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Design for Sustainable Behaviour: investigating design methods for influencing user behaviour

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Abstract

This research aims to develop a design tool for product and service innovation which influences users towards more sustainable behaviour, reducing resource use and leading to a lower carbon footprint for everyday activities. The paper briefly explains the reasoning behind the tool and its structure, and presents an example application to water conservation with concept ideas generated by design students.

Introduction: Behaviour change as a challenge for designers

As consumer products become increasingly efficient technologically, human behaviour is often the weak link, at a societal level but also at the scale of interaction with individual products and services. We buy 'energy-saving' lights and then leave them on all night, boil a kettle-full of water even though we only need a mug-full, and stick with the default setting on the washing machine, afraid of investigating the others.

Individual behavioural decisions (or the lack of them) are responsible for a significant proportion of household energy use (McCalley & Midden 2002; Wood & Newborough 2003). This issue goes beyond simply the "removal of barriers to behavioural change" identified by Stern (2007): while tax incentives and social marketing campaigns have a large part to play, in many ways, encouraging more sustainable behaviour can be seen as a *design* problem, concerned with how and why people interact with the products and systems around them, and how the interaction that contributes to the use phase might be influenced.

Sustainable innovation from this perspective starts to place the designer into the role of 'activist' (Thorpe 2008; Fuad-Luke 2009), and presents a challenge: designing with the intent to affect how people use and interact with things, rather than simply accommodating existing needs.

Cross-disciplinary approaches

There are many known techniques for using design to influence user behaviour from disciplines such as architecture, computer science and health & safety. Some aim to enable people to make better choices—very much Buckminster Fuller's approach, "modify[ing] the environment in such a way as to get man moving in preferred directions" (Krausse & Lichtenstein 2001); others aim to educate users about the impact of their behaviour; others still are primarily about 'designing out' inefficient user behaviour. Herbert Simon's assertion that "everyone designs who devises courses of action aimed at changing existing situations into preferred ones" (Simon 1969) applies to designing behaviour as well as physical features. Indeed, the concept of design *explicitly intended* to influence users towards particular behaviours recurs across a number of disciplines, from urban planning to reduce crime (e.g. Katyal 2002) to human-computer interaction (e.g. Beale 2007).

However, little work has been done to *link* ideas and techniques from these disparate fields and present them in a form which can be applied during the innovation process. While there is growing recognition that "designers are in the behaviour business" (Fabricant 2009), there is little general guidance available for design teams briefed with influencing user behaviour. As Blevis (2007) puts it, "[i]t is easier to state the kinds of behaviours we would like to achieve from the perspective of sustainability than it is to account for how such behaviours may be adequately motivated."

Design with Intent

Some design researchers (Lilley et al. 2005, 2006, 2009; Bhamra et al. 2008; Elias et al. 2007, 2009; Lockton et al. 2008b, 2009b; Wever et al. 2008; Rodriguez & Boks 2005; Pettersen & Boks 2008) have begun to develop the field of 'design interventions' applicable by designers as responses to user behaviour 'problems', particularly environmental, but also 'pro-social' behaviour generally. The Design with Intent method, briefly introduced in this paper, aims to complement and support these approaches, addressing the deficiency outlined above, by suggesting relevant design techniques for influencing types of behaviour, and providing examples of how similar problems have been tackled elsewhere.

Defining 'Design with Intent' (DwI) as 'design intended to influence or result in certain user behaviour', the authors have reviewed examples from a variety of disciplines (Lockton et al 2008a, 2008b), supported by a blog website and more recently an ongoing survey of designers, receiving comments, suggestions and examples from readers around the world, and incorporated this analysis into a tool for designers, the Design with Intent Method.

The Design with Intent Method

The starting point of the DwI Method is the existence of a product, service or environment—a *system*—where users' behaviour is important to its operation, or where it would be strategically desirable to alter the way it is used.

