Design, behaviour change, and the Design with Intent toolkit

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Abstract
Design for behaviour change involves a multidisciplinary perspective, drawing on insights around human action from multiple fields, and making them relevant to designers. This chapter explores some considerations which build on these multi- and cross-disciplinary concepts, and introduces the *Design with Intent* toolkit, a design pattern collection which aims to facilitate exploration of problem-solution spaces in 'behaviour change' contexts, with a brief case study of its application in idea generation in an educational setting. The chapter concludes with a discussion of models and assumptions in design and behaviour, and the need for further consideration of and reflection on these assumptions.

Keywords
design, behaviour, patterns, models, change

Introduction

What has become known as 'design for behaviour change' has grown significantly as a field of research in recent years (e.g. Lilley, 2009; Wever, 2012; Daae & Boks, 2014; Niedderer et al, 2014; Strömberg et al, 2015). The field aims, generally, to propose and evaluate design, which affects the social or environmental impacts of products, services and environments in use, through attempting to *understand* and *influence* user behaviour—perhaps as part of what Suchman (2011, p.15) calls "the rise of professional design as a dominant figure of transformative change." The degree of intervention varies with the boundary of how the 'problem' is considered, whether it is at the level of individual interaction with products, or part of a more systemic societal transition (Irwin et al, 2015).

Design for behaviour change must inherently involve a multidisciplinary approach, drawing on knowledge and models from other fields relating to human action. These include social, cognitive and ecological psychology, decision research, behavioural economics, human-computer interaction (HCI), ethnography, science and technology studies, cognitive anthropology, ergonomics, cybernetics, ethics, and architecture, as well as intersecting areas of design which focus on human experience and action, such as social implication design (Tromp and Hekkert 2014), persuasive technology (Fogg, 2009), social practice-oriented design (Kuijer et al, 2013; Scott et al, 2012; Pettersen, 2015), product experience (Desmet & Hekkert, 2007) and transformational products (Hassenzahl & Laschke, 2014). In this context, designed 'interventions' largely involve the redesign of products, services and environments, changing the *affordances* and *constraints* available to users, or the design of interfaces (often digital) which give users *information* and *feedback* on the use or the impact of people's actions, for example energy use, waste generation or transportation choices (Lockton et al, 2008).

Understanding how designers' decisions affect people's actions, and what—if anything—to do about them, is central to much of the recent discussions in fields such as architecture (e.g. Watson et al, 2015), service design (e.g. Bisset and Lockton, 2010; Mager, 2010) and interaction design (e.g. Blevis,

2007). This entry of designers into the ‘behaviour business’, as Fabricant (2009) has called it, accords with Herbert Simon’s assertion that “everyone designs who devises courses of action aimed at changing existing situations into preferred ones” (Simon, 1981) and, as Fry (2015) notes, “almost everything in the environment around us is designed”—and everything that is designed affects what people do.

Some relevant cross-disciplinary considerations

As noted, the scope of how design can be applied to change behaviour is broad and extremely multidisciplinary. Many fields, in both research and practice, both within and without what are termed the ‘behavioural sciences’, have insights or frameworks to contribute, and each works with particular *models* seeking to explain human behaviour in different ways—even if those models are sometimes mutually incompatible (Gintis 2007). For example, Darnton (2008), outlines 60 social-psychological and economic models of behaviour, and discusses their policy implications, without considering any arising from design and human factors research or even from ecological psychology.

There are some useful cross-domain, cross-disciplinary concepts, which can help frame and structure the discussion. None is the single ‘right’ way to think about things, but each offers something in terms of understanding how to integrate insights from different fields.

Enabling, motivating or constraining

At the level of individual behaviour, most approaches are either about trying to get people *to do* something, or trying to get people *not to do* something. Most possible ways to do that are either about changing how *easy* or *difficult* it is to do something, or about getting people to *want* to do (or not to do) something. This is a primitive classification, and probably not complete. But as a simple way of categorising design strategies, considering *enabling*, *motivating* and *constraining* approaches offers a quick way to assess (and question) any design brief and the relevant strategies. The overall approach within a project may, of course, be dictated by the client or other stakeholders rather than being the designer’s decision, but understanding whether the brief is about

- **enabling:** making the ‘target’ behaviour easier for a user to do
- **motivating:** trying to get users to want to perform or not perform a particular behaviour, or
- **constraining:** making an undesired behaviour harder to do

can be a useful first step. *Central route persuasion* (Petty and Cacioppo, 1981) along with much work in persuasive technology is about *motivating* behaviour, with attitude change being either a precursor or a result, although Fogg’s *reduction* and *tunnelling* (Fogg 2003) are arguably also *enabling* particular behaviours by making them simpler. Strategies aimed at influencing health and safety behaviour often employ a *constraining* approach.

A designer could potentially consider tackling any target behaviour through each of the three approaches—making it easier to do it (enabling), motivating users to do it, or constraining users so they have to do it. It is also relatively easy to apply the enabling / motivating / constraining distinction in reverse, i.e. looking at an existing example of design and assessing what the approach might have been.

The distinction between affordances, information flows and constraints (see 'Systems, affordances, constraints and information flows' below) maps quite well onto the enabling, motivating and constraining classifications respectively. In this context, it is important to distinguish between the *means* (the design strategies themselves) and the intended *ends* (the intended effects of the design on behaviour), because people do not always act as designers intend them to. A further consideration concerns how well the simplistic enabling / motivating / constraining framework applies to more complex systemic issues which are not simply about influencing individual actions. It raises the question whether the framework can take account of the messiness of transactional or game-theoretic situations in which enabling one person's actions constrains those of others, or wicked problems (Rittel & Webber 1973; Buchanan 1992) in which focusing on a single target behaviour may simply transform the problem into something else. What may seem a simple division into enabling, motivating and constraining, is somewhat less satisfactory when applied to the realities of complex situations.

Decisions, attitudes and practices

Much human behaviour can be seen as decision-making, conscious or otherwise, and so understanding and influencing those decision-making processes is often the focus in work on behaviour change. This is most evident at present in the dominance of models from behavioural economics in the work of policy bodies such as the Behavioural Insights Team (Haynes et al 2012), who apply theories such as Kahneman and Tversky's (1979) *prospect theory* and have a general focus on correcting 'cognitive biases' (Tverksy and Kahneman, 1974; Thaler and Sunstein, 2008). As Plous (1993, p.xv) notes, "more research has been published on failures in decision making than on successes". Decision-making research is often about deviations from what is assumed to be rational choice, whether these are framed as shortcomings in human reasoning, or as practically adaptive strategies (Todd et al 2012) from which designers or policy makers can learn.

