Design with Intent

A design pattern toolkit for environmental & social behaviour change

A thesis submitted for the degree of
Doctor of Philosophy

by Daniel J. G. Lockton
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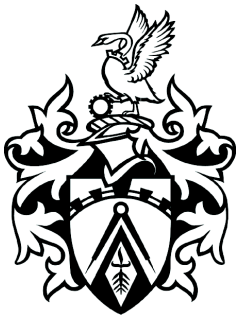

School of Engineering & Design
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"The engineer, and more generally the designer, is concerned with how things *ought* to be..."

Herbert A. Simon, *The Sciences of the Artificial*, 1969 (p.7 of 1981 MIT Press 2nd edition)

Abstract

This thesis describes a systematic research enquiry into influencing more sustainable behaviour through design, which has produced communicable new knowledge in the form of a design pattern toolkit, called Design with Intent, developed and evaluated through an action research process. The toolkit aims to help designers create products, services and environments which influence the way people use them, primarily for environmental and social benefit; it brings together techniques for understanding and changing human behaviour from a range of psychological and technical disciplines, illustrated with examples, with the aim of enabling designers to explore and apply relevant strategies to problems.

'Design for behaviour change' has grown significantly as a field in the past few years, to a large extent due to recognition of the contributions that user behaviour makes to the environmental and social impact of technology—and designed systems in general. People's behaviour is inevitably influenced by the design of the systems which they use, and it is not a great leap to consider that design could be used intentionally to influence behaviour where some benefit would result.

This thesis starts by identifying the need for a guide for designers working on behaviour change. It extracts insights from reviews of perspectives on influencing behaviour from different disciplines, inside and outside of 'design', which could be usefully applied in a design context. Through an action research process of iterative development and workshops with design practitioners and students, these insights are incorporated into a toolkit for designers, which is applied mainly to environmental and social behaviour change briefs. Versions of the toolkit are made publicly available, and feedback from early users in different contexts is analysed and implications for continuing development discussed.

A readers' guide to this thesis, with commentary from the author, useful aspects highlighted, and links to relevant literature, is available at:

http://danlockton.co.uk/phdintro

Declaration

I declare that this thesis was written by myself, that the work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or professional qualification.

Daniel Lockton

January 2012

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Contributions to knowledge

The contributions to knowledge in design research and design practice offered by this thesis[1] centre on a systematic research enquiry into influencing more sustainable behaviour through design, which has produced communicable new knowledge in the form of a design pattern toolkit. Developed and evaluated through an action research process, the Design with Intent toolkit is a collection of design patterns intended to be of use to design practitioners working on behaviour change-related problems for environmental and social benefit.

The focus is on making contributions to knowledge in the design discipline, by answering the research question:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

The question has been answered through synthesising and organising, into a design pattern form, a diverse set of behaviour change techniques and examples from a range of disciplines, to create the toolkit, contributing to design practice. A second research question has also been addressed:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

In answering this question through cycles of development and testing, a contribution has been made to design research.

The toolkit has been demonstrated to be of use for idea generation through a series of workshops and independent application of the toolkit by early users; it has helped design practitioners (and students) with a range of specialisms, from user experience to architecture, create concepts for tackling a wide range of environmental and social behaviour change problems through design. Insights from a survey and case studies detail how some designers have adopted the toolkit as part of their processes, for idea generation but also for a number of other use-cases.

[1] See section 7.3 for a more detailed discussion of the contribution to knowledge and how the research question has been answered.

Publications arising from this PhD

A number of articles, papers and other publications by the author have arisen from this PhD, and are available at http://danlockton.co.uk/pubs

These have each has been given a short reference, e.g. **[A1]** to enable clearer citations throughout this thesis; the publications include:

- Two versions of the Design with Intent toolkit (v.0.9 poster and both card and worksheet variants of v.1.0)
- Published articles and papers covering, and extending, work discussed in Chapters 4, 5 and 6 of this thesis
- Working papers comprising a literature review of treatments of 'behaviour' across multiple disciplines, and implications for designers (explained in sections 1.5 and 2.2)
- Articles and papers from the EMPOWER project (see section 5.4.1) which draw on, and extend, the work covered in this thesis

A: Publicly released versions of the Design with Intent toolkit

- **[A2]** Lockton, D., Harrison, D.J., Stanton, N.A. Design with Intent: 101 Patterns for Influencing Behaviour Through Design v.1.0, Windsor: Equifine 2010 (ISBN 978-0-9565421-0-6 print; 978-0-9565421-1-3 eBook). In both 'cards' and 'worksheet' form.
- **[A1]** Lockton, D., Harrison, D.J., Stanton, N.A. Design for Behaviour Change: The Design with Intent Toolkit v.0.9, Uxbridge: Brunel University Press 2009 (ISBN 978-1-902316-6-1 print; 978-1-902316-63-5 eBook). In poster form.

B: Academic journal articles based on PhD

- **[B4]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Exploring design patterns for sustainable behaviour'. *The Design Journal*, Vol. 17 No. 1, to appear, March 2014
- **[B3]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Models of the user: designers' perspectives on influencing sustainable behaviour'. *Journal of Design Research*, Vol. 10 No. 1/2, pp. 7-27, March 2012
- **[B2]** Lockton, D., Harrison, D.J., Stanton, N.A. 'The Design with Intent Method: a design tool for influencing user behaviour'. *Applied Ergonomics*, Vol. 41 No. 3, pp. 382-392, May 2010
- **[B1]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Making the user more efficient: Design for sustainable behaviour'. *International Journal of Sustainable Engineering*, Vol. 1 No. 1, pp. 3-8, March 2008

C: Academic conference papers and posters based on PhD

- **[C6]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Modelling the User: How design for sustainable behaviour can reveal different stakeholder perspectives on human nature'. ERSCP-EMSU 2010, Delft, Netherlands, 25-29 October, 2010, Proceedings, TU Delft

- **[C5]** Lockton, D., Harrison, D.J, Stanton, N.A. 'Concept Generation for Persuasive Design'. Persuasive Technology: 5th International Conference, Persuasive 2010, Copenhagen, Denmark, 7-9 June, 2010, Poster proceedings, University of Oulu Department of Information Processing Science

- **[C4]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Design for Sustainable Behaviour: investigating design methods for influencing user behaviour'. In Sustainable Innovation '09: Towards Sustainable Product Design 14, Farnham, UK, 26-27 October 2009, Proceedings, Centre for Sustainable Design, Farnham

- **[C3]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Choice Architecture and Design with Intent'. In Wong, W & Stanton, N.A. (eds.), NDM9: 9th Bi-annual International Conference on Naturalistic Decision Making, 23-26 June, 2009, London, UK, Doctoral Consortium Proceedings, British Computer Society, Swindon

- **[C2]** Lockton, D., Harrison, D.J., Holley, T., Stanton, N.A. 'Influencing Interaction: Development of the Design with Intent Method'. In Persuasive Technology: 4th International Conference, Persuasive 2009, Claremont, California, 27-29 April, 2009, Proceedings, ACM Digital Library, New York

- **[C1]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Design with Intent: Persuasive Technology in a Wider Context'. In H. Oinas-Kukkonen, P. Hasle, M. Harjumaa, K. Segerstahl, & P. Ohrstrom (Eds.), Persuasive Technology: 3rd International Conference, Persuasive 2008, Oulu, Finland, 4-6 June, 2008, Proceedings (p. 274—278), Lecture Notes in Computer Science vol. 5033, Springer, Berlin

D: Professional journal articles based on PhD

- **[D3]** Bisset, F. and Lockton, D. 'Designing Motivation or Motivating Design? Exploring service design, motivation and behavioural change'. *Touchpoint: The Journal of Service Design*, Vol. 2 No. 1, April/May 2010[2]

- **[D2]** Marsh, N. and Lockton, D. 'Research in practice: Bringing behaviour change from lab to studio'. *Touchpoint: The Journal of Service Design*, Vol. 2 No. 1, April/May 2010

- **[D1]** Lockton, D. 'Design for sustainable behaviour: influencing users to improve efficiency of product use' ('My PhD' series). *Interfaces* 78, British Computer Society Interaction Group, Spring 2009

E: Book chapters based on PhD

- **[E2]** Lockton, D., Harrison, D.J., Stanton, N.A. 'Design for Behaviour Change' in A.M. Columbus (ed.): *Advances in Psychology Research* 67/69, Hauppauge: Nova Science Publishers, 2010

[2] On this article and the following one (both from *Touchpoint*, Vol.2 No.1), Daniel Lockton was a second author, contributing around 50% of the text. On all other publications listed here, Daniel Lockton was the main author and both carried out the majority of the work described, and wrote the majority of the article.

