MODELLING THE USER

How design for sustainable behaviour can reveal different stakeholder perspectives on human nature

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Abstract
Influencing more environmentally friendly and sustainable behaviour is a current focus of many projects, ranging from government social marketing campaigns, education and tax structures to designers' work on interactive products, services and environments. There is a wide variety of techniques and methods used—we have identified over 100 design patterns in our Design with Intent toolkit—each intended to work via a particular set of cognitive and environmental principles. These approaches make different assumptions about 'what people are like': how users will respond to behavioural interventions, and why, and in the process reveal some of the assumptions that designers and other stakeholders, such as clients commissioning a project, make about human nature.
In this paper, we discuss three simple models of user behaviour—the Pinball, the Shortcut and the Thoughtful—which emerge from user experience designers' statements about users while focused on designing for behaviour change. We characterise these models using systems terminology and examine the application of each model to design for sustainable behaviour via a series of examples.

Keywords
Behaviour, sustainability, modelling, designers, patterns.

1. Introduction: design for sustainable behaviour

There is growing recognition that "designers are in the behaviour business", as Frog Design's Robert Fabricant (2009) puts it, which means that research on behaviour change is increasingly being called upon in the design and development of new products and services, especially with environmentally and socially beneficial aims. *Design for sustainable behaviour* is emerging as a research area at the intersection of sustainable design and interaction design, applying insights from multiple disciplines to the problems of influencing more environmentally friendly use of products, services and environments (e.g. Combe et al, 2010; van Dam et al, 2010; Froehlich et al, 2010; Elias et al, 2009; Matsuhashi et al, 2009; Lilley, 2009; Bhamra et al, 2008; Pettersen & Boks, 2008; Wever et al, 2008; Lockton et al, 2008; Rodriguez & Boks 2005). However, 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."

For energy-using products and services, or those which consume other resources or create waste during operation, the 'use phase' of the life cycle—determined by the interaction between user and artefact—can make a significant contribution to the overall environmental footprint. As consumer products become increasingly efficient technologically, individual behavioural decisions (or the lack of them) are responsible for a significant proportion of household energy use: Wood and Newborough (2003) and McCalley and Midden (2002) cite studies in the UK, US and the Netherlands giving 26-36% as the proportion of home energy usage due to user behaviour decisions—and there is substantial variation: people do not all use energy in the same way, even in identical houses, with factors of two or more difference having been recorded, driven by householder behaviour (Sonderegger 1978; Curtis 1992-93).

The behaviour component of the use phase may naïvely be seen as out of the hands of the designer or manufacturer, something that governments alone are best-placed to address, e.g. via social marketing techniques (Defra, 2008), taxation and legislation. However, in many ways, influencing behaviour can be seen as a *design* problem, concerned with how and why people interact with the products and systems around them, and how designed interventions might change this. In effect, it is possible to 'make the user more efficient'. Design for sustainable behaviour, from this perspective, starts to place the designer into the role of 'activist' (Thorpe, 2010; 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.

1.1 Design with Intent: a catalogue of cross-disciplinary patterns

Despite design's growing role in influencing sustainable behaviour, there is little guidance available for designers facing this sort of brief, which can be applied during the early stages of a project where discussions with clients and other stakeholders are likely to determine the approach taken. Designers do not have a clear set of use-cases for different behaviour-influencing design patterns, with information on their effectiveness; and while this is never likely to be definitive, there is an opportunity for a guide which can help designers explore and think about how to apply and transpose research and practice from many disciplines.

As an attempt to go some way towards achieving this, the authors have developed the *Design with Intent toolkit* (Lockton et al, 2009, 2010a, 2010b, 2010c), a catalogue of design patterns for influencing user behaviour, illustrated with examples, and grouped into eight 'lenses' (Table 1). The pattern structure is influenced by the work of Alexander et al (1977) and Tidwell (2005) as well as structured innovation methods such as TRIZ and IDEO's 'method card' collection.

The DwI toolkit has evolved through a series of workshops, both formal controlled trials with designers and students (Lockton et al 2010b), and informal sessions with designers and other stakeholders, applying it to some real projects, covering a range of socially beneficial behaviour change applications in addition to the explicitly 'environmental' briefs. In the controlled trials, the sustainable behaviour briefs addressed by participants were:

1. Helping people print more efficiently
2. Influencing people to turn off unnecessary household lighting
3. Encouraging householders to close curtains at night to conserve heat
4. Influencing people to boil the right amount of water in electric kettles
5. Influencing people not to leave water taps running while brushing their teeth

1.2 How designers think: models of the user

One insight which emerged from running these workshops was that for each brief, the concepts generated by different participants seemed to embody different assumptions about 'what users are like'—each behavioural intervention concept can be seen as a statement something like "people will do *that* if our design does *this*…" In the group sessions which formed part of the workshops, intriguing discussions ensued on what could be assumed about human nature when designing with the intention to influence behaviour. While there was recognition that the population could perhaps be segmented into groups with different levels of interest in and attitudes towards the environment (compare Defra, 2008), it was clear that unless a designed artefact was able to tailor *its own behaviour* to each segment of its user base automatically, it was going to be the case that each artefact embodied a particular model of how users think and behave. This model need not be generated by the designer him- or herself—it may well be the model that the client has used to understand the problem, or a model proposed by other project stakeholders. Nevertheless, the designer will have to apply it. As Froehlich et al (2010) put it, “Even if it is not explicitly recognised, designers approach a problem with some model of human behaviour”.