This current dominance of behavioural economics has—at least politically—partly supplanted a previous focus on *changing attitudes and beliefs* as a precursor to behaviour change, exemplified by models such as Ajzen's (1985) 'Theory of Planned Behaviour'. As Stern (2000) and Guagnano et al (1995) showed in relation to recycling behaviour, contextual factors, often related to the built environment (such as the lack of presence of kerbside recycling bins) will often trump even deeply held 'pro-environment' attitudes in terms of influencing actual behaviour. This is certainly not to decry the value and potential of increasing thoughtfulness (Grist, 2010; John et al, 2011) through the design of products, services and environments, but simply highlighting that *contextual factors*—something with which designers are already very familiar—play an important role in affecting decision-making and hence behaviour.

Even where spatial or other contextual factors are included, most common current models primarily focus on *individual* decision-making, lacking consideration of the *social* or supra-individual aspects of decisions, and the evolving social practices which affect how people interact with their environment (Kuijer and de Jong, 2011; Shove, 2010; Wilhite, 2013). Hazas et al (2012), specifically talking about 'design for sustainable behaviour' feedback interventions in the home, criticise the dominant models of individuals making "constant and active choices" about their behaviour around energy and resource use, without taking sufficient account of the contexts of everyday life, social and time commitments, and negotiating priorities within a family or household. A similar argument can be made about behaviours at work, and indeed in domains such as health, wellbeing, performance and productivity.

Classification, context and cognition

There are many cross-disciplinary ways in which insights on behaviour, and practically applicable strategies and tools for influencing it, can be categorised or classified, ranging from spectrums of *power* or *control* (e.g. Jelsma, 2006; Nuffield Council on Bioethics, 2007; Wever et al, 2008; Lilley, 2007; Zachrisson & Boks, 2012), to more nuanced multidimensional 'field' or 'wheel' approaches (e.g. Tromp et al, 2011; Michie et al, 2011; Chatterton & Wilson, 2013).

One broad distinction in terms of strategies and tools drawn from other disciplines is between those which address primarily *cognition*, and those which address the *context* itself (Clark, 2009)—a division which Simon (1990) illustrated through the metaphor of a pair of scissors. Both 'blades' shape behaviour, but often a model or technique will concentrate on either cognition (mind) or context (environment). For example, to attempt to influence staff to take more exercise at work, a 'cognition' approach might focus on campaigns to increase mindfulness around health, or persuading staff that exercise was a good thing to do, while a 'context' approach might look at changing the environment (built, corporate and social) itself, through making exercise easier, building more walking into daily activities, and so on.

Simon's scissors recall 'Lewin's equation' (1935)—$B = f(P, E)$—a person's behaviour (B) is a function of his or her own personality (or other 'internal' factors, P) and environment (physical and social, E). This may appear obvious, but it highlights one of the major divisions in psychological approaches to behaviour, between those which focus on the 'person' and those which focus on the 'environment' (however defined) or the situation (Ross & Nisbett, 1992).

Design strategies aiming to influence behaviour can be grouped or assessed according to whether they primarily address the person or the environment, although in practice, design approaches, particularly those drawing on human factors research (e.g. Stanton et al, 2013) or taking a sociotechnical systems-level perspective, often *combine* contextual and cognitive considerations.

Systems, affordances, constraints and information flows

In common with many areas of interaction design, design for behaviour change may benefit from the application of a 'systems' perspective to understand better the potentially complex interplay between technology and human behaviour. One relevant systems perspective is Donella Meadows' concept of 'leverage points', intended to be generally applicable to complex, non-linear systems. As presented in Meadows (1999, 2009), these are a list of 'places to intervene in a system', ranked in tentative increasing order of effectiveness. Humans are part of the system just as much as technology and political structures. Hence there is no single leverage point dealing with 'human behaviour'. Rather, human decisions, abilities and reactions can be inherent to each of the leverage points, and designers (if they have the opportunity) can address any of the leverage points. However, it is apparent that many designed interventions which specifically aim to influence user behaviour are concentrated on Meadows' leverage points 6, 5 and 4:

- the structure of information flows
- the rules of the system
- the power to add, change, evolve or self-organise system structure

These are aspects which designers are especially well-placed to tackle through changes to the design of everyday products, services and environments.

Information flows mainly comprise different kinds of feedback and presentations of antecedent information (*feedforward*: Djajadiningrat et al, 2002). The *rules of the system* can perhaps best be framed from a design perspective as being about designing in actual *affordances* and *constraints* (Gibson, 1979; Norman, 1988; Shingo, 1986) on behaviour (and perhaps also rules for 'reward' and 'punishment'). The power to add, change, evolve, or self-organise system structure could be seen as related to the design of *adaptive systems*, i.e. systems which can perhaps adapt the information flows and affordances or constraints present, based on users' behaviour and the performance or context of the system's use.

The practical 'design for behaviour change' use of these leverage points is often a combination of one or more of them. Therefore, these categories are not a mutually exclusive definition of possible strategies for intervention, but a way of framing some possible leverage points. For example, Lockton et al (2009) have linked themes around classification of affordances in design with the concept of *choice architecture* in behavioural economics (Thaler & Sunstein, 2008), highlighting the parallels between fields as part of the development of a design pattern approach (see 'Patterns and toolkits' below).

Mental models: ignore, work with or shift?

A key concept in design for behaviour change is the notion of *mental models* (Gentner & Stevens, 1983. There are different ways of defining and representing the term (Jones et al 2011; Moray 1996), but one definition commonly used in human-computer interaction is described broadly by Carroll et al (1987, p.6) as: "knowledge of how the system works, what its components are, how they are related, what the internal processes are, and how they affect the components". Users' mental models thus allow them "not only to construct actions for novel tasks but also to explain why a particular action produces the results it does" (p.6).

The idea is that understanding user behaviour in context, as part of a design process, can (or should) involve investigating users' own understanding and mental models of the systems with which they are interacting; as Krippendorff (2007) puts it, "designers who intend to design something that has the potential of being meaningful to others need to understand how others conceptualise their world". In the context of design for behaviour change, mental models could be important if a user's current model leads him or her to behave or interact with a system in a way which is undesirable, dangerous, inefficient or otherwise deemed deserving of a design 'intervention'.