- **[E1]** Lockton, D. 'Design with Intent: Influencing people's behaviour through products & services' in B. Davey et al (eds.), *250 Innovative Ideas: Made in Brunel 2010*, London: Papadakis, 2010

F: Working papers contributing to literature review for this PhD

- **[F9]** Lockton, D. 'Persuasive Technology and Digital Design for Behaviour Change'. Working paper, published on Social Science Research Network, August 2012
- **[F8]** Lockton, D. 'Simon's scissors and ecological psychology in design for behaviour change'. Working paper, published on Social Science Research Network, August 2012
- **[F7]** Lockton, D. 'Social and interpersonal approaches to design for behaviour change'. Working paper, published on Social Science Research Network, August 2012
- **[F6]** Lockton, D. 'Cognitive biases, heuristics and decision-making in design for behaviour change'. Working paper, published on Social Science Research Network, August 2012
- **[F5]** Lockton, D. 'Attitudes, meaning, emotion and motivation in design for behaviour change'. Working paper, published on Social Science Research Network, August 2012
- **[F4]** Lockton, D. 'Affordances, constraints and information flows as 'leverage points' in design for sustainable behaviour'. Working paper, published on Social Science Research Network, April 2012
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- **[F2]** Lockton, D. 'Architecture, urbanism, design and behaviour: a brief review'. Working paper, published on Design with Intent blog, September 2011
- **[F1]** Lockton, D. 'Design and behaviourism: a brief review'. Working paper, published on Design with Intent blog, July 2011

G: Articles and papers from the EMPOWER project, drawing on this PhD

- **[G2]** Lockton, D., Harrison, D., Cain, R. Stanton, N.A., Jennings, P. 'Exploring problem-framing through behavioural heuristics'. *International Journal of Design*, 7(1), 37-53, April 2013
- **[G1]** Lockton, D., Cain, R., Harrison, D., Giudice, S., Nicholson, L. & Jennings, P. 'Behaviour Change at Work: empowering energy efficiency in the workplace through user-centred design'. BECC 2011: Behavior, Energy & Climate Change, Washington, DC, November 30-December 2, 2011, University of California eScholarship repository

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Preface

I began this PhD in September 2007, but had been investigating the links between design and people's behaviour, informally, for a couple of years before that, mainly via a blog, 'Architectures of Control in Design'.[3]

The blog started in 2005 as a way of publishing and getting comments on my Master's project; I was studying Technology Policy (a joint course at Cambridge between the Judge Institute of Management and Cambridge University Engineering Department, initiated by the Cambridge-MIT Institute), and had become fascinated with the ways in which politics affected the design of products, systems and environments. In particular, learning more about the free software movement and issues around digital rights started to reveal a perspective on how consumers' behaviour was, in many cases, being not just influenced but *controlled* by aspects of technology—and this was a perspective to which I had rarely been exposed as an undergraduate industrial design engineering student at Brunel. What I had learned about behaviour was mainly from a usability angle, via Donald Norman's work—and from practical experience talking to users while working as a designer on mobility products—but it seemed that it might be possible to integrate a slightly different, strategic, approach to understanding and influencing people's interaction with the systems around them.

Aside from what was needed for the Master's dissertation (Lockton, 2005), it soon became something of a pastime to investigate and uncover the possible 'intent' behind lots of everyday systems—from printer cartridges with expiry chips in them to blue lighting in public toilets—where trying to get users to do, or not do something seemed to be part of the design strategy. The blog was a wonderful way to continue this research informally while I worked as a design engineer (mostly on folding bicycle design) after my Master's; comments and suggestions from readers all over the world convinced me that this was an interesting subject, and one that seemed under-explored.

Something which became clear the more I researched, was that while many of the examples I was seeing were quite socially 'negative'—e.g. benches to prevent homeless people sleeping on them—many similar techniques seemed as though they could be applied in more *positive*, socially beneficial ways. B.J. Fogg's *Persuasive Technology*, which I first read during my Master's, offered a template for designing systems which helped people behave in ways they wanted (exercising more, eating more healthily, and so on) through influencing their behaviour, and this more optimistic approach planted the seed in my mind that maybe I, as a designer, could bring together some of the techniques I had learned about through other research, into a form which would be of use to other designers who wanted to help people, help society, and indeed help the environment, through influencing behaviour.

Remembering the life-cycle energy implications of product use (as opposed to manufacture or disposal), which I had first learned during an undergraduate course on environmentally sensitive design, and thinking further about how much impact people's behaviour can have in a variety of ways, I decided that this was an opportunity: investigating design techniques for influencing more sustainable behaviour.

So, in September 2007, I returned to Brunel Design—now at Uxbridge, rather than Runnymede—to start this PhD, initially (naïvely) aiming to develop both some kind of

[3] Renamed 'Design with Intent' in December 2007: http://danlockton.co.uk

design guide *and* prototype and run user trials with devices with 'persuasive' interfaces within three years. In the event, developing the guide itself proved more than enough work, and it has taken a subsequent project, EMPOWER, to delve into real-life user trials. Throughout my PhD, I have been extremely fortunate to be funded, both by the Ormsby Trust and the Thomas Gerald Gray Charitable Trust, and to have had two very supportive supervisors, Professor David Harrison and Professor Neville Stanton (now at Southampton).

This thesis, along with the Design with Intent toolkit itself, is part of the output of five years of PhD work, the last two years very part-time alongside working primarily on the (related) EMPOWER project, a TSB-funded collaboration between Brunel, More Associates and WMG at the University of Warwick, in which we have applied behavioural insights to the design and development of a digital platform for engaging staff in more sustainable behaviour in workplaces.

There are a few people whose work recurs throughout this thesis, often touching on multiple problems which at first sight appeared disparate. The list is headed by Herbert Simon, whose work over a 60-year, Nobel Prize-winning career linked subjects including design, human behaviour, decision-making, problem-solving, artificial intelligence, cybernetics, games, cognitive psychology, economics and organisational structures. In particular, as well as using his 'scissors' metaphor to structure the literature review, I have quoted extensively Simon's *Sciences of the Artificial* (1969/1981), which is a book both amazing in its scope and somehow frustrating in seeming to come so close to many of the other ideas around behaviour and design which might have been expressed, but were left to others to do.

The influence of Donald Norman—whom I had the honour of meeting briefly in 2011 thanks to Andy Budd of Clearleft—pervades almost the entire thesis. He is not referenced as much as he should be: in some way, his ideas and forms of expression have become so central to my thinking as a designer that they are perhaps taken for granted. Looking through the references, other figures whose ways of thinking seem ever-present include Christopher Alexander and Edward de Bono.

One of the fascinating features of looking at 'design and behaviour' is how looking for links between the two involves taking a slice through so many disciplines and subjects, all of which have something to say about the way that *things* (products, services, environments—*systems*) affect what people do. Many of the subjects touched on in this thesis could, with a different method of analysis, have been suitable for a research project in cybernetics, political science, behavioural economics, architecture or science and technology studies, or indeed many branches of psychology.

The literature review providing input to this thesis was thus very broad, covering a diverse range of disciplinary approaches to behaviour. This material is important to understanding the development of the toolkit, but has been published separately **[F1–9]** to reduce the length of the thesis, on the examiners' instruction, with only a summary of some of the insights provided in the thesis itself. I hope that the connections revealed between concepts in different disciplines are adequately extracted and presented in a form which 'makes sense' in a design context.

In my relatively brief life as a designer in industry, I was always most interested in 'what we could do with' whatever new technology or method I came across—perhaps a bit like a chimpanzee working out that a twig affords reaching into a termite mound—and this is largely the approach taken in this thesis. Here are lots of ideas: what could we do with them?

1 Introduction

> "[A] technology does much more than realize the goal toward which it is put; it always helps to shape the context in which it functions, altering the actions of human beings and the relation between them and their environment."
>
> Peter-Paul Verbeek, *What Things Do*, 2005, p.43
>
> "Increasingly there has been a tendency to think of policies, institutions, and behaviour itself, as objects of design."
>
> Donald A. Schön, *The Reflective Practitioner*, 1983, p.77

Everything that is designed affects our behaviour, whether it is intended to do so or not. The layout of a room, the order of the options in a list, the colour of a warning sign, the markings on a kettle: they all affect the decisions we make and the actions we take. Stanton and Baber (1998, p.1-3) make the point that "[i]n designing products, designers are also designing user activity, which does not occur independently of the product... consumer behaviour is shaped by products as much as products are shaped by consumer behaviour." And that behaviour can have wider consequences, for the environment, for society, for ourselves and for others. As Cooper (2007, p.xvi) notes, "[d]esigners make daily decisions [not only] with regard to the use of resources, [but also] to the lifestyle and use of products, places and communications."

As designers, being conscious of the impacts that our design can have on behaviour leads naturally to the conclusion that we could use design to *influence* behaviour: if certain techniques have effects on people's behaviour unintentionally, some of those techniques might be applied *intentionally*. This is the origin of the term 'Design with Intent' as used in this thesis: it covers strategic design *intended* to result in certain user behaviour.

Sunstein and Thaler (2003, p.1,164) have argued—using the example of a cafeteria director choosing how to lay out the items presented to customers—that since in *any* planning process some decisions will be made which affect behaviour, it is incumbent on us as designers to consider the impact of these decisions, and try to achieve a 'desirable' behavioural outcome[1] (an approach they term *libertarian paternalism*). By this argument, choosing not to think about influencing behaviour *is still a decision about influencing behaviour*.

Indeed, there is growing recognition that "designers are in the behaviour business", as Frog Design's Robert Fabricant (2009) puts it. Kolko (2007, p.12) goes so far as to suggest that "the purpose of the [interaction design] profession [is] to change the way people behave".

In combination with acknowledgement of the behavioural contribution to environmental and social problems, research on how design influences behaviour is increasingly being called upon in the development of new products and services: 'design for behaviour change', with 'design for sustainable behaviour' as a subset, is emerging as a multidisciplinary field of design research and practice (Lilley, 2007).

[1] The author has discussed some ethical perspectives on design for behaviour change in **[F3]**

1.1 Sustainable behaviour as a challenge for designers

> "Behavioural change is fast becoming a kind of 'holy grail' for sustainable development policy—and in particular for sustainable consumption policies. How can we persuade people to behave in more environmentally and socially responsible ways? How can we shift people's transport modes, appliance choices, eating habits, leisure practices, lifestyle expectations (and so on) in such a way as to reduce the damaging impact on the environment and on other people? How can we encourage sustainable consumption and discourage unsustainable consumption?"
>
> Tim Jackson, *Motivating Sustainable Consumption*, 2005, p.105

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: Dietz et al (2009) estimate that 20% of direct household CO_2 emissions in the US could be saved through behaviour change, "with little or no reduction in household well-being," while 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. 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 (e.g. Sonderegger, 1978; Curtis, 1992-93; Guerra Santin et al, 2009).

