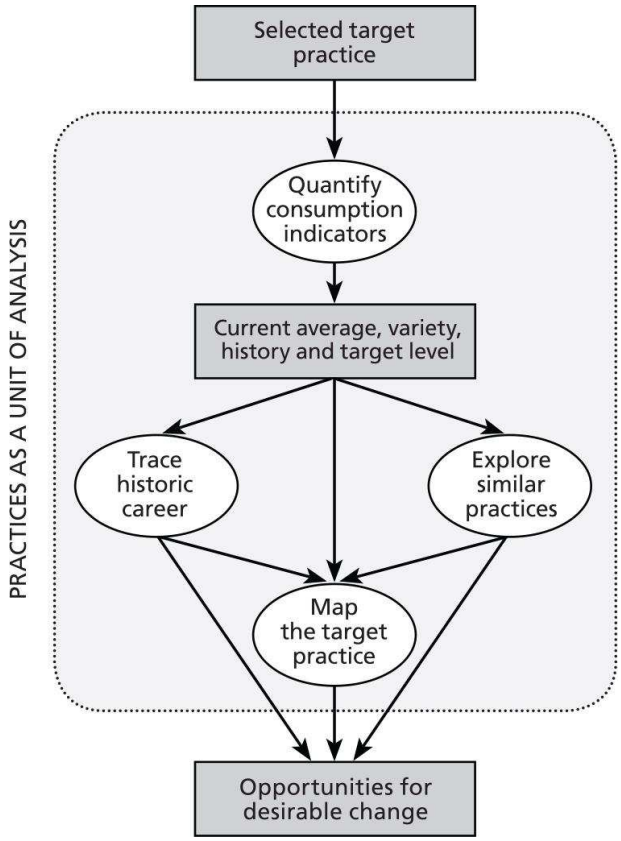
The behavioural theory provides heuristic frameworks for exploring and conceptualising human action, the underlying formation of habits as well as a theoretical basis for interventions. There is a growing body of work in sustainable design and an increasing number of DfSB case studies in the literature, such as, the design of fridge in Tang and Bharma (2008, 2012); washing machine in Lidman and Renström (2011); woodstove in Zachrisson Daae, (2014), which focus solely on individual change and conceptualising habit as a factor in behaviour. A range of strategies targeting individuals and their "rational" behaviour as the result of processes of cognitive deliberation, when tested more extensively, can be effective in promoting more pro-environmental behaviour, particularly focusing on the specific product, user type and moments in time. However, the effect on behavioural change may be only feasible for the short term (Lockton et al., 2008).

Practice-oriented Design

"Practice-oriented design" (Shove et al., 2008) is a relatively new area of research that emerged from the "Designing and Consuming: objects, practices and processes" research program in 2005 (kuijer, 2014). Drawing on the social practice theory as a potential way to inform the transition towards sustainable consumption, "practice-oriented design" takes the practice as a unit of analysis and design (Kuijer, 2014). Shove's Three Element model has been adopted as a tool to map practice, which has been dominating the recent investigations into how design processes can be informed by practice theory, such as the work of Scott (2008) and Kuijer (2014) on bathing.

The first step toward the intervention from a social practice perspective becomes a mapping of the elements that currently circulate to allow particular practices to successfully recruit their carriers. As Shove et al., (2008, p.5) suggest, the aim is to

understand the "trajectories and careers" of practices that vary in their level of resource intensity. Kuijer (2014) visualises the activities that are necessary to undertake for the practice mapping (Figure 5).



<INSERT Figure 5: Model for practices as a unit of analysis and intervention (circles represent activities, squares intermediate results) (Kuijer, 2014)>