The aim of a designer seeking to change behaviour via mental models would usually be to *shift* the user's mental model (if incorrect) to a more accurate one, perhaps by making the 'system model' evident (an aim of *ecological interface design*: Burns and Hajdukiewicz, 2004), via a series of analogical steps bridging the two models (Clement, 1991), or by increasing the repertoire of models available to users—as Papert (1980, p.xix) put it, "[learning] anything is easy if you can assimilate it to your collection of models". Alternatively, an aim could be to redesign a system so that it appears to work, or actually does work, in the way that the user assumes, *working with* his or her existing model even if incorrect (and thus turning it into the 'correct' model). In both cases, the effectiveness of the approach could be examined by measuring behaviour changes that have occurred as a result of intervention.

Both approaches require investigating users' current mental models of the systems they use. Within design research and in human factors, methods such as interviews, verbal protocol analyses, structured tasks (e.g. Payne, 1991), eye-tracking, cultural probes (Gaver et al, 1999), ethnography and shadowing can all help reveal aspects of people's understandings and internal representations of situations, via examining and mapping interaction behaviour, routines, shifts in focus or even the errors people make. For example, in a design for behaviour change context, Terzioğlu et al (2015) used cultural probes to explore and understand factors involved in consumers' actions around repairing broken household objects, as a precursor to designing interventions. However, even with an extensive palette of methods, the fundamental difficulty that mental models (and aspects of understanding more generally) are "not available for direct inspection or measurement" (Jones et al, 2011) remains.

Finally, we might consider situations where outright *ignoring* users' mental models—while still trying to influence behaviour—is an appropriate design approach. The most obvious ones are related to safety, where the designer is interested in a particular 'safe' behavioural outcome regardless of whether users' understanding is 'correct' or not.

Patterns and toolkits

It is important to recognise when exploring this area from a pragmatic design perspective that there is no accepted unified model of human behaviour. There are no 'look-up tables' for behaviour change, although theory and practice on behaviour-influencing design have been developed enough in particular specialist domains to allow the production of 'how-to' guides (e.g. Grout, 2007 in medical design, Armstrong, 2010 in advertising, and Crowe, 2000 in architectural design against crime), or in-depth disciplinary treatments such as Michie et al (2014) in health behaviour change. A whole range of guides have emerged around behaviour change online and in digital contexts (e.g. Wendel, 2013; Nodder, 2013; Eyal & Hoover, 2013).

However, negotiating the large field of possible design strategies from different disciplinary backgrounds and traditions—and their appropriateness for different situations—can be a challenge for designers briefed with 'changing behaviour' in a particular context. Quite apart from the implied determinism in any 'how to' process, the ability to question and reframe the assumptions inherent in a brief, as part of a problem-framing (Dorst 2015) or even problem-worrying (Anderson 1966) approach, potentially requires the designer to have a much greater awareness of the problem-solution space (Maher et al, 1996). This includes both deeper contextual enquiry, through researching the situation in the field, and a knowledge of the repertoire of design approaches which might be applicable (Lawson 2004). A number of toolkits and guides have been developed (e.g. Selvefors et al, 2014; Daae & Boks, 2014) which aim to provide designers with a more structured process for exploring these questions.

The design pattern format

One approach, taken by the author with the *Design with Intent toolkit* (Lockton et al, 2010; Lockton et al, 2013), is to provide an 'inspiration' guide for brainstorming, exploring problem-solution spaces and classifying existing ideas, drawing on examples and insights from different disciplines, and using a *design pattern* format.

A variety of 'creative thinking' techniques are commonly used to generate novel ideas as part of problem-framing and -solving processes, often in group-workshops, but also individually. Card-form tools such as IDEO's *Method Cards* (2003) often address this phase of the design process, either

through acting as ‘ideation decks’ (Golembewski, 2010) or by suggesting appropriate design research methods or approaches to help frame the problem better. A format widely used in human–computer interaction (HCI), primarily in interface and web design, is that of the design pattern, which describes a form of presenting a situation, and/or possible solutions, in a structured way. The form, via adoption in software engineering in the late 1980s, stems ultimately from architecture: Alexander et al’s (1977) *A Pattern Language*, which covers the design and layout of buildings, towns and communities. Patterns are essentially recurring problem-solution instances, described in a referenceable way which enables practitioners to recognize the situation. The pattern form can help a designer recognize that a ‘new’ problem situation is similar or analogous to one encountered previously elsewhere, even in a different context. This makes them a useful format for cross-disciplinary transfer.

Design with Intent

Figure 1. Design com Intento*, a Brazilian Portuguese translation of the toolkit by Luis Oliveira. A Czech translation by Jan Laky is also available.*

Using elements of the pattern form, *Design with Intent* (Figure 1) aims to help designers and other stakeholders explore the space of behaviourally relevant design concepts through presenting examples and insights from different disciplines. This could lead to idea generation through use as a ‘suggestion tool’ to help a form of directed brainstorming, or as an exploratory, reflective or teaching tool. Fincher (1999, p.331) notes that ‘the pattern form is singularly well adapted for the sharing of good practice between practitioners’, and certainly in HCI, patterns have been used as a pedagogical tool (e.g. Borchers, 2002; Kotzé et al, 2006) for students or novices learning about the discipline. The toolkit was developed via an iterative, participatory process, running workshops with students and designers throughout its development to understand how it is being used and how to improve its structure and content. The patterns were extracted—and abstracted—from an ongoing literature review of treatments of human behaviour in a range of disciplines, together with suggestions from readers of the project’s blog and workshop participants.

In the toolkit, 101 design patterns for influencing behaviour are described and illustrated, grouped into eight 'lenses' – categories which provide different disciplinary 'worldviews' on behaviour change, challenging designers to think outside the immediate frame of reference suggested by the brief (or the client), and helping with transposing ideas between domains. The lenses (described in Table 1) are not intended to be ontologically rigorous, but primarily a way of triggering multiple viewpoints within an ideation session. Each lens also represents a particular balance of emphasis on *cognition* or *context* (see above), e.g. the Cognitive lens is primarily about cognition, while the Architectural lens is primarily about context.