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 use and interact with the products and systems around them, and how *designed interventions* might change this.

As Redström (2006) puts it, "the intention to design the user experience is but the latest in a progression towards the user becoming the subject of design." The designer potentially starts to be placed into the role of 'interventionist' (Argyris and Schön, 1974) or even 'activist' (Thorpe, 2010; Fuad-Luke, 2009), designing with the intent to change how people do things, rather than simply accommodating existing needs. It is still "a focus on the designed thing [or service] but from a different point of view" (Redström, 2006).

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. Lilley et al, 2005, 2007; Rodriguez & Boks 2005; Elias et al, 2007; Bhamra et al, 2008; Wever et al, 2008; Pettersen & Boks, 2008; Froehlich et al, 2010). 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."

'Sustainability' in design is often taken as shorthand for concentrating on reducing the

environmental impact of products[2], but in this thesis, the broader scope of *sustainable development* is used. In many definitions, e.g. DEFRA (2005), this includes explicitly *social* aims such as promoting social cohesion and promoting public engagement in governance. Having said that, where it is possible in this thesis to distinguish between environmentally-related behaviour change and behaviour change with intended wider social benefit, this has been done. The next two sections elaborate on this.

1.2 Environmental impacts of behaviour

The environmental impacts of product and service use can comprise energy use (electricity or direct use of fossil fuels), water use, other resource use, waste generation and pollution, as well as socio-environmental impacts.

'Behaviour' is not necessarily easy to extract as a discrete component of the use phase of a life cycle: consumer demand for new products, leading to their manufacture in the first place (and probably disposal of old products) is clearly a behaviour—and one influenced by design—but of a different kind to day-to-day interaction with a household appliance. One-off behaviour changes such as persuading householders to insulate their homes can lead to large energy savings, but these are again a different kind of behaviour to choosing a lower temperature setting on the washing machine. Fogg (2009a) and Fogg and Hreha (2010) have recognised these differing schedules and types of behaviour in their 'Behaviour Grid', which has been applied by the author to some environmentally related behaviours in **[F9]**.

The term *pro-environmental behaviour* is often used in the literature (e.g. Darnton et al, 2006), but this may imply that a conscious *attitude* in favour of the environment is driving behaviours, which is not always the case[3] (see **[F5]**). In general, much behaviour which has effects on the environment—beneficial or damaging—is driven by other factors—costs and convenience being two that are especially common—and it is important to bear this in mind when thinking about the range of work in this field. 'Demand' for resources need not imply a conscious desire or preference to consume; choices often simply reflect the structure of situations.[4]

The question of "how important user behaviour is compared to efficient technology" (Gram-Hanssen, 2011) has been addressed by some researchers. Many energy-using consumer products have become increasingly efficient as new technologies are introduced—to the extent that in some cases it can be 'ecologically optimum' to replace an old appliance with a new one even though it still works (van Nes et al, 1999; Chalkley, 2004)—and as Elias et al (2008) note, this increasing technical efficiency means that behaviour-related energy losses represent an increasing *proportion* of total energy use for the products concerned.

However, this question is potentially complicated by a number of other issues[5], including:

- trends in some product categories towards more *powerful* products (e.g. vacuum cleaners, discussed by Chalkley (2004)) or, for example, heavier cars (primarily due

[2] Although, as Ehrenfeld (2008, p.20) notes, "Reducing unsustainability will not create sustainability".

[3] Tonkinwise (2004) notes that "[i[t is widely acknowledged for example, that sustainability is a strangely hypocritical politics: even when issues are well understood, actions fail to result; strong and comprehensive awareness of sustainability fails to translate into sustainable behaviour".

[4] Slee (2006, p.118) uses the example of coordination between multiple people or groups: "When pedestrians approach each other on the sidewalk, they are not choosing left or right, they are choosing to avoid each other."

[5] Some are examples of what Tenner (1996, p.6) calls *revenge effects*: "[W]henever we try to take advantage of some new technology, we may discover that it induces behaviour which appears to cancel out the very reason for using it."

to safety features and rising consumer equipment expectations)

- the increase in appliance numbers as once 'luxury' products become mainstream (e.g. Gram-Hanssen (2011) uses Danish national statistics to show that "growing energy efficiency gained over the last thirty years in the appliances in Danish households is counterbalanced by the growing amount of appliances in use")
- rebound effects (e.g. Jevons, 1865; Greening et al, 2000; Binswanger, 2001) where improvements in efficiency (and hence reductions in running costs) result in increases in use, and re-spending effects (e.g. Schipper and Grubb, 2000; Chalkley et al, 2001) where consumers spend the money saved through reduced energy use on greater numbers of energy-using products
- boomerang effects (e.g. Schultz et al, 2007) where users may reduce energy conservation efforts once they are told they have met a target or reduced levels below that of other group members

Elias et al (2008) distinguish between *intrinsic losses* in use, "caused by the engineering design, materials and technology used in construction of the product," and *user-related losses*, due to user behaviour:

> "For example a refrigerator with perfect insulation, potentially zero intrinsic losses, will still waste energy if the door is left open unnecessarily for extended periods of time... The inclusion of user losses, from the use and possible misuse of a product, adds a new dimension to the traditional measure of engineering energy efficiency calculations, giving a complete image of 'product-in-use' efficiency."

Behavioural contributions to environmental impact can also often be most evident through the *differences* in behaviour of different users of the same system. Continuing with the refrigerator example, Elias (2009), through a 'fly-on-the-wall' observational study of refrigerator use, found large variations in behaviour (such as how long the door was left open) between the two households in his study, contributing to the energy used and that considered 'wasted'. Tang and Bhamra (2008) also carried out observations of refrigerator use behaviour, uncovering details of the differences in routine and habit which contribute directly to the variations in energy use.

Rodriguez and Boks (2005) used a technique similar to cultural probes (Gaver et al, 1999) to examine people's interactions with a range of home electrical appliances, identifying opportunities for design interventions to match devices' functions more closely to users' needs from moment to moment. For example, the finding that 90% of participants at some point used the television as an audio device (i.e. listening, but not watching) suggested the idea of a 'blind' button for televisions, 'muting' the screen while continuing to issue sound.

These studies emphasise the importance of user research in understanding not only *how* people interact with products, but *why* they do so in the ways they do, providing insights to help influence that behaviour through redesign[6].

1.3 Broader social impacts of behaviour

Whether included within the scope of 'sustainable design' or as part of the wider field of 'design for social change' (e.g. Papanek, 1985, 1995; Mau and the Institute without

[6] Other researchers have studied interaction with everyday products through an approach emphasising socially embedded *practices* rather than behaviour as such, e.g. Shove et al, 2007 and Kuijer and de Jong, 2011.

Boundaries, 2004; Berman, 2009), it is clear that broader social impacts of behaviour, beyond environmental impacts, can also be affected by design. Health behaviour (including exercise and diet), encouraging social cohesion, adherence to safety rules, even world peace (Fogg, 2009b) could come within the possible remit of design for sustainable behaviour.

In line with the broader definitions of sustainability, it appears to be quite common for researchers and practitioners in this field to attempt to tackle multiple environmental and social problems.

For example, in her PhD thesis, Lilley (2007) addresses both environmental impacts (in her literature review and 'Design|Behaviour' workshop) and social impacts (in a case study on mobile phone use), defining 'negative social impact of use' (p.3) as: "Any action enacted or facilitated by the product or resulting from the behaviour of the user in the use of the product which diminishes the health, wellbeing, social equity or quality of life of others affected by the use of the product." Tromp et al (2011) integrate environmentally-related and wider social issues of design for behaviour change in a succinct exploration of the field, including discussing influencing healthier eating, discouraging train fare-dodging and encouraging safer driving alongside 'environmental' examples such as Ehrnberger and Broms' 'Puzzle Switch' (2007).

Where research groups working on 'design for behaviour change' have established industrial partnerships—for example the commercial collaborations of Stanford's Persuasive Technology Lab, or DUB at the University of Washington's work in conjunction with Intel Research—they may address both environmental and more socially related behaviours according to partner interests, often via similar mechanisms and techniques. DUB's UbiFit (Consolvo et al, 2008) and UbiGreen (Froehlich et al, 2009) mobile phone applications address exercise and sustainable transport choices respectively, using essentially the same approach.

Informed by a diverse cross-disciplinary review of perspectives on behaviour **[F1-9]**, this thesis takes the view that while there is specialist knowledge applicable to behaviour in every domain, there are also common design principles and patterns, at least some of which are applicable across domains. Thus both 'environmental briefs' (largely centred on reducing resource use) and a number of briefs relating to wider social benefit (including ATM design, increasing public confidence in the police, community engagement, improving financial decision-making, staff behaviour in hospitals and encouraging interaction in the workplace) are included in this thesis as applications of the Design with Intent toolkit in various forms. Using design to influence behaviour in more commercial contexts, which may or may not have concomitant social benefits, is also covered, not least because, again, many of the same principles and patterns are relevant.

1.4 The aims of this thesis

The overall aim of this thesis is to describe a systematic research enquiry into influencing more sustainable behaviour through design (identified as a challenge in section 1.1), which has produced communicable new knowledge in the form of a 'design toolkit'.

The literature review (Chapter 2) identifies the opportunity for a guide or toolkit which can help designers explore and transpose behaviour change principles and practice from other disciplines during the idea generation phase of a design project, framing the research questions as:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?

The thesis aims to answer this question through an action research process, developing and evaluating the Design with Intent toolkit through a series of workshops. One aim is that the toolkit should furnish designers with a resource of transposable design patterns for influencing user behaviour, intended primarily for use during the idea generation stage of a design process; another aim is to develop this through engagement with design practitioners, students and other potential users, with feedback being used to improve the next iteration (see discussion of action research methodology in section 3.4.4).