The method is a 'suggestion tool', suggesting design patterns (after Alexander et al (1977) and Tidwell (2005)), with examples from a range of fields and contexts. The patterns are intended to inspire a range of ways to address the brief, which can be developed into concepts and assessed further against the project criteria. While the DwI Method cannot replace the domain expertise, insight or creativity which experienced professionals can bring, it is intended to assist in exploring responses to a brief and allow designers to benefit from others' work on analogous problems. Workshop sessions (Lockton et al 2009b) have shown that some participants found it useful to *combine* two or more patterns to suggest novel approaches to briefs. The reality of most design processes is that situational constraints will make many patterns difficult to apply, but even a few patterns and examples can inspire a range of concepts.

Structure of the method

There are two 'modes' in which the method can be used, *inspiration* and *prescription*, depending on how the designer or design team prefers to make use of it. In inspiration mode (Figure 1), a subset of the most important patterns is presented as a 'toolkit' or 'idea space' (Lockton et al 2009a), also made

available online as a reference for designers (*www.designwithintent.co.uk*). In prescription mode, the designer expresses the brief in terms of one of a set of 'target behaviours', each of which has particular design patterns associated with it—a more TRIZ-like approach (Altshuller 1996; Jones et al. 2001; Craig et al. 2008). The modes are demonstrated and explained in more detail in a forthcoming article (Lockton et al, in press); from the point of view of this paper, the results of applying both modes to a single brief will be aggregated.

Figure 1. The 'toolkit' layout used for the inspiration mode, with a close-up of *Social proof*, one of the patterns.

Six 'lenses' on influencing user behaviour

The six lenses (Table 1) are a way of grouping design patterns which share similar considerations or assumptions about how to influence users: to some extent, these groups—Architectural, Errorproofing, Persuasive, Visual, Cognitive and Security—resolve into particular 'worldviews', the way that a designer versed in a particular discipline might approach a brief on influencing behaviour. The aim of the lenses is primarily to allow designers to see 'how others might approach a problem', allowing designers to think outside the immediate frame of reference suggested by the brief (or client).

Table 1. Six 'lenses' on influencing user behaviour, with a number of design patterns for each

Architectural patterns *Positioning & layout, Material properties, Segmentation & spacing, Orientation, Removal, Movement & oscillation*	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 (Crowe 2000; Katyal 2002; see also the Security lens). While the techniques have been developed in the built environment (e.g. Alexander et al. 1977), many ideas can also be applied in interaction and product design, even in software or services; they are effectively about using the *structure of systems* to influence behaviour.
Errorproofing patterns *Defaults, Interlock, Lock-in & lock-out, Extra step, Specialised affordances, Partial self-correction, Portions, Conditional warnings*	The Errorproofing Lens treats deviations from a 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 (Shingo 1986; Chase & Stewart 2002; Grout 2007). This view on influencing behaviour is often found in health & safety-related design, medical device design and manufacturing engineering.
Persuasive patterns *Self-monitoring, Kairos, Reduction, Tailoring, Tunnelling, Feedback through form, Simulation & feedforward, Operant conditioning, Respondent conditioning, Computers as social actors*	The Persuasive Lens represents the emerging field of persuasive technology (Fogg 2003), where computers, mobile phones and other systems with interfaces are used to persuade users: changing attitudes and so changing behaviour through contextual information, advice and guidance.
Visual patterns *Prominence & visibility, Metaphors, Perceived affordances, Implied sequences, Possibility trees, Watermarking, Proximity & similarity, Colour & contrast*	The Visual Lens combines ideas from product semantics, semiotics, ecological psychology and Gestalt psychology about how users perceive patterns and meanings as they interact with the systems around them, and the use of metaphors (e.g. Saffer 2005; Barr et al. 2002).
Cognitive patterns *Social proof, Framing, Reciprocation, Commitment & consistency, Affective engagement, Authority, Scarcity*	The Cognitive Lens draws on research in behavioural economics looking at how people make decisions, choice architecture (Lockton et al 2009c) and how this is affected by heuristics and biases (Kahneman et al. 1982). If designers understand how users make interaction decisions, that knowledge can be used to influence interaction behaviour. Where users often make poor decisions, design can help counter this.
Security patterns *Surveillance, Atmospherics, Threat of damage, What you have, What you know or can do, Who you are, What you've done, Where you are*	The Security Lens represents a 'security' worldview, i.e. that undesired user behaviour is something to deter and/or prevent though 'countermeasures' (Schneier 2003) designed into products, systems and environments, both physically and online, with examples such as digital rights management. From a designer's point of view, this can be an 'unfriendly' and, in some circumstances unethical view to take, effectively treating users as 'guilty until proven innocent'.