Table 1: The Design with Intent toolkit lenses and patterns

Lenses	Patterns
Architectural The Architectural Lens draws on techniques used to influence user behaviour in architecture, urban planning and related disciplines such as traffic management and crime prevention through environmental design	Angles; Converging and diverging; Conveyor belts; Feature deletion; Hiding things; Material Properties; Mazes; Pave the cowpaths; Positioning; Roadblock; Segmentation and spacing; Simplicity
Errorproofing The Errorproofing Lens represents a worldview treating deviations from the target behaviour as 'errors' which design can help avoid, either by making it easier for users to work without making errors, or by making errors impossible in the first place.	Are you sure?; Choice editing; Conditional warnings; Defaults; Did you mean?; Interlock; matched affordances; Opt-outs; Portions; Task lock-in/out
Interaction All the patterns are really about interaction design in one form or another, but the Persuasive / Interaction Lens brings together some of the most common design elements of interfaces where users' interactions with the system affect how their behaviour is influenced, including from the growing field of Persuasive Technology (Fogg, 2003)	Feedback through form; Kairos; Partial completion; Peer feedback; Progress bar; Real-time feedback; Simulation and feedforward; Summary feedback; Tailoring; Tunnelling and wizards
Perceptual The Perception Lens combines ideas from product semantics, ecological psychology and Gestalt psychology about how users perceive patterns and meanings as they interact with the systems around them	(A)symmetry; Colour associations; Contrast; Fake affordances; Implied sequences; Metaphors; Mimicry and mirroring; Mood; Nakedness; Perceived affordances; Possibility trees; Prominence; Proximity and grouping; Seductive atmospherics; Similarity; Transparency; Watermarking

Cognitive The Cognitive Lens draws on research in behavioural economics and cognitive psychology looking at how people make decisions, and how this is affected by 'heuristics' and 'biases'. If designers understand how users make interaction decisions, that knowledge can be used to influence interaction behaviour. Equally, where users often make poor decisions, design can help counter this.	Assuaging guilt; Commitment and consistency; Decoys; Desire for order; Do as you're told; Emotional engagement; Expert choice; Framing; Habits; Personality; Provoke empathy; Reciprocation; Rephrasing and renaming; Scarcity; Social proof
Security The Security Lens represents a 'security' worldview, i.e. that undesired user behaviour is something to deter and/or prevent though 'countermeasures' designed into products, systems and environments, both physically and online, with examples such as digital rights management.	Coercive atmospherics; Peerveillance; Sousveillance; Surveillance; Threat of injury; Threat to property; What you can do; What you have; What you know; What you've done; Where you are; Who or what you are
Ludic Games are great at engaging people for long periods of time, influencing people's behaviour through their very design. The Ludic Lens includes a number of 'gamification' techniques for influencing user behaviour that can be derived from games and other 'playful' interactions, ranging from basic social psychology mechanisms such as goal-setting, to common game elements such as scores and levels.	Challenges and targets; Collections; Leave gaps to fill; Levels; Make it a meme; Playfulness; Rewards; Role-playing; Scores; Storytelling; Unpredictable reinforcement
Machiavellian The Machiavellian Lens comprises design patterns which, while diverse, all embody an 'end justifies the means' approach. This may be unethical, but is nevertheless commonly used to control and influence consumers through advertising, pricing structures, planned obsolescence, lock-ins and so on.	Anchoring; Antifeatures and crippleware; Bundling; Degrading performance; First one free; Forced dichotomy; Format lock-in/out, Functional obsolescence; I cut, you choose; Poison pill; Serving suggestion; Slow/no response; Style obsolescence; worry resolution

Figure 2: Alexander Ambridge's Twist kettle—requiring the user to set the desired water temperature by rotating the base.

Case study: Twist Kettle, Alexander Ambridge

A brief case study of the toolkit's application in an educational context can help demonstrate one way in which it can be used. Alexander Ambridge, a final year BSc Product Design student at Brunel University, used the Design with Intent toolkit to generate concepts for his major project, the *Twist Kettle*. This aims to reduce the energy used by electric kettles, not by influencing people to use only the right amount of water, but by encouraging users to set the required temperature (between 65° and 100° C) to suit different kinds of drinks, before the water is heated:

> "Although there are a number of variable temperature kettles already available, my design has focused on the temperature setting interface to encourage users to interact with the temperature setting feature. The 360° base becomes a dial, so twisting the kettle sets the temperature (Figure 2).
>
> Setting the temperature on existing variable temperature kettles is an optional part of the process. I wanted the action of setting the temperature to become an essential part of the process (like the 'Interlock' card [one of the Design with Intent patterns]) although I didn't want the users to feel constrained. The dial base interface requires the user to only slightly change the way they use the kettle. Setting the temperature will become an extension of an existing action within the process of using the kettle. Every time the user places the kettle back down on its base they then must consider the temperature that they wish the kettle to heat to." (Ambridge, personal communication.)