1.5 The structure of this thesis

Figure 1.1 shows the structure of the PhD and the thesis chapters. Research on behaviour change and idea generation methods (Chapter 2) leads to the Design with Intent toolkit, which was iteratively developed and evaluated via rounds of both academic and applied workshops, and receiving feedback from early users of the toolkit (Chapters 4 and 5).

Chapter 1: Introduction

This introduction (Chapter 1) has covered some of the background to this thesis—the challenge of design for sustainable behaviour, and the environmental and social factors behind that challenge, along with the aims of the thesis.

Chapter 2: Literature review

The literature review, Chapter 2, examines the field of approaches to influencing more sustainable behaviour through design, the need for a toolkit, and idea generation methods and problem-solving in design, to uncover formats and elements which could be useful in structuring the toolkit. A summary is also included of an extensive literature review **[F1-9]** of behaviour change concepts and principles from other disciplines, with their implications for designers.[7]

The chapter ends with a summary of the need and opportunity identified.

Chapter 3: Research methodology

Chapter 3 covers research methodology, including the epistemology, theoretical perspectives, methodology and specific research methods used in the thesis, along with critical reflection on sampling and research quality.

[7] Alongside the widening of the author's understanding initiated through running the trials described in Chapter 5, the expanding domain of 'behaviour change' meant that the scope of relevant literature grew throughout the process as pertinent avenues of research became apparent. Some design PhD theses on very 'current' topics, e.g. Han (2010a) on service design, have dealt with this sort of issue by 'revisiting' the literature in a different light towards the end of the thesis. In the thesis you are reading, the literature review of behaviour change concepts and principles has instead been rewritten over time to incorporate new material, in the process expanding in scope. On the instruction of the examiners, this part of the literature review has been kept outside the thesis, instead presented as a series of 'working papers' **[F1-9]** which are summarised in Chapter 2 and further referenced in Chapter 4. These papers constitute a substantial portion of research primarily because of their breadth; the toolkit depends heavily on incorporating insights from a diverse range of disciplinary approaches to behaviour.

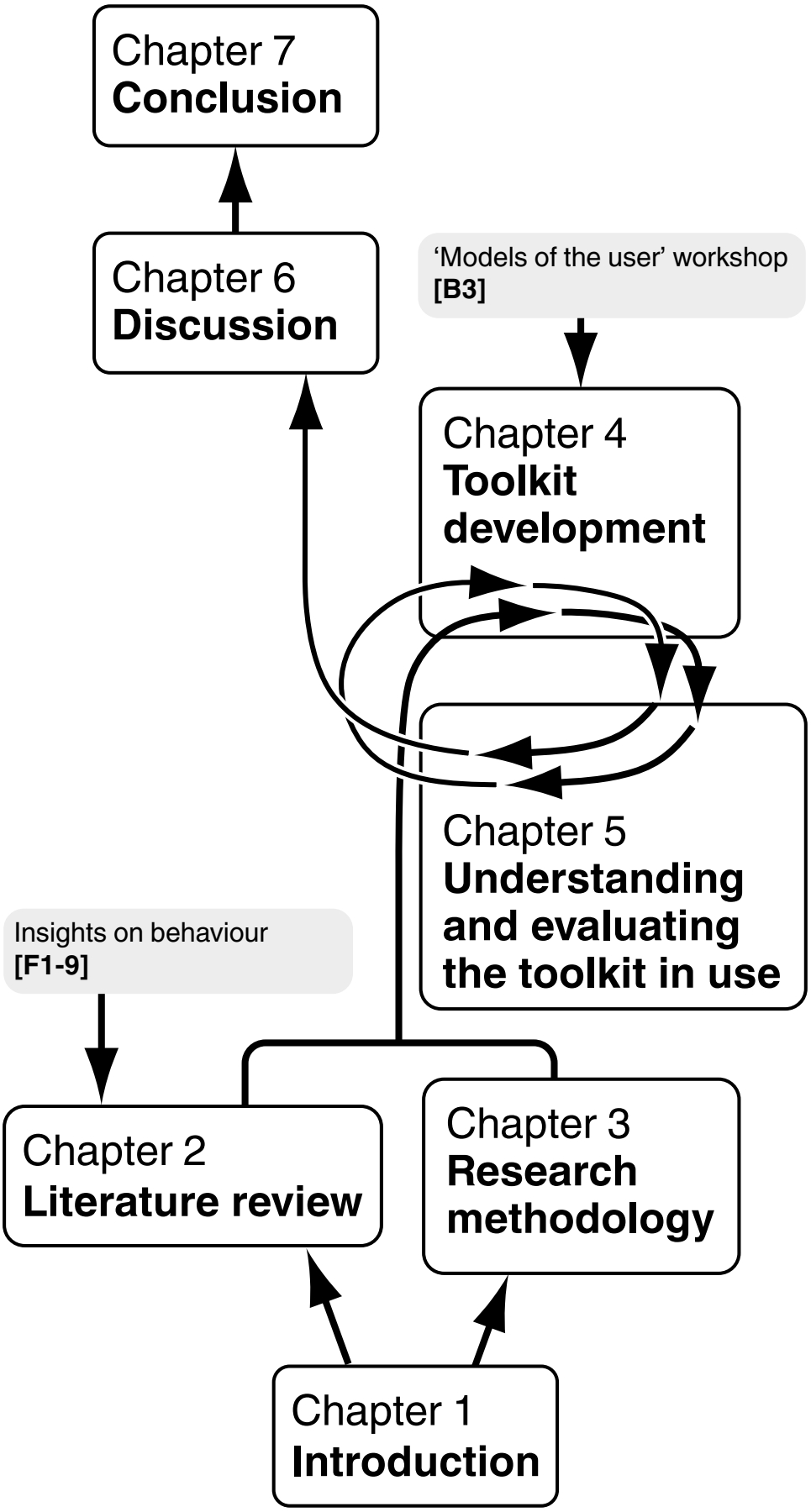

Figure 1.1: The thesis chapter structure. The 'action research spiral' between chapters 4 and 5 is explained further in section 3.4.4

Chapter 4: Toolkit development and Chapter 5: Understanding and evaluating the toolkit in use

Chapters 4 and 5 cover the development of the toolkit and its evaluation respectively, through versions 0.1 to 1.0, via a series of workshops and exploratory applications with designers, design students and other stakeholders. The toolkit is applied to a number of environmentally and socially related briefs, and feedback from early users in academia, industry and the public sector enables evaluation of both how to improve the toolkit and how people have actually used it in different contexts.[8]

Chapter 6: Discussion and Chapter 7: Conclusion

Implications from Chapter 5 for further development of the toolkit are noted, and are brought together with the other insights from Chapters 4 in the discussion (Chapter 6), which also covers how the DwI toolkit fits into the design process and what further work is recommended.

Finally, the conclusion (Chapter 7) provides a summary of what has been achieved, together with justification of the contributions to knowledge claimed (also listed in the front matter).

1.6 Summary of introduction

All design affects our behaviour, whether it is intended to do so or not.

The use of products (and services and environments) can have negative impacts on the environment and on society more broadly. We could use design to *influence* more sustainable behaviour, for environmental and social benefit, for example influencing energy use, water or other resource use, other resource use, waste generation, or broader social issues such as health-related behaviour, social cohesion or safety.

This thesis aims to address the challenge of influencing more sustainable behaviour through design, through the iterative development and evaluation of a 'design toolkit' (the need for this is articulated in Chapter 2).

The research questions are framed as: *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?* and *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

A review (Chapter 2) will thus be carried out of treatments of 'behaviour' in a range of fields, concentrating on transposable insights which might be applicable in design, and idea generation methods and problem-solving in design, to decide on formats and elements which might be of use. Research methodology will be investigated (Chapter 3) to determine the most appropriate perspectives and methods.

[8] Also included are insights from a study covered in **[B3]**, concerning how designers model users when seeking to influence behaviour. This was investigated via an exercise with practising designers, and the application of the models to sustainable behaviour problems examined via a series of examples. Insights from this study led to an additional element, the pinball / shortcut / thoughtful spectrum, being incorporated into the toolkit in Chapter 4.

2 Literature review

In Chapter 1, the challenge of influencing more sustainable behaviour through design was identified. Chapter 2 initially examines the field of approaches to influencing more sustainable behaviour through design, through a summary of an extensive literature review **[F1-9]** of behaviour change concepts and principles from other disciplines, with their implications for designers.

The chapter goes on to identify and articulate the 'gap', or opportunity, for a toolkit incorporating these insights, then investigates the literature on idea generation methods and problem-solving in design, to uncover formats and elements which could be useful in structuring the toolkit.

2.1 Approaches to influencing sustainable behaviour through design

At this stage in the development of 'design for sustainable behaviour' as a field, the majority of academic work is focused on exploring the field of possible interventions and the ways designers can apply ideas relating to behaviour. As Boks (2011, p.2) notes, "[o]ne of the key understandings needed to develop and successfully apply design for sustainable behaviour strategies has been found to be a certain categorisation of mechanisms that can be used to influence user behaviour".

Within design research, behavioural intervention studies are not yet common; the majority of such studies over the last 40 years have come from social and environmental psychology and allied fields. It is only recently that 'design' (in particular interaction design and human-computer interaction (HCI) research) has started to become involved.[1]It is noticeable that environmentally related intervention studies seem to have become especially popular during the mid-to-late 1970s, in the era of energy crises, and then largely faded from view until a recent resurgence.