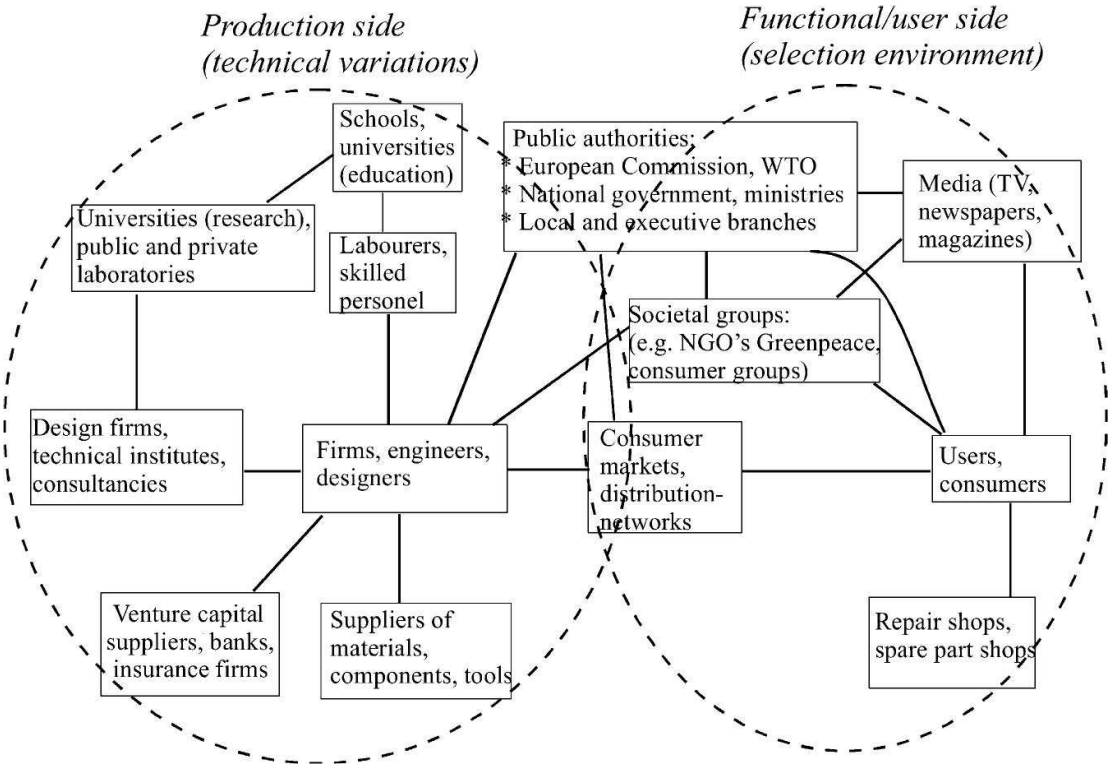
Placing a practice– what is actually done, at the centre of attention could help provide a richer understanding of some hidden issues that prevent effective implementation of interventions based on single products or users, highlighting the mutual dependencies and complex interactions in systems of ideas, skills, and objects that "lock-in" unsustainable behaviours (Chatterton, 2011). Using the Three Element model as a mapping tool in the early design development process allows framing problems in a more holistic and systemic manner. This method involves convening resources and skills from different sectors around the practices in question (Darnton et al., 2011) and the identification of connection to challenges present in the technology development context, for example, related to resources and lock-in to existing manufacturing sche mes (Pettersen, et al., 2013).

However, as noted by Pettersen (2013, p55), the practice theory is strong at conceptualising "the interplay between humans and technology and system level dynamics between practices", but not equipped with the tools and approaches for defining system boundaries which is needed for the assessment of "absolute" reductions (Pettersen, 2015, p255). Pettersen (2015) argues that the impact would not necessarily be measured at the level of practice. Due to the systemic nature of consumption, changes in one practice may influence other relevant practices areas

resulting in consumption shifting accordingly. It might, therefore, make more sense to look at changes at the level of households, than at the level of single practices. Drawing on practice theory and system innovation theory, Pettersen (2015) suggests using multi-level perspective (MLP) on sociotechnical change as a supplement to social practice theory that would help analyse the conditions for design activities in commercial firms to achieve actual reductions in resource consumption. The following sections outline these two perspectives in relation to design briefly.