Example application: water conservation

Eight participants (undergraduate and postgraduate design students) were given the following brief (Figure 2) – relating to influencing householders to reduce water wastage while cleaning their teeth – and asked to apply patterns from the DwI toolkit, to generate possible design concepts relevant to the problem, looking at each lens in turn and imagining how the design patterns in each could be relevant. Participants worked on this problem as part of a series of other briefs, having around 15 minutes to think about this particular issue, in which time they were free to sketch, note, or discuss their ideas out loud. (The full details of the experimental design, results and the control conditions, will be included in a forthcoming article from the authors; for this paper, the example is included as a quick demonstration of how the DwI Method *can* be used, rather than proof of its usefulness.)

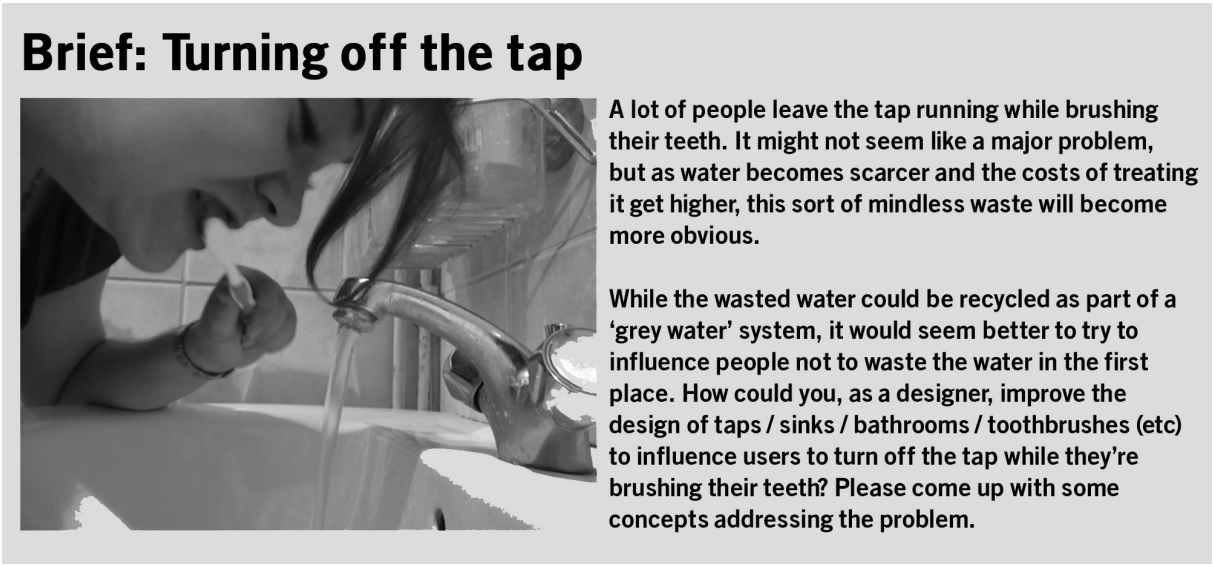

Figure 2. The brief given to participants.