Alongside interventions, design researchers exploring the potential of design for sustainable behaviour have recently developed a range of taxonomies and classifications for the techniques involved. Some of the techniques themselves have been explored in **[F1-9]**, and are summarised in section 2.2 below; here, some potentially useful taxonomies will be introduced to help set the context of design for sustainable behaviour.

2.1.1 The models of Lilley and Wever

Lilley et al (2005, 2006) divide 'interventions to change behaviour' into: educational interventions aiming to "encourage the public to behave more sustainably"; technological interventions; and product-led interventions. This last category comprises *scripts and behaviour steering*, *eco-feedback* and *'intelligent' products and systems.* Wever et al (2008) use a similar approach to Lilley et al, splitting strategies for 'inducing sustainable use'

[1]Froehlich et al (2010) note that only a few HCI researchers in this area cite principles from environmental psychology studies, and likewise no environmental psychology researchers cite work in HCI and design; this is, as they put it, "unfortunate because it can lead to redundant efforts and, at worst, ineffective designs." Few researchers working within a psychological context explain in depth the design details of interfaces or feedback, at least in write-ups of trials; on the other hand, few design or HCI researchers carry out large controlled trials along the lines of those expected in psychology.

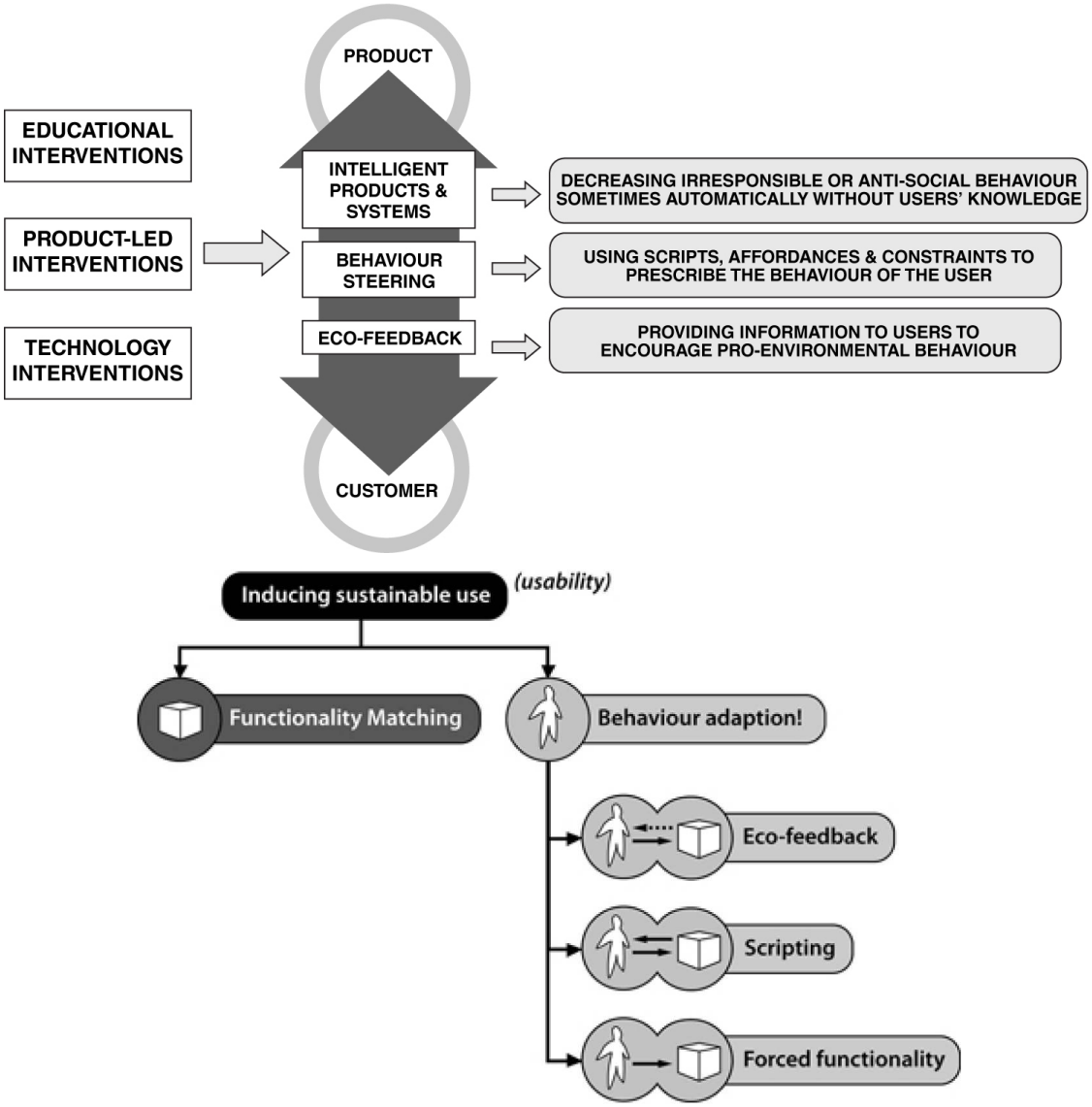

Figure 2.1: Comparison of models of sustainable behaviour interventions from Lilley et al (2006; top) and Wever et al (2008; above)

into: *functionality matching* (such as Rodriguez and Boks' TV 'blind' button mentioned in section 1.1.1); and *behaviour adaptation*, in turn comprising *scripting*, *eco-feedback* and *forced functionality* (Figure 2.1).

The notion of 'scripts and behaviour steering' draws in particular on the work of Jelsma (e.g. Jelsma, 2000, Jelsma and Knot, 2002) but has much in common with Norman's *perceived affordances* (see **[F4]**). The idea here is that a product's features can be designed to imply or suggest a particular mode of use or interaction behaviour; Lilley et al also include aspects of product semantics, such as using particular materials to suggest longevity, while Wever et al mention "making sustainable behaviour so easy, it is performed almost without thinking by the user" (p.15).

The term 'eco-feedback' is used by both Lilley et al and Wever et al, and also by some researchers approaching behaviour change from an HCI perspective (e.g. Froehlich et al, 2010) to describe strategies "which inform users of their impact in an attempt to persuade them to modify their behaviour" (Lilley et al, 2005, p.7).

There is some difference in the boundaries of what kinds of feedback are considered under this heading—such as whether the feedback makes 'recommendations' about what the user should do differently, and whether the feedback is attempting to 'persuade' (via raising awareness of a behaviour's impact, as recommended by van de Velden, 2003) or simply to 'prompt' or 'cue' a different behaviour. In Wever et al's definition (2008, p.15), "the user is presented with specific information on the impact of his or her current behaviour, and it is left to the user to relate this information to his or her own behaviour, and adapt this behaviour, or not," whereas developments in, for example, electricity monitors (e.g. Ambient Devices, n.d.) often include behavioural prompts alongside feedback on energy use, pricing and so on. **[F4]** examines the different kinds of feedback and the opportunities for designers in more detail.[2]

Wever et al's 'forced functionality' incorporates Lilley et al's 'intelligent' products and systems—those involving "circumventing the user's decision-making function and arguably decreasing the potential for irresponsible environmental or social behaviour" (2005, p.9)—but also covers "designing-in strong obstacles to prevent unsustainable behaviour" (2008, p.15), which sound very much like Norman's *constraints* (see **[F4]**).

In this category, it is debatable where the line might be placed between design for behaviour change and automatic systems which silently (or not-so-silently) structure users' behaviour: should a device designed simply not to be operable in a certain way be seen as a *technological* intervention rather than a *behavioural* one? Where is the line between something which is 'impossible' to operate inefficiently, and just very 'difficult'?

For some users, a complex interface for changing settings may effectively mean that a device is impossible to operate in other modes than the default (e.g. see Combe et al, 2011), while for others that complex interface may be an *enabler*, allowing the configuration of more options and better matching the desired performance. **[B3]** addresses some of the design implications of these questions, which are summarised in section 4.4.2 of this thesis.

2.1.2 Elias's model

As hinted at above, changes to the overall 'use phase' of a system can result from the product or system itself changing, users changing their behaviour, or a combination of both.

Elias et al (2007) have captured these possibilities with a 2 × 2 matrix (Figure 2.2), in which 'new products' and 'old products' are combined with 'new user behaviour' and 'old [existing] user behaviour', giving four possible scenarios. The inclusion of 'old' (i.e. existing, current) products is an important point, particularly with systems which are unlikely to be replaced at the same rate as electronic appliances, such as domestic heating systems, but also where existing products are not necessarily inefficient technically, but end up being *used* inefficiently.

Elias et al suggest 'new user behaviour with old products' as being addressable through 'user education and energy feedback', while 'User-centred Eco-design' or 'Behaviour-based Design' (Elias et al, 2009) comprises both new user behaviour with new products, and current user behaviour with new products. This latter category involves "work[ing] with the existing user behaviour" (p.2), designing new products to take account of how

[2] Another issue is important here: the 'eco' in 'eco-feedback' emphasises the environmental component to the feedback, but the majority of energy monitors available feature energy *costs* fairly saliently as a mechanism for influencing lower usage rather than measures of environmental impact such as CO_2 equivalent. While reduced energy use as a result of feedback will have environmental benefits, if the motivation for the behaviour change is not environmental, is 'eco-feedback' really the best term? In Lilley's thesis (2007), she expands the category to the more general 'feedback' to cover use of the techniques in other socially-related behaviour situations.