Socio-technical system: the context for practice-oriented intervention

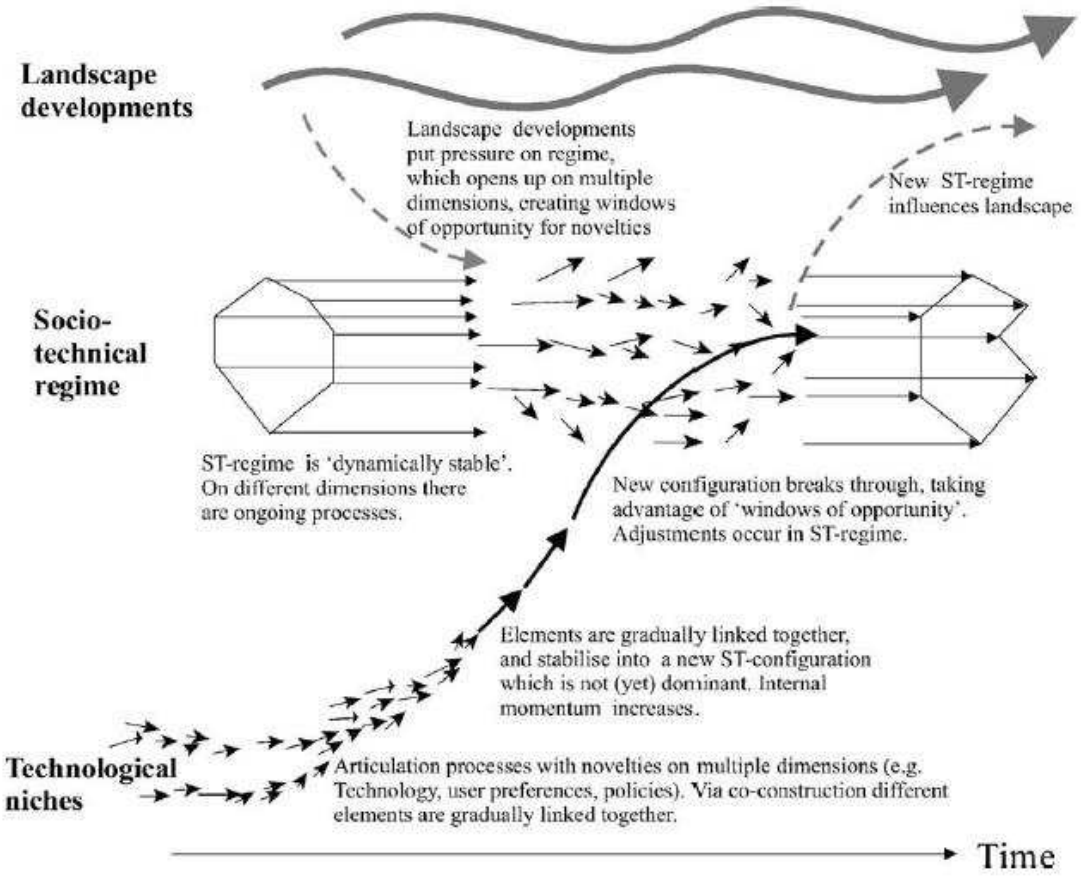
Socio-technical systems refer to deep-structural changes (Elzen *et al*., 2004), which include the wider context (e.g. firms and industries) and multiple social actors (e.g. policy makers, politicians, consumers, civil society, engineers and researchers) (Geels, 2011). Geels defines socio-technical system as "the linkages between elements necessary to fulfil societal functions" (Geels, 2004, p900), such as energy supply, transport or communication, and breaks them into sub-functions "production", "diffusion" and "use". The fulfilment of sub-functions requires necessary elements or resources and socio-technical systems thus consist of these elements, such as artefacts, knowledge, capital, labour and cultural meanings, etc. Figure 6 gives a schematic representation of social groups and their related recourses and functions, which carry and reproduce socio-technical systems.



<INSERT Figure 6: Social groups which carry and reproduce ST-systems (Geels, 2004, p.901)>

The ST-system presents the context that may enable and impede design actions (Pettersen, 2015). It is reconstructed and changed, as social actors work toward their

goals and follow the rules that might enable, guide, organise and even constrain their activities and interactions. The rules that may be cognitive, normative and regulative are linked together and organised into rule private or social systems (Greels, 2004). Interrelated rules would form rule-regimes. By recognising this, designers may produce or reproduce rules that are linked within and between regimes of policy, science, technology, user and market and sociocultural issues. This would offer designers a new perspective to understand and frame problems and identify new opportunities for creating a large scale change, which probably involves product requirements and regulations, but also the company's product portfolio management. From a systematic perspective, portfolio management covers product strategy, portfolio management process, portfolio methods and models. However, there might remain a challenge for prioritising new kinds of ideas and concepts. Pettersen (2015) suggests that the multi-level perspective (MLP) (Geels, 2004; Geels, 2011) that appears to play a decisive role in helping to overcome this. MLP explains the potential effects of introducing innovation at different levels of structuration: how the innovation, established practices and society would co-evolve. The multi-level model consists of three levels: technological niches, socio-technical regime and landscape developments. Figure 7 presents a dynamic multi-level perspective on system innovations.