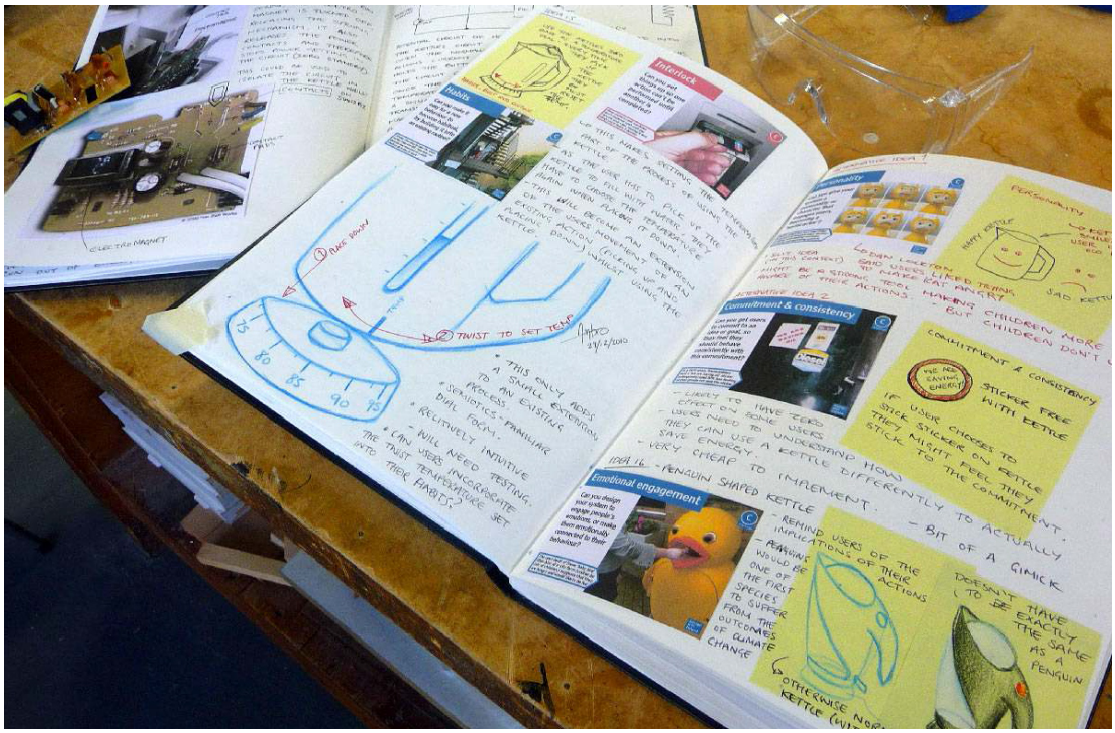

Figure 3: Alexander Ambridge's sketchbook showing how the DwI cards were used directly to inspire concepts.

Before arriving at the 'twist' concept, Ambridge used the toolkit cards for a comprehensive individual brainstorming process (Figure 3) in which he went through the cards on screen, first noting and sketching ideas on Post-It notes, and then elaborating on each as they were stuck (with printed versions of the cards) into his sketchbook. These earlier concepts drew on patterns including personality, emotional engagement, habits, commitment and consistency, feedback through form, nakedness, framing and conditional warnings.

Discussion: models and assumptions

This chapter has opened up the complexity of the field of design for behaviour change through looking at some relevant cross-disciplinary considerations, and introducing the *Design with Intent* toolkit, which aims to bring together some of these insights from multiple disciplines. We have seen how it can be applied to a simple problem.

However, it is clear that we should question the perhaps deterministic assumptions embedded in much of the work that presumes one-to-one mappings between design features and resulting ‘behaviours’ (Broady, 1966; Lockton, 2012). People will not always behave how designers intend or expect them to (Kanis, 1998; Stanton and Baber, 2002; Redström, 2005), even as designers attempt to ‘script’ behaviour (Akrich, 1992; Jelsma and Knot, 2002). As Brand (1994, p.178) puts it, in reference to the built environment, “All buildings are predictions. All predictions are wrong”.

Assumptions about people—how they live, how they make decisions, and what affects their actions—are integral to the whole programme of design for behaviour change. Designers are engaged generally not in describing existing situations, but in *transforming* existing situations into preferred ones (Simon, 1981), in “act[ing] to change the actuality of the world” (Dilnot 2015, p.134). While these assumptions and issues surrounding them are not necessarily always explicit stances taken by designers or

researchers, they embody tensions that arise when a new approach touches on areas that have previously been the preserve of other disciplines with different traditions, expectations and aims.

We cannot avoid having models of people (Dubberly & Pangaro, 2007) but the question of how these models and assumptions are applied in design is of practical relevance—how those models can be translated, tested, questioned and improved through use in the real world, rather than in laboratory studies. In this sense, it is wise to heed Box and Draper (1987): "essentially, all models are wrong, but some are useful" because from a design perspective, we are looking for the 'useful' parts. Designers' mental models of 'users', or theories of action (Argyris & Schön, 1974) about how people behave (at least the simplified models which are implicit in the selection of particular features with the aim of influencing behaviour) are diverse, but necessarily reductive—and we should keep an awareness of this reductiveness in mind.

Looking at how designers themselves model 'their' intended users can be instructive in understanding how design for behaviour change techniques are applied in practice (Lockton et al 2012). Considering which model(s) of users designers and other stakeholders in a project have can be useful for a more reflective design process, but also for understanding the different approaches to design for behaviour change that are taken in commercial or other practical applications. For example, some companies appear to model their customers as 'thoughtful' (and design accordingly), while others take a quite different approach. As Dunne (2005, p.21-22) notes, "while electronic objects are being used, their use is constrained by the simple generalised model of a user these objects are designed around… we unwittingly adopt roles created by the human factors specialists of large corporations." Or, as Ranner et al (2016, p.1) put it, "in drafting a normal, everything else is treated as defective."

For example, in applications of design for behaviour change to reducing home energy use, Strengers (2011) considers it "alarming" that the model of individual householders as "micro-resource managers", and the language of 'demand management', continue to dominate the design of feedback systems. Brynjarsdóttir et al (2012, p.950) describe persuasive design for sustainability as "a modernist enterprise", focusing both on individuals at the expense of broader social considerations, and on narrowing the broad scope of sustainability into "the more manageable problem of 'resource minimisation'," drawing on Scott's (1999) conception of how states have attempted to make populations 'legible' through reducing their variety (of behaviour as of other characteristics). Fantini van Ditmar and Lockton (2016) explore the ways in which simplistic models of motivation underlie much of the quantified self behaviour change technology arising from Silicon Valley, while Whitson (2015) draws parallels between this gamified quantification and Foucauldian governance and normalisation.

This criticism links well with approaches highlighting the potential value of considering social practices (Wilhite, 2013; Shove et al, 2012) in this area, rather than 'behaviour'—specifically because social practice theory's emphasis on shared activities and ways of meeting daily needs can "lift understandings of resource consumption to [a] supraindividual level" (Kuijer et al, 2013). Scott et al (2012) call for "a more comprehensive understanding of 'users' as social creatures, and the role of consumption in everyday life, than has ever been undertaken through design". Nevertheless, adopting a practice theory-based approach in a design process—treating practices as "a unit of design" (Kuijer et al, 2013)—is not straightforward. Enabling the framing of problems to evolve and be expanded (Maher et al, 1996), while valuable in exploring the scope of sustainability or other social benefit considerations, can be difficult to translate directly into insights usable for designers.

There is potentially a need for a structured way of exploring the assumptions and implications inherent in design which seeks to influence behaviour, to enable a more reflective design approach. The next stage of the author's research aims to explore this in more detail.

References

Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In J. Kuhl & J. Beckman (Eds.), *Action-control: From cognition to behavior*, pp. 11-39. Heidelberg: Springer.