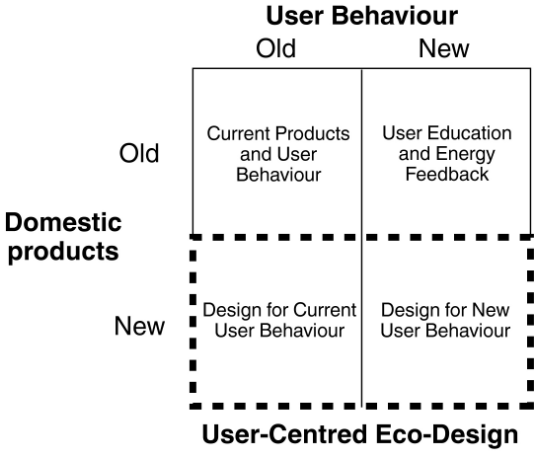

Figure 2.2: Elias et al's (2007) matrix, showing "three strategies in relation to product design and user behaviour" together with the 'no change' situation (top left cell).

people use the current ones, so that behaviours which are currently problematic are no longer so. As developed further in Elias et al (2009, p.119), this category might include examples such as "an automatic switchoff for a phone charger that turned itself off when not being used, preventing the user from ever leaving it on unnecessarily, but also allowing the current behaviour of many users to forget to switch it off to continue."

The 'new user behaviour with new products', or Design for New User Behaviour (Elias et al, 2009) category includes products which change behaviour through their functionality—the example given is the Tefal QuickCup, a hot water dispenser marketed as a replacement for an electric kettle.

Elias et al's classifications address somewhat different aspects of design for sustainable behaviour compared with those of Lilley et al and Wever et al. While there is overlap in the scope of the possibilities that are covered, the way of structuring the possibility space differs. For example, it would seem that Lilley et al's eco-feedback might be considered as part of Elias et al's 'user education and energy feedback' category if implemented in terms of a household-level feedback display (i.e. influencing behaviour with existing products) but if built into a new product—such as a water tap with a flow meter—could come under the Design for New User Behaviour category.

Such classification issues abound in work seeking to map possibility spaces, and will recur throughout this thesis; as Bowker and Star (2000) note, every method of categorising things inescapably prioritises some perspectives over others. From a pragmatic perspective, the necessary consideration is probably whether particular classifications offer perspectives which are *of use* in some circumstances in advancing understanding or suggesting possibilities which would be missed by using a different perspective[3], even if the perspectives are not necessarily "ontologically unique" (in the words of one journal article reviewer).

The particular distinction inherent in Elias et al's matrix (and also present in Lilley et al's model) which has been especially useful in this thesis is the consideration of 'technology change' and 'human change' as two possible routes to achieve an overall behaviour change, working independently or being applied together. In Chapter 5, a classification derived from this is used to help analyse the concepts arising from a series of workshops using the v.0.9 of the Design with Intent toolkit.

It is perhaps this *intersection of technology change and human change*—the design

[3]This is, essentially, the purpose of the Design with Intent 'lenses' (see Chapter 4).

of systems which, through behaving differently themselves, influence user behaviour—which is what design for sustainable behaviour offers beyond more traditional social marketing (e.g. McKenzie-Mohr & Smith, 1999; Weinreich, 2010) or purely technological interventions to reduce environmental and social impacts.

2.1.3 The spectrum of control, axis of influence and intervention ladder

Bhamra et al (2008) extend Lilley et al's classifications into seven 'design for behavioural change' strategies: *eco-information, eco-choice, eco-feedback, eco-spur, eco-steer, eco-technical intervention* and *clever design*. These strategies provide a more nuanced exploration of the possibilities inherent in Lilley et al's original model, expanding in detail while narrowing in scope.

For example, Bhamra et al's eco-information, eco-spur and eco-feedback all cover different forms of Lilley et al's original eco-feedback (and perhaps some forms of educational intervention too). 'Clever design', in this context, refers to examples such as an integrated toilet and washbasin, which "automatically act environmentally or socially without raising awareness or changing user behaviour" (Bhamra et al, 2008, p.4)—similar in scope to Elias et al's 'current user behaviour with new products', perhaps.

One advance made by Bhamra et al in the explanation of their seven strategies is mapping them onto a spectrum of who has the 'power in decision-making' when an intervention is applied—from the 'user' having complete control at the 'eco-information' end of the spectrum to the 'product' having complete control at the 'clever design' end. In her thesis, Lilley (2009) terms this the 'axis of influence'.

This approach elaborates what Jelsma (2006, p.224) terms the *distribution* of "power between humans and nonhumans". In the Persuasive Technology literature, a similar distinction (if not necessarily placed along a spectrum) is often made between 'persuasion' and 'coercion', although Fogg (2003, p.21) recognises that "the line between persuasion and coercion can be a fine one" (and somewhat subjective). Oinas-Kukkonen and Harjumaa (2008), in developing their 'Persuasive Systems Design' model, emphatically exclude any techniques which can be construed as coercive.

As well as being a useful dimension along which to assess and classify strategies for influencing behaviour[4], the 'spectrum of control' also potentially provides a starting-point for *selecting* which strategies might be most appropriate to apply in different situations.

This is the approach taken by Zachrisson and Boks (2010) and Zachrisson et al (2011), who have developed a spectrum (Figure 2.3)—ranging from 'Informing' at the end where the user is in control, through 'Persuading', to 'Determining' at the end where the product is in control. This is intended as a precursor to a procedure or set of guidelines to help a designer match the *degree of control* employed in an intervention to the behavioural factors considered important in the situation concerned, such as whether the behaviour is habitual, whether the user has a desire to behave in the way intended by the designer, and how much attention the user should be expected to devote to the interaction.

Tromp et al (2011) have taken a slightly different view of the 'spectrum of control', instead using two dimensions ('force' and 'salience') to represent possible intervention types (Figure 2.4). The strong-to-weak dimension of force is crossed by the explicit-to-implicit (apparent-to-hidden) dimension of salience, leading to four possible types of

[4] Three- and even *four*-dimensional models relating to this area have been developed—see Brand (2004) for an example. Other researchers have developed dimension-based models which focus on particular subcategories of behaviour-influencing techniques. For example, in a comprehensive review, Froehlich (2011) presents "an eco-feedback design space" comprising eight dimensions (with further subdimensions) specifically relating to types of feedback that a system can give to users about their behaviour and/or resource use.

Figure 2.3: Zachrisson et al's (2011) 'distribution of control' spectrum

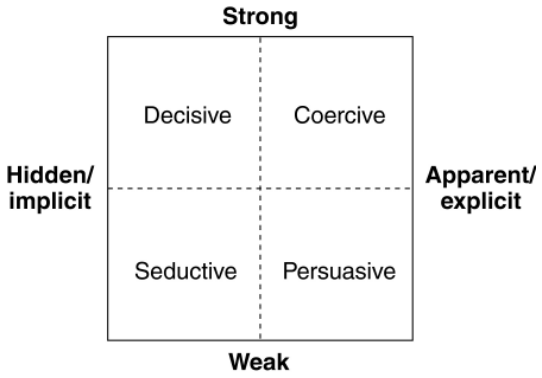

Figure 2.4: Tromp et al's (2011) diagram with 'force' and 'salience' as two dimensions, leading to four possible types of influence.

influence: coercive (strong and explicit), decisive (strong and implicit or hidden), persuasive (weak and explicit) and seductive (weak and implicit).[5] These are intended to be the influence type *as experienced by a user* (rather than a classification of individual products), and can change over time, if, for example, a user develops a different understanding or attitude towards the influence a particular product is having on his or her behaviour. Eleven design strategies are then located in the force/salience space. A broader insight here is that the perspective on behaviour change experienced by the user (and by different users) is not necessarily the same as that intended by the designer. This issue is discussed further in **[B3]**.

Outside of the design context, one of the most high-profile uses of a 'spectrum of control' dealing with kinds of interventions is the Nuffield Council on Bioethics' 'Intervention Ladder', outlined in the report *Public Health – Ethical Issues* (2007).[6]

While dealing solely with the "intrusiveness" (p.42) of health-related interventions from a governmental perspective, the ladder nevertheless has many parallels with the kinds of possible interventions for environmentally and socially beneficial behaviour change, at least in policy terms.

Figure 2.5 adds some 'sustainable behaviour' policy parallels to the Council's health policy examples (there is some overlap). Health-related behaviour change programmes represent a significant body of work, and while there are many domain-specific issues, some of the findings potentially have applicability in other fields. One aspect not explicitly addressed in the Council's model is the possibility of fostering *intrinsic* motivation

[5] Tromp et al's use of 'seductive', with the example given of "a microwave's effect on [the social practice of] family dinners" (2011, p.12) is narrower than that used by Anderson (2011) in his book *Seductive Interaction Design*, which deals with influencing user behaviour online through a variety of user experience approaches, both explicit and implicit.

[6] In the context of medical ethics, the report also discusses of a spectrum of perspectives emphasising collective social benefit at one end, and individual freedom at the other (Nuffield Council on Bioethics, 2007, p.13). It is not a large leap to consider that this approach might be applied to sustainable behaviour interventions: whether a behaviour change benefits only the 'user', benefits society as well, or benefits society at the 'expense' of the user. This question of *cui bono*? in design is discussed briefly in **[F3]**.