<INSERT Figure 7: Multiple levels of a nested hierarchy (Geels, 2004, p.915)>

The levels of niches and landscape are defined in relation to the regime level. The niche level refers to "practices or technologies that deviate substantially from the existing regime" (Geels, 2011, p.26-27). Niches provide spaces for experimentation

and learning in the form of small market niches where users have special demands or the form of technological niches which are often played out as experimental projects in R&D labs (Geels, 2004; 2011). Examples given of such niches include grassroots initiatives for collaborative consumption and smart city demonstration arenas. Niche actors hope that their novelties are used in the regime or even replace it, although this may not be easy because the existing regime is stabilised by many locked-in mechanisms.

The landscape is the most stable level. It is beyond the reach of single actors, and cannot be changed at will (Greels, 2004). The landscape refers to the wider exogenous environment that influences niches and regime dynamics, such as "demographical trends, political ideologies, societal values, and macro-economic patterns" which influences niches and regime dynamics (Geels, 2011, p.28).

The regime level is generally stable and coordinates the activities of social groups (Geels, 2011). It includes "cognitive routines and shared beliefs, capabilities and competences, lifestyles and user practices, favourable institutional arrangements and regulations and legally binding contracts" (Geels, 2011, p.27). Small changes accumulate, creating stable trajectories along the dimensions of technology, culture, policy, science, market, user preferences and cultural meaning. These co-evolve and have their own dynamics. The actors make moves within and between social groups, reacting to each other's actions, with changes in the sociotechnical systems as a result (Geels, 2004). Take an example of socio-technical laundering system from Pettersen et al.'s (2013), to reduce water consumption, washing machine manufacturers may make products more efficient, textile manufacturers may develop materials that are solid enough to tolerate frequent washing cycle, policy-makers may launch gradually stricter regulations for the other actors. In the process of transition, one regime can be replaced by another (Geels, 2011), where major changes occur in the ways that societal functions are achieved (Pettersen, 2015). This may result from niche innovations, such as waterless washing machine (Xeros, n.d.) and associated infrastructures and practices that gain momentum; or from landscape changes, such as climate change that creates pressure on the regime and destabilisation of the regime to offer windows of opportunity for niche innovations (Geels, 2004).

The multi-level perspective can be particularly helpful for the understanding processes of societal co-evolution, transitional processes, and identifying hinders and opportunities for change. Although changes in habits as routine practices do not necessarily involve societal transitions and regime replacements, the space for creating such change can be constrained by reigning regimes (Hargreaves et al., 2013). The development of interventions tackling practices involves the rearrangement of the parts, the rules and resources made up the practice, which may be impeded by current systems and provisions. To capture such issues, Pettersen (2015) proposes using the strengths of practice theory and theories on system innovation and the MLP for studies of the potential role and feasibility of practice-oriented design in fostering absolute reductions. More specifically, practice theory is used to (1) understand the characteristics and development of the practice, enabler and hinders of change, and (2) identify design directions for fostering absolute reductions. The MLP is then used to (1) characterise the situation and identify resistance and inertia against and windows of opportunity for change in the direction of absolute reductions, and (2) assess the feasibility of the design directions and interventions

proposed.

Feasibility of design directions for changing practices and fostering absolute reductions

Design directions for reducing the resource intensity of practices could be divided into three groups: regime compliant interventions; stretch interventions; and interventions unlikely to be implemented in the current regime (Pettersen, 2015).

Most of the regime compliant interventions are incremental innovations which do not necessarily lead to actual reductions in resource consumption. Business favours product centric interventions in pursuit of resource efficiency. It could be enhanced with traditional ecodesign approaches and tools that improve the resource and energy efficiency throughout the complete life cycle of the product, e.g. low-impact material selection, product lifetime extension (van Hemel and Cramer, 2002). To make up for the limitation of ecodesign (e.g. rebound effects, lack of consumer demand), practice-oriented design involves the explorations of the possible practice elements, such as, interventions (e.g. products, resources, space) may be developed to disrupt and (re)establish routines and social conventions that work, and foster collaborative action to join in the experimentation and learning (e.g. Scott et al., 2012; Kuijer et al., 2013). This would start with using the Three Elements model to map the parts, the rules and resources which make up the habit as routine practices, their relations to other practices, and finally the careers of practitioners and the trajectories of practices (Shove et al., 2012). The investigation into the practice performances in the past or other cultural contexts, and the variation between different social groups may also inspire the development of the interventions (e.g. Kuijer and de Jong, 2012).