Akrich, M. (1992) The De-scription of Technical Objects. In W.E. Bijker & J. Law (Eds.), *Shaping Technology/Build-ing Society: Studies in Sociotechnical Change*, pp. 205– 224. Cambridge, MA: MIT Press

Alexander, C., Ishikawa, S., Silverstein, M. (1977). *A Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press

Anderson, S. (1966). Problem-Solving and Problem-Worrying. Presentation to the Architectural Association, London, March 1966. Available at http://web.mit.edu/soa/www/downloads/1963-69/TH_AALond-Lect_66.pdf

Argyris, C., & Schön, D. A. (1974). *Theory in practice: Increasing professional effectiveness*. San Francisco, CA: Jossey-Bass.

Armstrong, J. (2010). *Persuasive Advertising: Evidence-Based Principles*. London: Palgrave Macmillan.

Bisset, F. and Lockton, D. (2010). Designing Motivation or Motivating Design? Exploring service design, motivation and behavioural change. Touchpoint: The Journal of Service Design 2(1), pp.14-27.

Blevis, E. (2007). Sustainable interaction design: invention & disposal, renewal & reuse. In *Proceedings of CHI 2007*. New York: ACM, pp. 503-512.

Borchers, J. (2002). Teaching HCI design patterns: Experience from two university courses. In *Proceedings of CHI 2002: Workshop Position Papers*. New York: ACM.

Box, G.E.P. and Draper, N.R. (1987). *Empirical model-building and response surfaces*. New York: Wiley.

Brand, S. (1994). *How Buildings Learn: What Happens After They're Built*. London: Viking.

Broady, M. (1966). Social Theory in Architectural Design. In: Gutman, R (ed) (1972), *People and Buildings*. Basic Books, New York, NY.

Brynjarsdóttir, H., Håkansson, M., Pierce, J., Baumer, E.P.S., DiSalvo, C., and Sengers, P. (2012). Sustainably unpersuaded: How persuasion narrows our vision of sustainability. In *Proceedings of CHI 2012*, New York: ACM.

Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Issues, 8*(2), pp.5-21

Burns, C. M. and Hajdukiewicz, J. R. (2004). *Ecological interface design*. Boca Raton, FL: CRC Press.

Carroll, J. M., Olson, J. R., & Anderson, N. S. (1987). *Mental models in human-computer interaction: Research issues about what the user of software knows*. Washington, DC: National Research Council.

Chatterton, T. and Wilson, C. (2013) The Four Dimensions of Behaviour framework: A tool for characterising behaviours to help design better interventions. *Transportation Planning and Technology*,

37 (1), pp. 38-61.

Clark, G.L. (2009). Human nature, the environment, and behaviour: explaining the scope and geographical scale of financial decision-making. *SPACES online*, 7(2009-01).

Clement, J. (1991). Non-formal reasoning in experts and in science students: The use of analogies, extreme cases, and physical intuition. In J. F. Voss, D. N. Perkins, & J. W. Segal (Eds.), *Informal reasoning and education*, pp. 345-362. London: Routledge.

Crowe, T. D. (2000). *Crime Prevention through Environmental Design*, 2nd edition. Boston, MA: Butterworth-Heinemann

Daae, J.Z. and Boks, C. (2014). Dimensions of Behaviour Change. Journal of Design Research 12(3), pp. 145-172.

Darnton, A. (2008). *Reference Report: An overview of behaviour change models and their uses*. Government Social Research, July 2008.

Desmet, P. M. A., & Hekkert, P. (2007). Framework of product experience. *International Journal of Design*, 1(1), pp.57-66.

Dilnot, C. (2015). History, Design, Futures: Contending with what we have made. In: Fry, T., Dilnot, C & Stewart, S.C., *Design and the Question of History*. London: Bloomsbury, pp.131-272.

Djajadiningrat, T, Overbeeke, K, Wensveen, S (2002). But how, Donald, tell us how?: on the creation of meaning in interaction design through feedforward and inherent feedback. In: *Proceedings of DIS'02: Designing Interactive Systems: Processes, Practices, Methods, & Techniques*, pp. 285-291

Dorst, K. (2015). *Frame Innovation*. Cambridge: MIT Press.

Dubberly, H., & Pangaro, P. (2007). Cybernetics and service-craft: Language for behavior-focused design. *Kybernetes*, 36(9), pp.1301-1317.

Dunne, A. (2005). Hertzian Tales. Cambridge: MIT Press.

Eyal, N. & Hoover, R. (2013). Hooked: How to build habit-forming products. Portfolio.

Fabricant, R. (2009). 'Behaving badly in Vancouver'. *Design Mind*, 11 February. San Francisco: Frog Design. Available at:http://designmind.frogdesign.com/blog/behaving-badly-in- vancouver.html

Fantini van Ditmar, D. & Lockton, D. (2016). Taking the code for a walk. *Interactions* 23(1), pp.68-71

Fincher, S. (1999). Analysis of design: An exploration of patterns and pattern languages for pedagogy. *Journal of Computers in Mathematics and Science Teaching*, 18(3), pp.331–348.

Fogg, B. J. (2003). *Persuasive Technology: Using Computers to Change What We Think and Do*. San Francisco, CA: Morgan Kaufmann.

Fogg, B.J. (2009). A behavior model for persuasive design. In *Proceedings of the 4th International Conference on Persuasive Technology* (Persuasive '09). New York: ACM

Fry, T. (2015). Whither Design / Whether History. In: Fry, T., Dilnot, C & Stewart, S.C.,*Design and the Question of History*. London: Bloomsbury, pp.1-130.

Gaver, W., Dunne, A., & Pacenti, E. (1999). Cultural probes. *Interactions*, 6(1), pp.21-29.

Gentner, D. & Stevens, A.L. (eds.) (1983). *Mental Models*. Englewood Cliffs: Lawrence Erlbaum Associates.

Gibson, J.J. (1979). *The Ecological Approach to Visual Perception*. New York: Houghton-Mifflin.

Gintis, H. (2007) A framework for the unification of the behavioral sciences. Behavioral and Brain Sciences 30(1), pp.1-16.

Golembewski, M. (2010). Ideation decks: A card-based tool designed to help creative practitioners develop project ideas. Horizon DTC report, University of Nottingham

Grist, M. (2010). *Steer: Mastering our Behaviour through Instinct, Environment and Reason*. London: RSA

Grout, J. (2007). Mistake-Proofing the Design of Health Care Processes. Rockville, MD: Agency for Healthcare Research and Quality.Mzon DTC r

Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships. *Environment and Behavior*, 27(5), pp.699-718.