It was decided to investigate the field of *models of the user* further to understand how these models relate to design for sustainable behaviour, and to the kinds of design patterns applied by designers.

Table 1: The eight lenses of the Design with Intent (DwI) toolkit v.1.0 (Lockton et al, 2010c)

Lens	Description
Architectural 12 patterns	Patterns from architecture & planning, also applicable to system architecture: basic affordance patterns such as *Segmentation & spacing*, breaking a system up into parts which users interact with separately rather than all together—e.g. fast food restaurant drive-through split up into multiple windows to prevent one customer blocking it.
Errorproofing 10 patterns	Sees deviations from a target behaviour as ‘errors’ which design can help avoid. Often found in medical device design and manufacturing engineering (as *poka-yoke*)—patterns such as the *Interlock* on an ATM which makes sure the customer removes the card before the cash is dispensed.
Interaction 10 patterns	Patterns where users' interactions with the system affect how their behaviour is influenced—some core human-computer interaction patterns such as kinds of feedback, progress bars, previews, etc, but also Fogg's (2003) work on *Persuasive Technology*, such as *Kairos* (context-sensitive suggestion of behaviour at the right moment, e.g. Amazon's 'often bought with' recommendations).
Ludic 11 patterns	Patterns drawn from games or modelled on more playful forms of influencing behaviour. A great nonprofit sector physical example is the type of spiral charity donation wishing well that provides an exciting, engaging experience for 'users' (often children) while encouraging donations, but lots of digital examples too.
Perceptual 17 patterns	Ideas from product semantics and ecological & Gestalt psychology about how users perceive patterns and meanings. A pleasing sustainable behaviour example is the use of different shaped apertures on recycling bins to suggest which types of rubbish should go where.
Cognitive 15 patterns	Draws on behavioural economics & cognitive psychology, understanding how people make decisions, and using that knowledge to influence actions. Example: I Move You (http://imoveyou.com) employs people's desire to reciprocate socially to encourage people to 'barter' exercise commitments with each other.
Machiavellian 14 patterns	Patterns embodying an 'end justifies the means' approach. Often unethical, but nevertheless commonly used to influence consumers through advertising, pricing structures and so on. E.g. provoking consumers' worry about a problem they didn't know they had (chronic halitosis), and then offering to 'solve' it (Listerine).
Security 12 patterns	Represents a ‘security’ worldview, i.e. that undesired user behaviour is something to deter and/or prevent though ‘countermeasures’ designed into systems: examples such as the threat of surveillance built into environments, digital rights management on music, DVDs & software

2. Uncovering designers' models of users

In order to collect a representative range of designers' models of users relevant to a behaviour-change context, an informal exercise was carried out as part of two workshops at UX London 2010, a major design industry conference focused on user experience, an interaction design specialism focused strongly on understanding and shaping users' interactions with products and services. Over two days, around 130 participants took part in the workshops, the main part of which involved applying some of the Design with Intent patterns (see section 1.1) to a range of behaviour change briefs suggested by the participants.

2.1 Method

Before the DwI patterns had been introduced, participants were asked to write down statements about 'what users are like' in the form 'USERS [verb] [rest of statement]' on Post-It notes (to allow anonymity, and facilitate the next stage of the process)—one statement per note. It was suggested that these could be explicit assumptions that the participants may have heard while working on projects, such as '[Our] USERS WON'T READ INSTRUCTIONS' or implicit assumptions embedded in project briefs, such as 'Reduce the number of options available [because USERS ARE BAD AT MAKING DECISIONS]'. The statements could be assumptions that participants themselves had made (and/or indeed believed) or ones which they had felt were being expressed by others during the design process (which they may have disagreed with). It was emphasised that as many ideas as possible should be included, along the lines of one of Osborn's (1953) primary recommendations for brainstorming: 'Quantity is wanted.'

Participants placed the Post-It notes on the walls of the room, and were asked to spend a couple of minutes reading others' ideas, before collectively attempting to create an *affinity map* (Kawakita, 1991; Scupin, 1997; Gray, Brown and Macanufo, 2010) by clustering similar statements together. After 10 minutes of sorting, a group discussion followed about some of the clusters found, the attitudes revealed, and how common certain types of statements were, compared with others.