The "Turning off the tap" brief is an example of *demand management* through design: "influencing consumption patterns that reflect idiosyncrasies of human behaviour" (Winkler 1982), though the focus on influencing *user behaviour* sets this particular exercise apart somewhat from purely technological demand management initiatives such as flow constrictors.

A number of design concepts have been developed and trialled relating to water conservation through influencing consumption behaviour, e.g. adding feedback to the tap (e.g. Arroyo et al 2005) or shower (Kappel & Grechenig 2009), redesign of the sink itself (Sherwin et al 1998) or the design of informational materials (Kurz et al 2005); each of these approaches is reflected in the wide range of concepts generated by the participants, shown in Table 2; some ideas also relate to the toothbrush itself. Figure 3 shows a selection of participants' concept sketches.

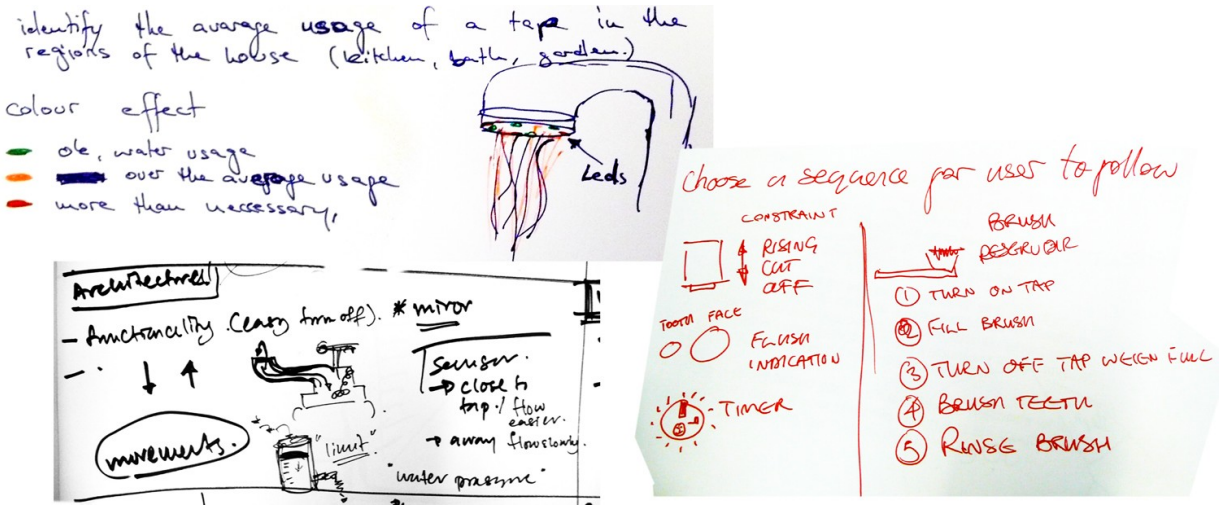

Figure 3. A selection of participants' sketches of ideas relating to the brief

Table 2. Some of the concepts proposed by participants to address the brief

Architectural patterns *Positioning & layout, Material properties, Segmentation & spacing, Orientation, Removal, Movement & oscillation*	- Position the knob at the front of the sink rather than on the tap itself, so that it's closer and easier to turn off while brushing - Combine water with brush (fill it up with water) - Brush reservoir – a little bucket, thimble of water on the brush, branded - Brush where foam bristles retract as they dry out, (so user knows right amount of water to use?)
Errorproofing patterns *Defaults, Interlock, Lock-in & lock-out, Extra step, Specialised affordances, Partial self-correction, Portions, Conditional warnings*	- Simple spring-return push-taps which only dispense water while the button is held down, and spring to 'off' position otherwise - Timed push-taps, as used in many public toilets, similar to a flush ("You don't have to turn toilets on and off – why do you need to do this with taps?") - Taps with proximity or motion sensors - Movable cut-off level that can be set on the tap or sink - Tap that doesn't operate unless plug is in place - Very flat sink that cannot hold much water - Sink where the plug is, by default, closed: users will see the amount of water being wasted very quickly - Timer that can be dialled to give water again after a period, would help people brush for the right amount of time too - Use a cup which must be pressed against a valve to fill it - Separate buttons for different amounts of water, e.g. "teeth" / "face"
Persuasive patterns *Self-monitoring, Kairos, Reduction, Tailoring, Tunnelling, Feedback through form, Simulation & feedforward, Operant conditioning, Respondent conditioning, Computers as social actors*	- Beeping, other sounds or coloured lights indicating flow rate of water - Running water gauge in the bathroom showing water wasted, measured in easy-to-understand units (e.g. cupfuls), energy or carbon impacts, or cost - Signal when a certain amount of water goes through the tap in a certain period of time - Water doesn't flow directly down from tap into plughole, but somewhere else first (e.g. a tray?) so you can see how much you're using - Identify average usage of a tap in the various regions of the house (kitchen, bath, garden) and display current usage relative to average - Information on toothpaste tube about how much water you waste if you leave tap running - (Electric) toothbrush with accelerometer so it knows if it's being used, with display on handle "Turn tap off" or icons – could be charged by kinetic energy of movement during use - Active feedback on sink or tap when it detects water is being wasted, suggesting user turns tap off - Computer system for house that monitors everything could include display of this kind of water waste alongside other information