Hassenzahl, M., & Laschke, M. (2014). Pleasurable Troublemakers**.** In S. Walz & S. Deterding (Eds.), *The Gameful World*. Cambridge, MA: MIT Press, pp.167-195.

Haynes L., Service, O., Goldacre, B. and Torgersen, D. (2012). *Test, Learn, Adapt: Developing Public Policy with Randomised Controlled Trials*. London: Cabinet Office.

Hazas, M., Bernheim Brush, A.J., & Scott, J. (2012). Sustainability does not begin with the individual. *Interactions* 19(5), pp.14-17.

IDEO (2003). *IDEO Method Cards: 51 Ways to Inspire Design*. Palo Alto, CA: IDEO.

Irwin, T., Kossoff, G. and Tonkinwise, C. (2015). Transition Design Provocation.*Design Philosophy Papers* 13(1), pp.3–11.

Jelsma, J. (2006) Designing 'Moralized' products: theory and practice, In Verbeek, P.-P. and Slob, A. (eds), *User Behaviour and Technology Development,* Berlin: Springer, pp. 221–231.

Jelsma, J. and Knot, M. (2002). Designing environmentally efficient services: A "script" approach. *Journal of Sustainable Product Design*, 2(3–4), pp.119–130.

John, P., Cotterill, S., Richardson, L., Moseley, A., Stoker, G., Wales, C. and Smith, G. (2011). *Nudge, Nudge, Think, Think: Experimenting with Ways to Change Civic Behaviour*. London: Bloomsbury

Jones, N. A., Ross, H., Lynam, T., Perez, P., & Leitch, A. (2011). Mental models: An interdisciplinary synthesis of theory and methods. *Ecology and Society*, 16(1), article 46.

Kahneman, D. and Tversky, A. (1979). Prospect Theory: An Analysis of Decision under Risk. *Econometrica*, 47(2), pp. 263-291

Kanis, H (1998). Usage centred research for everyday product design. *Applied Ergonomics*, 29(1), pp.75–82.

Kotzé, P., Renaud, K., Koukouletsos, K., Khazaei, B. and Dearden, A. (2006). Patterns, anti-patterns and guidelines – Effective aids to teaching HCI principles? In Hvannberg, E. T., Read, J. C., Bannon, L., Kotzé, P. and Wong, W. (eds), *Proceedings of HCIEd2006-1: First Joint BCS/IFIP WG 13.1/ICS/EU CONVIVIO HCI Educators' Workshop*, Limerick, Ireland. Limerick: University of Limerick, pp. 115–120.

Krippendorff, K. (2007). The cybernetics of design and the design of cybernetics. *Kybernetes*, 36(9/10), pp.1381-1392.

Kuijer, L., and de Jong, A.M. (2011). Practice Theory and Human-Centered Design: A Sustainable Bathing Example. In *Proceedings of Nordes2011*. Helsinki: Aalto University, pp.221-27.

Kuijer, L., de Jong, A.M. and van Eijk, D. Practices as a Unit of Design: An Exploration of Theoretical

Guidelines in a Study on Bathing. *Transactions on Computer-Human Interaction* 20(4), article 22.

Lawson, B. (2004). Schemata, gambits and precedent: some factors in design expertise. *Design Studies*, 25, pp.443–457.

Lewin, K (1935). *A Dynamic Theory of Personality*. New York: McGraw-Hill.

Lilley, D. (2007). Designing for behavioural change: reducing the social impacts of product use through design. PhD thesis, Loughborough University.

Lilley, D. (2009). Design for sustainable behaviour: Strategies and perceptions. *Design Studies*, 30(6), pp.704-720.

Lockton, D. (2012). POSIWID and determinism in design for behaviour change.Working paper, *Social Science Research Network*. Available athttp://papers.ssrn.com/sol3/papers.cfm?abstract_id=2033231

Lockton, D., Harrison, D. and Stanton, N. A. (2008). Making the user more efficient: Design for sustainable behaviour. *International Journal of Sustainable Engineering*, 1(1), pp.3–8.

Lockton, D., Harrison, D. & Stanton, N.A. (2009) Choice Architecture and Design with Intent. In Wong, W & Stanton, N.A. (eds.), *NDM9 – 9th Bi-annual International Conference on Naturalistic Decision Making*, June 23-26, 2009, London, UK, Doctoral Consortium Proceedings. Swindon: British Computer Society.

Lockton, D., Harrison, D., and Stanton, N. A. (2010). The Design with Intent method: Adesign tool for influencing user behaviour. *Applied Ergonomics*, 41(3), pp.382-392.

Lockton, D., Harrison, D., and Stanton, N. A. (2012). Models of the user: Designers' perspectives on influencing sustainable behaviour. *Journal of Design Research*,10(1/2), pp.7-27.

Lockton, D., Harrison, D., and Stanton, N.A. (2013). Exploring design patterns for sustainable behaviour. *The Design Journal*, 16(4), pp.431-459.

Mager, B. (2010). Editorial: Isn't life always centred around influencing the behaviour of other people? *Touchpoint: The Journal of Service Design*, 2(1), pp.6–7

Maher, M. L., Poon, J., & Boulanger, S. (1996). Formalising design exploration as co-evolution: A combined gene approach. In J. S. Gero & F. Sudweeks (Eds.), *Advances in formal design methods for CAD,* London: Chapman & Hall, pp.3-30.

Meadows, D (1999). *Leverage Points: Places to Intervene in a System*. SustainabilityInstitute, Vermont

Meadows, D (2009). *Thinking in Systems: A Primer*. Earthscan, London

Michie, S., van Stralen, M. M., & West, R. (2011). The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implementation Science*, 6, article 42.

Michie, S., West, R., Campbell, R., Brown, J. & Gainforth, H. (2014). ABC of Behaviour Change Theories. London: Silverback Publishing.