Following the workshops, the authors retyped the clustered Post-Its, simplifying the clusters slightly where duplication was apparent or where the statements related too closely to the specifics of a particular project, product or interface element, and gave each cluster a summary label also in the form 'USERS [verb] [rest of statement]' to represent best the plurality of statements contained within it.

2.2 Results

Participants produced 492 statements, equivalent to a mean of around 3.75 per person. Of these, 124 were either not clusterable or related too specifically to a particular product or interface element, leaving 368, grouped into 25 clusters. Table 2 reproduces the detail of two of the clusters to illustrate the kind of statements produced by participants (space does not permit listing all 368 statements in this paper).

Table 2: Two of the 25 clusters of statements generated by participants

USERS CARE ABOUT THEIR SOCIAL CONTEXT *(19 statements)*	**USERS KNOW WHAT THEY WANT** *(14 statements)*
Users like to become experts	Users are aware of their needs
Users want recognition	Users are goal-oriented
Users seek approval	Users are looking for specific information
Users want to be loved	Users are motivated
Users want to be loved / liked	Users are trying to reach a goal
Users want to be noticed	Users have a purpose
Users want to share	Users have clear goals
Users will refer your services to others	Users have clear goals
Users will want to do things that make them look good to family / friends / peers	Users know what they are doing
Users will upload content or increase their contribution	Users know what they are looking for
Users like to know what other users do	Users know what they want
Users like to please (in a test situation)	Users will find it, if they want it
Users like to share stuff	Users are task-focused
Users like to share things with their friends	Users are using our system to reach a goal
Users like to be part of a group	
Users like neighbour stories	
Users are influenced by their peers	
Users are people: people need people	
Users are social: people need people	

It is evident from some of the statements that the primarily digital/web focus of the participants' jobs has led to an emphasis on elements of online interaction, which may not have been apparent with a different group of designers. Nevertheless, product/service systems—often including an online or networked component—are increasingly common in environmentally sensitive design, including in a behaviour-change context (e.g. Consolvo et al, 2007; Dillahunt et al, 2008; Shiraishi et al, 2009), so these statements are still valuable alongside the more generally applicable ones.

Table 3 lists all 25 clusters. A number of them essentially expressed opposite views, while others, though emphasising one aspect of human nature, were not necessarily incompatible with one another. (The most striking personal observation from the authors is that we can imagine using every one of the statements about *ourselves*, at different times and in different contexts.) Equally, many clusters could well overlap: they are not by any means mutually exclusive, or indeed collectively exhaustive, but they represent the kinds of statements designers actually made—or those they have heard from other stakeholders such as clients—about 'what users are like' in the context of developing new products and services. It is interesting to consider the balance of 'user-centredness' in the statements, given the predominance of the user-centred design paradigm in current design thinking: all the statements are inherently 'user-centred', but not all are particularly complimentary about users' abilities or tendencies.

Table 3: Names of all 25 clusters of statements

USERS ARE STUPID	USERS ARE CLEVER / THOUGHTFUL AND WANT TO BE TREATED AS SUCH	USERS DON'T READ OR NOTICE THINGS	USERS WILL READ CERTAIN THINGS	USERS LIKE FEEDBACK, INFORMATION AND ANALYSIS
USERS DON'T WANT CHOICE	USERS WANT CHOICE	USERS DON'T INVESTIGATE FURTHER	USERS WANT TO DISCOVER AND EXPLORE	USERS JUST WANT TO GET ON WITH IT
USERS WANT THE EASIEST WAY TO DO THINGS	USERS WILL SEE PATTERNS AND LEARN FROM THEM	USERS DON'T KNOW WHAT THEY WANT	USERS KNOW WHAT THEY WANT	USERS CARE ABOUT THEIR SOCIAL CONTEXT
USERS CANNOT OR DO NOT MAKE DECISIONS FOR THEMSELVES	USERS ARE RISK-AVERSE / SCEPTICAL / NERVOUS	USERS JUST WANT 'BREAD AND CIRCUSES'	USERS ARE AVERSE TO CHANGE	USERS ARE IMPATIENT / BUSY / TIRED
USERS DON'T UNDERSTAND AND DON'T WANT TO THINK	USERS ARE LAZY	USERS ARE SELF-CENTRED	USERS ARE MONEY- OR REWARD DRIVEN	USERS HAVE A SHORT ATTENTION SPAN

2.3 Understanding the clusters: modelling systems

What can we understand about design for sustainable behaviour from examining the clusters of statements?

Each cluster essentially represents a model of how 'users' will behave in the context of interacting with a product, service or environment. These are not at the level of *personas* as commonly used in interaction design (e.g. Cooper, 1999), which are essentially fictitious-but-useful single users with certain characteristics, but at a higher, 'system' level. Both the user and the product / service / environment can be seen as systems—let us call them the *human system* and the *artefact system*—with the interaction behaviour linking them together into a larger supersystem, which (at least partly) represents the use phase of a product, service or environment's life cycle. Figure 1 illustrates this relationship, borrowing Norman's (1986) concepts of the 'gulf of execution' and 'gulf of evaluation', describing the gaps between the state of the artefact and the user's goals.