Stretch interventions may move away from the product centric improvement and redesign into holistic approaches of function innovation in the Brezet's (1998) four stages in ecodesign (Stage 1 Product improvement; Stage 2 Product redesign or eco-redesign; Stage 3 Function innovation or alternative function fulfilment; and Stage 4 Sustainable systems innovation). This would involve reconsidering firm business models, and embracing the opportunity of service based business models building on work in the product-service systems (PSS) field (Roy, 2000). Major changes in consumer lifestyle and infrastructure are needed. The implications may go beyond individual companies or a cluster of companies, as switches to servicing to actually reduce the resource intensity of practices may require infrastructural change and initiatives from other stakeholders. This increased challenge includes investments, supplier chain, consumer acceptance or infrastructure that might not yet be in place. One possible way to do this to further develop product-service systems in practice theory (Piscicelli et al., 2014; Pettersen, 2015). Pettersen (2015) suggests the focus of the practice theory on the co-dependence of ostensibly unrelated practices opens up alternatives for service level interventions. It would redefine of service quality and establish less resource intensive conventions. Practice-oriented design could contribute with insights on sociomaterial dynamics and draws together resources and skills from different social groups around practices in which there are common interests, essentially, using practice change as a means of joining up within and across sectors (Darnton et al., 2011). Once alternative solutions have been generated, further efforts are required from distribution and sales to develop them into marketable

propositions. The distribution and sales related opportunities may include transferring practical skills transfer, providing people with access to the products before the purchase, and reconfiguring the social meaning of new products and 'doings' through, for example, marketing campaign, networking and partnerships building (Pettersen, 2015).

Given that the fact an alternative solution might fall the realm of the design, business and related regime actors, some more radical interventions might be hard to achieve in the current regime. For example, manufacturers operating on commercial grounds cannot be expected to go for options that break with shared values and beliefs or to stop catering to what are taken to be desired service levels given established performance evaluation criteria.

Conclusion

This chapter has explored two different conceptualisations of habit, coming from social psychology and sociology that offer useful intervention design insights. It has focused on design opportunities to alter or interject change in habits to facilitate the envisaged significant environmental improvements.

A social psychology approach to habit provides heuristic frameworks for exploring and conceptualising individualistic, social and psychological structures, various behavioural drivers which inform users' actions at different stages of change. Integrating different behavioural psychology models into the habit-based intervention design allows identifying and analysing the various factors influencing the interaction between users and products in given contexts. Grounded in the psychological principle of breaking habits through disruption, a range of strategies have been proposed, and can be effective in promoting behaviour change with a potential to develop into pro-environmental habits.

In contrast, social practice theory, an emerging branch of sociology, considers practices to be connected in systems and does not focus on specific interaction at a specific product-user level. Instead of targeting individuals' motivations, practice theory calls for the rearranging of the materials, skills and meanings which hold the habit as routine together. Using practice theory and system innovation theory together provides a possibility to capture the dynamics of social practice and opportunities for design interventions that foster absolute reductions. Sociotechnical systems and the multi-level perspective (MLP) have been introduced to supplement practice theory that help analyse the conditions for design activities in commercial firms to bring about systemic change in resource consumption.

The sociological critique is that the impact of the psychological approach to habit is limited to incremental environmental improvements. Practice theory from sociology gives a potential to make more fundamental changes and absolute reduction in resource use. This is an on-going debate that approaches resulting in more radical innovations may, however, conflict with how the business currently operates. Both design for habit change and practice-oriented design are, however, still a relatively underdeveloped research area and further work needs to be carried out with a real test and generate its own materials, approaches and procedural contexts

and understandings for future sustainable interactions. To solve the environmental challenges, both the improvements are needed: incremental innovations that can easily be implemented immediately; and the radical innovations that would be aided by the multi-level perspective on sociotechnical change. Both psychology and sociology have relevant and interesting perspectives that can be applied into design process and contribute to the transition to sustainability. It would also be beneficial for future designers to comprehend these two dominating perspectives and the complexity in habit, and thus potentials in designing habit-based interventions.

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