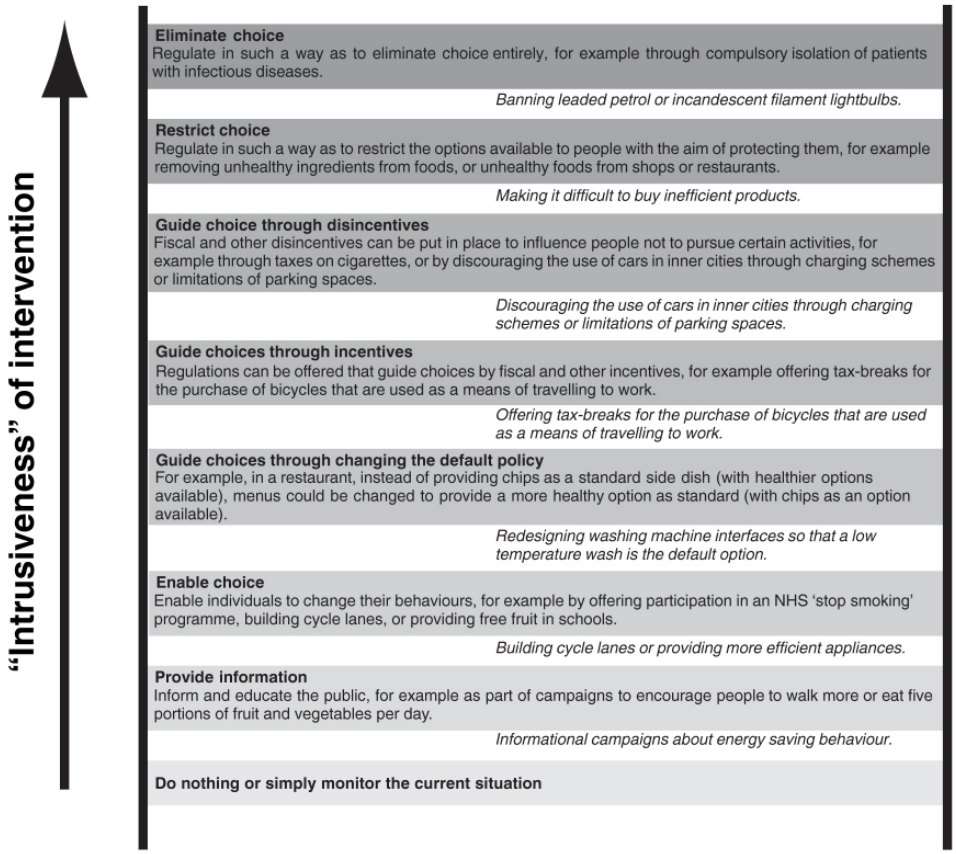

Figure 2.5: 'Intervention Ladder' for health behaviour policy interventions, adapted from Nuffield Council on Bioethics (2007), with sustainable behaviour policy examples added (in italics)

(see **[F5]**), as opposed to the extrinsic motivation covered by the rung 'Guide choices through incentives'.

In Chapter 4, this thesis introduces what might be considered a modified variant of the spectrum of control, the three approaches of *enabling*, *motivating* and *constraining*. **[B3]**, insights from which are discussed in Chapter 4, also explores a related dimension, how designers *model* users when seeking to influence behaviour, which necessarily involves assuming different balances of control between users and the products or systems with which they are interacting.

2.1.4 A systems approach: applying Meadows' Leverage Points to design

Donella Meadows' paper 'Leverage Points: Places to intervene in a system' (Meadows, 1999) and her posthumously published *Thinking in Systems* (Meadows, 2009) both include a list of 'places to intervene in a system', ranked in tentative increasing order of effectiveness. Originally developed by Meadows in the context of systems modelling for world trade negotiations, they are intended to be generally applicable to complex, non-linear systems:

> PLACES TO INTERVENE IN A SYSTEM (in increasing order of effectiveness)
>
> *Adapted from Meadows (1999)*
>
> 12. Constants, parameters, numbers (such as subsidies, taxes, standards)

11. The sizes of buffers and other stabilising stocks, relative to their flows

10. The structure of material stocks and flows (such as transport networks, population age structures)

9. The lengths of delays, relative to the rate of system change

8. The strength of negative feedback loops, relative to the impacts they are trying to correct against

7. The gain around driving positive feedback loops

6. THE STRUCTURE OF INFORMATION FLOWS (who does and does not have access to what kinds of information)

5. THE RULES OF THE SYSTEM (such as incentives, punishments, constraints)

4. THE POWER TO ADD, CHANGE, EVOLVE, OR SELF-ORGANISE SYSTEM STRUCTURE

3. The goals of the system

2. The mindset or paradigm out of which the system—its goals, structure, rules, delays, parameters—arises

1. The power to transcend paradigms

A 'systems' viewpoint sees humans as part of the system just as much as technology and political structures. Hence there is no single leverage point dealing with 'human behaviour'—human decisions, abilities and reactions can be inherent to each of the leverage points, and designers (if they have the opportunity) could address any of the leverage points. However, it is apparent that many designed interventions which specifically aim to influence user behaviour are concentrated on leverage points 6, 5 and 4: these are the aspects which designers are well-placed to deal with.

The *structure of information flows* is easily addressable through design: it mainly comprises different kinds of feedback, feedforward and also different presentations of antecedent information (see section 2.2.3).

The *rules of the system* can perhaps best be framed from a design perspective as being about designing in actual affordances (and constraints) and/or rules for 'reward' and 'punishment' (see section 2.2.2).

The *power to add, change, evolve, or self-organise system structure* can be seen in design terms as being related to *adaptive systems*, i.e. systems which can perhaps adapt the information flows and affordances / constraints / rules on offer, based on users' behaviour and the performance or context of the system's use. There are parallels here with Lilley et al's and Wever et al's models (section 1.2.1); Table 2.1 breaks down these three leverage points into some possible sub-categories pertinent to design for behaviour change.

The 'design for behaviour change' use of these leverage points is often, in practice, a combination of one or more of them—e.g., depending on the context, rewards or punishments could be seen as a kind of feedback, and indeed for a user to be aware of the affordances, constraints and rules that exist, there must be an information flow going on.[7]

Thus these categories are not a mutually exclusive definition of possible strategies for intervention, but a way of framing some possible leverage points. A classification based on the leverage points is used in the discussion in the Appendix to help assess the diversity of concepts generated by workshop participants in Chapter 5.

[7] It is unclear though where some approaches would fit. For example, where do emotional engagement, guilt or excitement fit in Meadows' leverage points?

Table 2.1: Some possible sub-categories of leverage points 6, 5 and 4

LEVERAGE POINT		POSSIBLE SUB-CATEGORIES		EXAMPLES
6	Information flows	Antecedent information	6.1	"This car can achieve up to 6o mpg"
		Antecedent information with recommendation	6.2	"This car can achieve up to 60 mpg if you drive it carefully, so please do so"
		Simple feedback	6.3	"You have achieved 48 mpg today"
		Comparative feedback	6.4	"You have achieved 48 mpg today, which is better than the average of 32 mpg"
		Feedforward	6.5	"If you drive more carefully, you should be able to achieve 55 mpg tomorrow"
5	Affordances, constraints & rules	Actual user-level affordances & constraints	5.1	The car affords economical use if driven carefully
		Perceived user-level affordances & constraints	5.2	The driver believes that the car affords economical use if driven carefully
		Built-in system structure & limits	5.3	There is an upper limit on the mpg the car can return even if driven carefully
		Incentives & rewards	5.4	Saving fuel will save the driver money
		Punishments	5.5	Wasting fuel will cost the driver more money
4	Adaptive systems	Adaptive variants of all the above, where possible		

2.2 What influences behaviour? What implications are there for designers?

At this stage, the author had been writing the *Architectures of Control in Design* blog (soon to be renamed the *Design with Intent* blog) for two years (see Preface), and had built up a spreadsheet of examples of 'design influencing behaviour', drawn from a variety of sources, including blog readers' suggestions, but these were not classified in a meaningful way.

A more formal, literature-based investigation was needed, and so, as explained in section 1.5, a substantial review was carried out of behaviour change concepts and principles from other disciplines, with a focus on extracting potentially useful insights and implications for designers seeking to influence behaviour through design.

This section aims to summarise the most important insights from that review **[F1-9]**, via addressing the question "What influences behaviour?"; it cannot hope to answer the question definitively, since that would require a review of the entire history of psychology, and still not come to a conclusion. However, it attempts to review the field of disciplines and perspectives which have some practical implications for designers seeking to influence human behaviour, and which thus form a basis for the techniques and patterns included in the toolkit (see Chapter 4).

Subsection 2.2.2, after different approaches to understanding and modelling human behaviour have been introduced in section 2.2.1, covers the ways in which *context*—the physical and social environment and the structure of situations—affects behaviour, as seen by a number of different disciplines. In each case, implications for designers are extracted—techniques and insights which it may be possible to apply through design to influence behaviour. Subsection 2.2.3 covers approaches to how *cognition* (as opposed to context) affects behaviour are examined, and, similarly, implications for designers extracted.

2.2.1 Simon's scissors, Lewin's equation and the fundamental attribution error

> "Human rational behaviour is shaped by a scissors whose blades are the structure of task environments and the computational capabilities of the actor."
>
> Herbert Simon, 'Invariants of human behaviour'. *Annual Review of Psychology*, 41, 1990, p.1-19.

A framework which has proven useful in structuring the research process is to consider relevant disciplinary perspectives loosely along the lines of Simon's 'behavioural scissors' (Figure 2.6) mentioned in the above quote, simplifying the two blades to be concerning 'context' and 'cognition' respectively (following Clark, 2009). 'Environment' and 'mind' might be further simplifications[8]. The point behind Simon's metaphor is that just as a pair of scissors needs both blades to operate, understanding behaviour requires an understanding of both context and cognition: focusing exclusively on one blade will not give a complete picture. Design is well placed to address 'where the blades cross'—dealing with both context and cognition.

[8] **[F1]**, **[F2]** and **[F4]** cover primarily the context blade, while **[F5]**, **[F6]** and **[F7]** cover the cognitive blade; **[F3]**, **[F8]** and **[F9]** cover areas perhaps in the intersection of the blades, dealing with both context and cognition.