The salient point here is that any interaction situation consists of (at least) these two systems coupled together. And while the designer can specify the behaviour of a simple artefact system under different conditions, the behaviour of the human system is—even for the most ardent Behaviourist—not specifiable in the same way. If the designer's aim is to shape the interaction (e.g., in our application, reducing the environmental impact of the use phase), the best that he or she can do is to *model* the human system's behaviour under different conditions, coupled to the behaviour of the artefact system, and design the artefact system's behaviour to work with the assumed model of the human system, to engender the desired interaction.

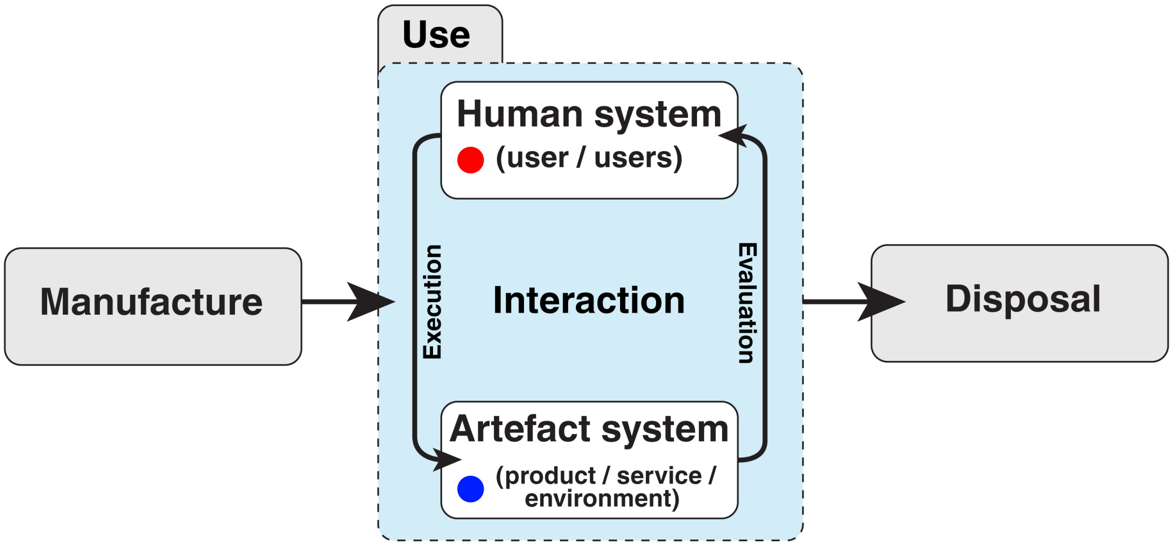


Figure 1: Interaction between the human and artefact systems represented as the 'Use' phase of a simple life cycle.

Applying the work of systems theory pioneers such as Boulding (1956) and Pask (1976) to human-computer interaction, Dubberly, Haque and Pangaro (2009) have presented a simplified set of interaction archetypes, each involving two systems interacting. Each of the two systems can be a *linear* (zeroth-order), *self-regulating* (first-order) or *learning* (second-order) cybernetic system. A linear system is 'open-loop' and can only react to a stimulus or input; a self-regulating system is closed-loop and adjusts its behaviour to match some goal (which it cannot alter itself); while a learning system comprises two nested self-regulating systems such that the second system can alter the goal of the first system.

While Dubberly et al consider users (the human system) as primarily *learning systems*, we have seen from the designers' statements in the clusters in Tables 2 and 3 that designers do not always view users in this way. For example, USERS DON'T UNDERSTAND AND DON'T WANT TO THINK models the human system very differently to USERS WANT TO DISCOVER AND

EXPLORE. Table 4 shows the 9 permutations produced: this expands Dubberly et al’s work slightly, by explicitly including reversed permutations of coupled systems such as 1-0 as well as 0-1 (since in the context under discussion, the order in which the models of the human- and artefact systems are coupled matters).

It can be seen from the table that focusing on the way the human system is modelled, there are three groups (human system as linear, human system as self-regulating and human system as learning) of three archetypes each. How well do these map to the statements made by designers? In the context of thinking about *people*, what do terms such as ‘self-regulating’ really mean?