Visual patterns *Prominence & visibility, Metaphors, Perceived affordances, Implied sequences, Possibility trees, Watermarking, Proximity & similarity, Colour & contrast*	- Transparent sink or pipes showing how much water is being wasted - Colour effect LEDs under the tap indicating 'OK', 'above average' and 'more than necessary' usage - Colour-changing sink to show energy used - Signage in bathrooms asking people to think about their water usage - 'Shots' of water, the right amount for brushing – using the metaphor of a shot of liquor - Tap working like an ale pump or old-fashioned water pump, changing the on / off mental model
Cognitive patterns *Social proof, Framing, Reciprocation, Commitment & consistency, Affective engagement, Authority, Scarcity*	- Framing different 'modes' of water use that user can choose - Train schoolchildren in economical resource use as part of home economics / life skills, to educate their parents and each other (social proof)
Security patterns *Surveillance, Atmospherics, Threat of damage, What you have, What you know or can do, Who you are, What you've done, Where you are*	No participants suggested any concepts inspired by these design patterns for this brief

The concepts suggested by participants using the Dwl design patterns are mostly realistic ideas, which could be developed further, prototyped and tested in user trials to determine how effective they actually are in practice at influencing user behaviour, and reducing water wastage. Some concepts, especially the ones involving giving users feedback on their water usage within a household, could be combined as part of a system also monitoring energy use (or overall carbon footprint); others would work as alternative designs of sink or taps that could be fitted to new-build or refurbished houses, or even retro-fit products which householders could fit themselves to try to influence their own family behaviour, or which could be supplied by water companies as part of a water conservation campaign.

Discussion

Studying the practical effects of designs developed using the DwI method, both technologically and in human factors terms, will be the most important test of its utility as a design tool. Alongside running workshop sessions with designers to improve and test the method further, the authors are currently building working prototypes of electric kettles redesigned according to concepts suggested by design students applying the DwI method, in order to run comparative user trials. Quantifying the difference in resources used by designs, compared with existing products, and the human factors involved, will permit refining the DwI Method to incorporate evidence about the application of the techniques and their efficacy.

Design considerations should be part of any environmental behaviour change strategy where human behaviour plays a part. This is a young, emerging field, and its potential for improving human well-being has yet to be demonstrated on a large scale, but the opportunities exist to match design solutions to a wide range of the behaviour problems facing society today and in our shared future. As behaviour change becomes more widely seen as part of the 'design' remit (e.g. Fabricant 2009), methods for incorporating these ideas into the design process have the potential to help designers explore problems they have not previously considered, contributing significantly to sustainable innovation.

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