Moray, N. (1996). Mental models in theory and practice. In D. Gopher, & A. Koriat (Eds.), *Attention and performance XVII, cognitive regulation of performance: Interaction of theory and application*. Cambridge, MA: MIT Press, pp. 223-258

Niedderer, K., MacKrill, J., Clune, S., Evans, M., Lockton, D., Ludden, G., Morris, A., Gutteridge, R., Gardiner, E., Cain, R. & Hekkert, P. (2014). Joining Forces: Investigating the influence of design for behaviour change on sustainable innovation. *NordDesign 2014: 10th biannual conference on design and development*, 27-29 August 2014, Aalto University, Espoo, Finland

Nodder, C. (2013). *Evil by Design*. New York: Wiley.

Norman, D. A. (1988). *The Psychology of Everyday Things*. Basic Books, New York

Nuffield Council on Bioethics. (2007). *Public health: Ethical issues*. Available at: http://www.nuffieldbioethics.org/sites/default/files/Public%20health%20-%20ethical%20issues.pdf

Papert, S. (1980). *Mindstorms: Children, computers, and powerful ideas*. New York, NY: Basic Books.

Payne, S. J. (1991). A descriptive study of mental models. *Behaviour & Information Technology, 10*(1), pp.3-21.

Pettersen, I.N. (2015) Towards practice-oriented design for sustainability: the compatibility with selected design fields. *International Journal of Sustainable Engineering.* vol. 8 (3).

Petty, R. E., & Cacioppo, J. T. (1981). *Attitudes and persuasion: Classic and contemporary approaches*. Dubuque, IA: William C. Brown.

Plous, S. (1993). The psychology of judgment and decision making. New York: McGraw-Hill

Ranner, V., Lockton, D., Steenson, M.W., Galik, G. and Kerridge, T. (2016). T. (2016). (2016). (2016). 16)*DRS 2016: Design, Research, Society: Future-Focused Thinking*, 27-30 June 2016, Brighton, UK. Available at: http://drs2016.org/549

Redström, J. (2005). Towards user design? On the shift from object to user as the subject of design. *Design Studies*, 27, pp.123–139.

Rittel, H.W.J. & Webber, M.M. (1973). Dilemmas in a general theory of planning. *Policy Sciences* 4, pp.155-169.

Ross, L. & Nisbett, R.E. (1992). *The Person and the Situation*. New York: McGraw-Hill.

Scott, J.C. (1999). *Seeing Like A State: How Certain Schemes to Improve the Human Condition Have Failed*. Yale University Press: New Haven.

Scott, K., Bakker, C.A. and Quist, J. (2012). Designing Change by Living Change. *Design Studies* 33(3), pp.279-297.

Selvefors, A., Renström, S. and Strömberg, H. (2014). Design for Sustainable Behaviour: A Toolbox for Targeting the Use Phase. *Eco-Design Tool Conference*, Gothenburg, Sweden

Shingo, S. (1986). *Zero Quality Control: Source Inspection and the Poka-Yoke Method*. Boca Raton: CRC Press.

Shove, E. (2010). Beyond the ABC: climate change policy and theories of social change. *Environment and Planning A,* 42(6), pp.1273-1285.

Shove, E., Pantzar, M. & Watson, M. (2012). *The Dynamics of Social Practice: Everyday life and how it changes*. London: Sage

Simon, H.A. (1981). *The Sciences of the Artificial*, 2nd edition. Cambridge, MA: MIT Press.

Simon, H.A. (1990). Invariants of Human Behavior. *Annual Review of Psychology*, 41, pp.1-19.

Stanton, N. A. and Baber, C. (2002). Error by design: methods for predicting device usability. *Design Studies*, 23, pp.363–384.

Stanton, N.A., Salmon, P.M., Rafferty, L.A., Walker, G.H., Baber, C., Jenkins, D.P. (2013). *Human Factors Methods: A Practical Guide for Engineering and Design* (2nd edition). Farnham: Ashgate.

Stern, P. C. (2000). Toward a coherent theory of environmentally significant behavior. *Journal of Social*

Issues, 56(3), pp.407-424.

Strengers, Y.A. (2011). Designing eco-feedback systems for everyday life. In: *Proceedings of CHI 2011*, New York: ACM, pp.2135-2144.

Strömberg, H., Selvefors, A. and Renström, S. (2015). Mapping out the design opportunities: pathways of sustainable behaviour. *International Journal of Sustainable Engineering* 8(3), p.163-172.

Suchman, L. (2011). Anthropological Relocations and the Limits of Design. *Annual Review of Anthropology*, 40, pp.1-18.

Terzioğlu, N., Brass, C. & Lockton, D. (2015). Understanding User Motivations And Drawbacks Related To Product Repair. *Sustainable Innovation 2015*, 9-10 November 2015, Epsom, UK

Thaler, R. H., & Sunstein, C. R. (2008). *Nudge: Improving decisions about health, wealth, and happiness*. New Haven, CT: Yale University Press.

Todd, P. M., Gigerenzer, G., & the ABC Research Group. (2012). *Ecological rationality: Intelligence in the world*. New York, NY: Oxford University Press.

Tromp, N., and Hekkert, P.P. (2014). Social Implication Design (SID) – A design method to exploit the unique value of the artefact to counteract social problem. *Proceedings of the Design Research Society Conference 2014*, Umeå Design School, Umeå, Sweden.

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, *185*(4157), pp.1124-1131.

Watson, J., Clegg, C., Cowell, C., Davies, F., Hughes, C., McCarthy, N., Westbury, P. (eds.), *Built for Living: Understanding behaviour and the built environment through engineering and design*. Royal Academy of Engineering, London.

Wendel, S.A. (2013). *Designing for Behavior Change*. Sebastopol, CA: O'Reilly.

Wever, R. (2012). Editorial: Design Research for Sustainable Behaviour. *Journal of Design Research* 10(1/2), pp.1–6.

Wever, R., van Kuijk, J. and Boks, C. (2008). User-centred Designfor Sustainable Behaviour. *International Journal of SustainableEngineering*, 1(1), pp.9–20

Whitson, J.R. (2015). Foucault's Fitbit: Governance and Gamification, in S. Walz andS. Deterding (eds.), *The Gameful World*. MIT Press: Cambridge, MA.

Wilhite, H. (2013). Energy consumption as cultural practice: implications for the theory and policy of sustainable energy use. In Strauss, S., Rupp, S. & Love, T. (eds), *Cultures of Energy*, Walnut Creek: Left Coast Press.

Zachrisson, J., & Boks, C. (2012). Exploring behavioural psychology to support design for sustainable behaviour research. *Journal of Design Research*, 10(1/2), pp.50-66.

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