2.4 Pinballs, shortcuts and thoughtfulness

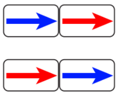
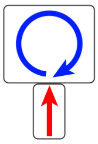
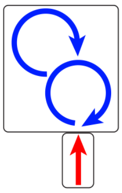
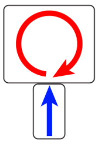
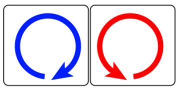
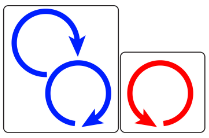
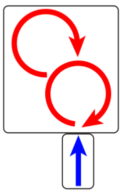
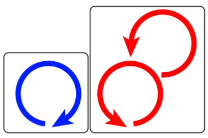
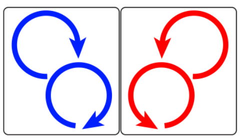
The limited context in which we are trying to understand how designers model users relates specifically to *influencing users’ behaviour*. It makes sense, then, to consider the linear, self-regulating and learning archetypes with reference to this.

2.4.1 The ‘pinball’ metaphor for linear models of the human system

A linear human system implies a model of a user who only reacts simply to inputs, doing the same thing each time the same stimulus is applied, and does not think about any decisions. To influence this kind of user’s behaviour, the designer will probably be applying techniques such as *forcing functions* (Lewis and Norman, 1986) or *control poka-yokes* (Shingo, 1986).

This linear approach can be seen as modelling users as something like *pinballs* to shunt around, ignoring any more nuanced interaction processes, and not taking into account any kind of feedback loop. Many other products and services have aspects where a degree of control is desired, often for safety or security reasons. The interlock on a microwave door prevents using the oven with the door open, yet does not try to educate users as to why it is safer. It just silently structures behaviour: users follow the designers’ behaviour specification without necessarily being aware of it. If a bank has a row of ATMs, it doesn't want customers at adjacent machines to stand too close together, so it spaces them far enough apart for this not to happen: the actual affordances of the system are designed so that only certain behaviours occur, regardless of whether users are even aware of how their behaviour is being influenced. Note that the pinball model is really shorthand for ‘model users as *no better than linear systems* even though we are aware that humans are really higher-order systems than this.

Table 4: Permutations of artefact- and human-system models, following Dubberly et al (2009). The example statements are drawn from both the titles of the clusters in Table Y and the individual designers' Post-It notes discussed in section 2.2

Interaction archetype	Diagrammatic representation	Model of artefact system	Model of human system	Example statements about human system in this context
0-0		linear	linear	e.g. USERS ARE STUPID
1-0		self-regulating	linear	e.g. USERS ARE NOT AS SAVVY AS WE ARE
2-0		learning	linear	e.g. USERS CANNOT OR DO NOT MAKE DECISIONS FOR THEMSELVES
0-1		linear	self-regulating	e.g. USERS WANT THE EASIEST WAY TO DO THINGS
1-1		self-regulating	self-regulating	e.g. USERS ARE IMPATIENT / BUSY / TIRED
2-1		learning	self-regulating	e.g. USERS ONLY LOOK AT A FEW OPTIONS
0-2		linear	learning	e.g. USERS ARE CLEVER / THOUGHTFUL AND WANT TO BE TREATED AS SUCH
1-2		self-regulating	learning	e.g. USERS WILL SEE PATTERNS AND LEARN FROM THEM
2-2		learning	learning	e.g. USERS LIKE FEEDBACK, INFORMATION AND ANALYSIS

Two clusters in Table 3 which fit strongly with the pinball model are USERS ARE STUPID and USERS CANNOT OR DO NOT MAKE DECISIONS FOR THEMSELVES. There are also a number of clusters which describe something close to this model, but perhaps crediting users with a slightly more nuanced behavioural response: USERS DON'T READ OR NOTICE THINGS, USERS DON'T INVESTIGATE FURTHER, USERS JUST WANT 'BREAD AND CIRCUSES' and USERS DON'T KNOW WHAT THEY WANT. In each of these cases, there is something else beyond the linear system of the pinball—it seems to credit users with some element of a mind of their own, even if the assumption is that this mind is not applied fully to behaviour. We will return to discuss these cases in section 2.4.4.

2.4.2 The 'shortcut' metaphor for self-regulating models of the human system

In the context of user behaviour, a self-regulating human system can perhaps be understood by drawing parallels between the kind of behaviour exhibited by the centrifugal 'fly-ball' governor James Watt employed on his steam engines (Maxwell, 1868; also noted by Dubberly et al (2009) as an archetypal 'mechanical' example of self-regulation), and the concept of bounded rationality—e.g. *satisficing* (Simon, 1956, 1969) and *fast-and-frugal heuristics* (Gigerenzer and Selten, 2001)—in which actors employ decision strategies to make a 'good enough' choice rather than expending largely unproductive effort in trying to 'optimise' their choices. In both cases, a 'stopping rule' is employed which prevents the system (human or mechanical) entering an inefficient state where energy is wasted: these are essentially conservative strategies. Wallace (1858) compared Watt's governor with what would become known as natural selection in his 'Ternate letter' to Darwin, in the sense that it prevented any "unbalanced deficiency…reach[ing] any conspicuous magnitude," and Bateson (1972) and Smith (2004) have extended this in a cybernetic context by considering the kinds of feedback involved.

Returning to our context, a self-regulating human system can thus be seen as a user who is boundedly rational, who makes choices to minimise energy or cognitive expenditure. This means wanting the easiest way to do things, being influenced by cognitive biases and heuristics (Tversky and Kahneman, 1974) such as *social proof* or the *status quo bias* and not wanting to have to think (Krug, 2006): this model is of a user who takes *shortcuts* rather than thinking deeply about problems and how to solve them.

He or she makes decisions based on how choices are presented, and does not devote the same mental effort to engage with every decision faced. If something is the default option, whether double-sided printing in a dialogue box or a 30°C wash cycle on the washing machine, the shortcut user will probably stick with it. Clusters of statements matching this model most directly are USERS WANT THE EASIEST WAY TO DO THINGS, USERS DON'T WANT CHOICE, USERS CARE ABOUT THEIR SOCIAL CONTEXT, USERS ARE AVERSE TO CHANGE, USERS ARE IMPATIENT / BUSY / TIRED, USERS DON'T UNDERSTAND AND DON'T WANT TO THINK, USERS ARE LAZY, USERS HAVE A SHORT ATTENTION SPAN, USERS ARE MONEY- OR REWARD-DRIVEN and USERS ARE SELF-CENTRED.

2.4.3 The 'thoughtful' term for learning models of the human system

In a behaviour-change context, a learning human system can be seen as modelling users as *thoughtful* people, who think about what they are doing, and why, analytically—they are able to set and modify their own goals and are open to 'central route' persuasion (Petty and Cacioppo, 1981) through reasoned arguments about why some behaviours are better than others, maybe motivating them to change their attitudes about a subject as a precursor to changing their behaviour mindfully. These are users who can learn from their mistakes (and those of others) and change their behaviour accordingly.

Designers modelling users as thoughtful will probably be presenting them with information and feedback allowing them to explore the implications of what they're doing, and understand their impacts on the world. This is the case with many sustainable behaviour interventions such as educational campaigns about pro-environmental behaviour, much work on feedback with energy meters (e.g. Darby 2006) and so on. Most designers—indeed most people—probably like to model *themselves* as thoughtful, even though we know we don't always fit the model.

Some clusters matching this model are easy to identify: USERS ARE CLEVER / THOUGHTFUL AND WANT TO BE TREATED AS SUCH, USERS KNOW WHAT THEY WANT, USERS WANT CHOICE, USERS WILL SEE PATTERNS AND LEARN FROM THEM, USERS WANT TO DISCOVER AND EXPLORE and USERS LIKE FEEDBACK, INFORMATION AND ANALYSIS. There are, again, a few which seem to fall slightly short of the full 'thoughtful' characterisation, which will be examined in the next section.

2.4.4 The pinball-shortcut-thoughtful spectrum

It is clear that the models outlined above are not definitive: they are simply a way of understanding how to apply the different kinds of system archetypes in the context of design for behaviour change. One very important point is that designers can (and indeed probably should) assume variability across the range of the prospective users of the product / service / environment. For example, designing the 30°C wash cycle to be the default setting on a washing machine may represent a pinball model of some users, who will simply accept the setting without even considering that it *can* be changed; a shortcut model of other users, who know it can be changed but assume it's probably right (since it's the default, or is perceived to be too much effort to change); and a thoughtful model of another group of users, who will investigate other settings, treating the default as nothing more than a starting-point for exploration of the interface. For any interaction situation—any coupling of the human- and artefact systems—there is perhaps a *spectrum* of users matching the different models, some more than others. Appreciating, or determining where on the spectrum different users will lie, and matching the artefact system models accordingly, seems crucial to effective design for sustainable behaviour.

As part of a spectrum, the pinball, shortcut and thoughtful models can be treated as 'markers' rather than absolute categories. This allows more nuanced statements such as USERS DON'T INVESTIGATE FURTHER (mentioned in section 2.4.1) to be positioned somewhere between models with which they share some characteristics (in this example, some users may not investigate further because they're 'pinballs', while others may not do it as they take whatever shortcuts they can, including avoiding extra investigation). Table 5 shows the 25 clusters of Table 3 distributed on the spectrum.

3. Implications for design for sustainable behaviour

As discussed in section 1.2, all design happens with *some* model of the user in mind, and in designing to influence user behaviour, this potentially becomes even more important to consider. While it is outside the scope of this paper to review the whole field of 'sustainable behaviour' interventions to uncover the models designers have used, it is worth examining how the pinball-shortcut-thoughtful spectrum outlined above can be seen to manifest itself in some examples aiming to produce environmental benefit through behaviour change.

3.1 The pinball model and influencing more sustainable behaviour

Manifestations of the pinball model in the context of influencing more sustainable behaviour centre around the ideas expressed by the USERS ARE STUPID and USERS CANNOT OR DO NOT MAKE DECISIONS FOR THEMSELVES clusters (see section 2.4.1). Interventions such as removing tungsten filament incandescent lightbulbs from sale (e.g. Commission of the European Communities, 2009) or the Eaton MEM BC3 system (Lockton, 2008) use patterns such as *choice editing*, *matched affordances* and *format lock-in* to force consumers to change their behaviour—the aim is not to provide users with a range of choices and help them choose what is best for them, but to cause absolute compliance with a target behaviour (knowingly or otherwise).

Table 5: The 25 clusters of Table 3, distributed on the pinball-shortcut-thoughtful spectrum derived from Table 4. The clusters in bold represent perhaps a 'prototypical' description of each model.

Pinball	⟷	Shortcut	⟷	Thoughtful
USERS ARE STUPID	USERS DON'T READ OR NOTICE THINGS	**USERS WANT THE EASIEST WAY TO DO THINGS**	USERS WILL READ CERTAIN THINGS	**USERS ARE CLEVER / THOUGHTFUL AND WANT TO BE TREATED AS SUCH**
USERS CANNOT OR DO NOT MAKE DECISIONS FOR THEMSELVES	USERS DON'T INVESTIGATE FURTHER	USERS DON'T WANT CHOICE	USERS JUST WANT TO GET ON WITH IT	USERS KNOW WHAT THEY WANT
	USERS JUST WANT BREAD AND CIRCUSES	USERS CARE ABOUT THEIR SOCIAL CONTEXT	USERS ARE RISK-AVERSE / SCEPTICAL / NERVOUS	USERS WANT CHOICE
	USERS DON'T KNOW WHAT THEY WANT	USERS ARE AVERSE TO CHANGE		USERS WILL SEE PATTERNS AND LEARN FROM THEM
		USERS ARE IMPATIENT / BUSY / TIRED		USERS WANT TO DISCOVER AND EXPLORE
		USERS DON'T UNDERSTAND AND DON'T WANT TO THINK		USERS LIKE FEEDBACK, INFORMATION AND ANALYSIS
		USERS ARE LAZY		
		USERS HAVE A SHORT ATTENTION SPAN		
		USERS ARE MONEY- OR REWARD DRIVEN		
		USERS ARE SELF-CENTRED		

A pinball approach often involves legislation. The aforementioned MEM BC3 system (Figure 2)—effectively a 3-pin bayonet light fitting, and special 3-pin compact fluorescent bulbs to fit it—arose from Amendment L1 of the UK Building Regulations (Office of the Deputy Prime Minister, 2002, p. 17), which from 2002 required all new residential properties to be fitted with a number of light fittings that could *only* accept 'low energy' bulbs'. The need to comply with this requirement led to Eaton's MEM BC3 system being widely incorporated into new houses, with the fittings designed to accept only the BC3 compact fluorescent bulbs (retailing at around £10 each) rather than the standard two-pin CFLs (or other bulb types). This monopoly situation has not pleased consumers faced with paying significantly more than necessary for replacement bulbs (see readers' comments on Lockton, 2008). One reader commented that she has "220 social housing tenants, many of whom are on low incomes, who are sitting in the dark because they cannot afford the bulbs." In this sort of situation, treating all users as pinballs in an attempt to force behaviour change risks provoking significant reactance, which may even 'poison' user attitudes towards other environmentally beneficial products or design changes.

In Table 6, a range of example sustainable behaviour interventions using a pinball approach are listed, together with the DwI patterns they employ (see section 1.1).

Figure 2: Eaton MEM BC3 bulb & fitting (right) compared with standard bayonet bulb & fitting (left).

Table 6: Five examples of sustainable behaviour interventions taking a pinball model approach.

Design with Intent patterns	**Example *pinball* sustainable behaviour interventions**
Feature deletion	Removing standby buttons from television sets
Hiding things	Covering up heating controls to prevent users changing settings
Choice editing	Removing leaded petrol from sale
Interlock	System preventing air conditioning from operating if windows are open
Matched affordances	Eaton MEM BC3 bulb and fitting (see above)

3.2 The shortcut model and influencing more sustainable behaviour

One consequence of the shortcut model especially relevant to sustainable behaviour is how it relates to the concept of *energy literacy*. Without thinking or understanding too much about energy use, people tend to overestimate the energy used by some appliances where it is very visible (e.g. lighting) compared with invisible uses such as air conditioning (Kempton & Montgomery, 1982). This immediately suggests redesigning devices to incorporate obvious, vivid displays of energy use, which could be feedback on actual energy use (fitting more closely with a thoughtful model) or simply a *reminder that energy is being used*—an ultra-simple kind of feedback.

It could be that it 'translates' all environmental impact into some single vivid shortcut 'measure' which is intended to have an emotional impact on householders, such as Shiraishi et al's EcoIsland game (2009), which "visualises the user's current eco-friendly behaviour as an island shared by his/her family members," with the island sinking if the family does not work together to reduce their CO_2 impact. A trial with six families led to increases in environmental awareness but not significant changes in actual behaviour.

In this context, Wilson & Dowlatabadi (2007) note that "emphasising one particularly salient or emotional attribute may influence a decision more than providing information on all attributes." There is a risk here of oversimplification, of conflating unrelated environmental behaviours and impacts into a 'measure' which is nothing of the sort, without educating users about anything deeper, but it may be that designed shortcuts which just allow users to make rapid, satisficing decisions about what action to take (and in the process reduce their environmental impact) can be effective. This is the sort of thinking behind Thaler and Sunstein's *Nudge* (2008) and a number of interventions using principles from behavioural economics; Table 7 gives some examples of interventions assuming a shortcut model of the user, with the relevant DwI patterns identified.

Table 7: Four examples of sustainable behaviour interventions taking a shortcut model approach.

Design with Intent patterns	**Example *shortcut* sustainable behaviour interventions**
Simplicity	Ecobutton (Figure 3) allows users to put a computer into a low-power mode with a single press
Defaults	40°C or even 30°C default wash cycles on washing machines
Portions	Unilever's 'portion' detergent tablets are in part an attempt to ensure that users do not use more (or less) than the optimum amount of powder for each wash (Lilley et al, 2005)
Social proof	OPOWER (e.g. Allcott, 2010), building on the work of Schultz et al (2007), gives electricity and gas customers 'neighbourhood comparisons' of their energy use

Figure 3: Ecobutton is a USB device allowing a computer to be put into a low-power mode very simply

3.3 The thoughtful model and influencing more sustainable behaviour

Thoughtful users are assumed to think about what they are doing—and why—and learn from their experiences and those of other people. In the context of sustainable behaviour, this may take the form of presenting users with educational information exhorting behaviour change, and/or feedback on energy use and environmental impact allowing them to explore the implications of what they are doing (or could do better), and understand the consequences of behaviour.

A key point here is that a thoughtful user model of behaviour change assumes that where people profess the intention to behave in a more environmentally beneficial way, they will actually be able to do this in practice. This is not necessarily the case: Guerin et al (2000), reviewing 45 US studies of residential energy use from 1975-98 note that it was demographic characteristics of the occupants and their homes (e.g. age, income, home ownership, education, number of occupants, and physical size of the house) that were actually the better predictors of environmentally beneficial behaviour and reduced energy usage, rather than occupants' professed attitudes in favour of conservation. Table 9 gives some examples of sustainable behaviour interventions assuming a thoughtful model of the user, with the relevant Dwl patterns identified.

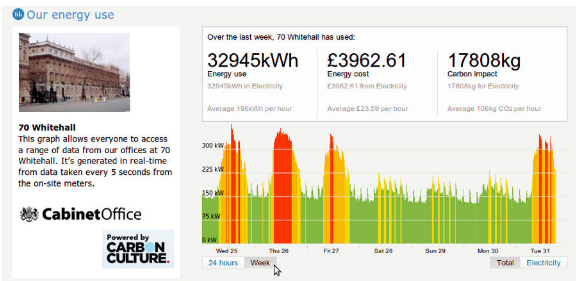


Figure 4: More Associates' CarbonCulture energy display for the UK government's Cabinet Office

Table 9: Four examples of sustainable behaviour interventions taking a thoughtful model approach.

Design with Intent patterns	Example *thoughtful* sustainable behaviour interventions
Feedback through form	The AWARE Puzzle Switch, produced by Stockholm's Interactive Institute, is a patterned light switch which is visibly disordered when switched on
Real-time feedback	McCalley & Midden (2002), focusing on washing machine use, gave users immediate feedback on the energy (kWh) used per load, and allowed them to set goals for reducing their usage
Provoke empathy	Dillahunt et al (2008) produced a game with a 'virtual polar bear' standing on a shrinking (or growing) ice floe to represent the effects of participants' (self-reported) environmentally responsible behaviour
Sousveillance	CarbonCulture, by More Associates (Figure 4) is being used by a number of UK government departments to make energy use data, trends and costs available publicly—allowing public scrutiny of civil servants' energy behaviour

3.4 Discussion

The real test of how appropriate the different models are in particular sustainable behaviour situations is the change in user behaviour that results in practice.

The vibrancy of the emerging design for sustainable behaviour field is testament to the fact that definitive answers about what works and what doesn't, when and why, have not yet been found for many domains. Indeed, if in reality the users of a new product or service display a multiplicity or spectrum of models, it may never be possible to design artifacts which can match all of them at once.

However, the models developed in this paper from statements about the nature of users, made by designers, can certainly be seen to provide an additional perspective on how the design process can work for sustainable behaviour problems: even the step of a design team recognising which model of the user is dominating a client's thinking could be an important trigger for considering other models which might also be worth investigating.

The authors intend to do further work exploring both designers' models of users, and also users' mental models of the technology around them—and how matching, and shifting, these can work to influence behaviour for environmental benefit.

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