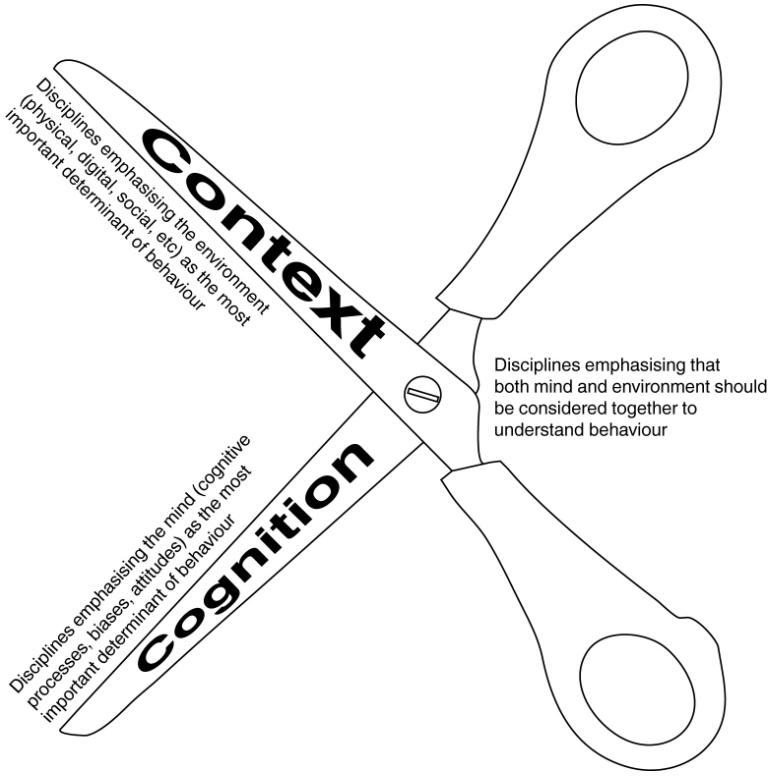

Figure 2.6: An interpretation of Herbert Simon's 'behavioural scissors'

Of course, all cognition necessarily occurs *in* a context, so the scissors are not a perfect metaphor for 'how behaviour occurs'.[9] Nevertheless, for helping to structure a literature review, the two blades have been helpful in providing a simple 'shape' to the disciplines reviewed, especially since the scope of the research has expanded over the course of the Design with Intent project.

One obvious parallel to Simon's scissors is 'Lewin's equation' (Lewin, 1935, p.241), part of his *field theory* (1943):

$$B = f(P, E)$$

According to this, behaviour, in any situation, is a function of the person and his or her environment: "Lewin believed that the stream of activity we call human behaviour resulted from the continuing interaction of factors within the person... with other external factors as they are perceived in a given behavioural setting." It is "the constellation or pattern of inner and outer influences that he experiences" that determine someone's behaviour (Ittelson et al, 1974, p.69). In Lewin's treatment, the 'environment' expressly includes social factors as well as the physical, and this approach has been taken in the structure of this literature review.[10]

Jackson (2005, p.89), focusing specifically on consumer behaviour, summarises the con-

[9] The work of Gerd Gigerenzer and colleagues (e.g. Gigerenzer and Fiedler, 2004; see **[F6]**) provides an explicit treatment of the fit between the blades: cognition and decision-making in context via the use of heuristics.

[10] Lewin also made use of the concept of *channel factors*, "apparently minor but actually important details" in the context of situations which have the effect of being "critical facilitators or barriers" (Ross and Nisbett, 1991, p.10). In a sustainable behaviour context this may describe some of the oft-recognised gaps between 'pro-environmental attitudes' and actual behaviour in practice (see **[F5]**). For example, someone holding an empty soft drink can may have the intention to recycle it, but if a recycling bin is not available (the channel factor), it is likely it will not be recycled.

text / cognition distinction (though in the opposite order) in terms of how branches of psychology take different approaches: "[T]here are—broadly speaking—two identifiably different kinds of approaches to understanding consumer behaviours... The first ('internalist') perspective carries an implicit assumption of consumers as atomistic agents autonomous of social structure, while the second ('externalist') perspective sees consumers as constrained operators programmed (or at least heavily influenced) by external forces beyond their comprehension or control."

The *fundamental attribution error* (e.g. Ross and Nisbett, 1991) is relevant here. This is, essentially, the finding that "[w]e overestimate the degree to which other people's behaviours are due to their personal traits, and underestimate the degree to which they are caused by the situation" (Winter & Koger, 2004, p.66). From a design point of view, this might be expressed in terms of assumptions that users will behave in a certain way—e.g. wasting energy—because they are intransigent, or have the wrong attitude, rather than because contextual factors make it easy to waste energy, or difficult to save it.

Conversely, when explaining variances in our *own* behaviour, we often emphasise context factors:

> "For example, when Deborah [Winter] sees a colleague drive his car two blocks to the library, she explains the behaviour as laziness and a lack of awareness about environmental issues; she's less likely to attribute it to the possibility that he has to carry 14 books back. But when she drives her car around the campus to the library, it's obviously due to the situational demand of returning so many books. "I'm not lazy, but he is"" (Winter & Koger, 2004, p.66).

[B3] explores some of the assumptions that designers make when 'modelling' users with a view to influencing their behaviour. Many approaches to influencing behaviour emphasise one blade or the other of Simon's scissors—context or cognition. They try to change the context in which people behave (e.g. making it easier or harder to behave in a particular way) or try to change people's thinking, so that they behave or don't behave in a particular way. Design often combines both approaches—it can address both the context of behaviour *and* the way that people perceive and make decisions about what to do.

Some more recent models of behaviour follow Lewin and do include both context and cognition, such as the *A-B-C* model (Guagnano et al, 1995; Stern, 2000)—developed in the context of a study of recycling—which incorporates both attitudes (A) and 'external conditions' (C) as determinants of behaviour (B). The model results in an "inverted U-shaped function" (Stern, 2000, p.415) with the contextual factors C 'trumping' personal factors A as a determinant of behaviour B when they are very strongly positive or negative, but A being the dominant variable affecting B as C tends towards neutrality. **[F5]** addresses the importance of attitudes in behaviour change—and how designers can affect them—in more detail, including discussion of models such as the Theory of Planned Behaviour (which emphasises cognitive rather than contextual factors), while **[F6]** looks in more detail at cognitive biases and decision-making.

2.2.2 Contextual approaches to behaviour

These perspectives on behaviour model (and try to change) the contexts in which people act (for example, by making it easier, harder or more or less reinforcing to behave in a particular way). Some are psychological approaches, while others are more directly related to 'design' concepts, such as affordances and constraints.

Behaviourism

Behaviourism as a psychological approach is based on empirical observation of human (and animal) behaviour—stimuli in the environment, and the behavioural responses which follow—and attempts in turn to apply stimuli to *provoke* desired responses, via a process of either classical ('Pavlovian') or operant conditioning. Watson (1913, p.158), in laying out the behaviourist viewpoint, reacted against the then-current focus by Freud and others on unobservable concepts such as the processes of the mind: "Psychology as the behaviourist views it... [has as its] theoretical goal...the prediction and control of behaviour. Introspection forms no essential part of its methods, nor is the scientific value of its data dependent upon the readiness with which they lend themselves to interpretation in terms of consciousness".

While behaviourism is no longer mainstream psychology, many of the principles have potential application in design for behaviour change. **[F1]** covers some implications, including:

- Behaviourism recognises that the environment shapes our behaviour both *before* and *after* we take actions (Skinner, 1971)—a useful insight for designing interventions
- There is also a recognition that (longer-term) behaviour change does not necessarily happen in a single step, but as part of an ongoing cycle of shaping
- Where cognitive processes cannot be understood or examined, modelling users in terms of stimuli and responses may still offer valuable insights
- Positive and negative *reinforcement*, and positive and negative *punishment* can all be implemented via designed features, and often underlie designed interventions without being explicitly named as such
- Schedules of reinforcement can be varied (e.g. made unpredictable) to drive continued behaviour
- Design could either exploit or help people avoid 'social traps' (Cross & Guyer, 1980) where both reinforcement and punishment exist, or reinforcement is currently misaligned with the behaviour, converting them into 'trade-offs' which more closely match the intended behavioural choices
- Considering *means* and *ends* (Studer, 1970) may provide a useful perspective on design for behaviour change. The end from the user's perspective effectively becomes the means by which the designer's end might be influenced

Architecture and urbanism

> "There is no doubt whatever about the influence of architecture and structure upon human character and action. We make our buildings and afterwards they make us. They regulate the course of our lives."
>
> Winston Churchill, addressing the English Architectural Association, 1924, quoted in Brand (1994).

In designing and constructing environments in which people live and work, architects and planners are necessarily involved in influencing human behaviour. From Howard's

Garden Cities of To-morrow (1902), through Le Corbusier's *Ville Contemporaine* and *La Ville Radieuse*, to the Smithsons' 'Streets in the sky', there has been a long-standing thread of recognition that the way people live their lives is directly linked to the designed environments in which they live.[11]

Whether an explicit intention to influence behaviour drives the design process—*architectural determinism* (Broady, 1966: see section 6.4)—or whether the behaviour consequences of design decisions are only revealed and considered as part of a post-occupancy evaluation (e.g. Zeisel, 2006), there are links between the design of the built environment and our behaviour, both individually and socially. Some concepts related to influencing behaviour in the built environment may be transposed to other designed systems and contexts, or the same underlying principles could be relevant.

[F2] discusses insights around behaviour from architecture and urbanism which are relevant to designers working to influence behaviour, including coverage of Alexander et al's (1977) *A Pattern Language*, which includes a number of instances of design being used to influence behaviour intentionally, as well as a form of presentation potentially relevant to the 'design toolkit' context (see section 2.6). Summarising the main implications for designers extracted in **[F2]**:

- It is important to recognise that designed environments influence people's behaviour in a variety of ways, and some have been designed expressly with this intention, often for political or crime prevention reasons
- This can range from high-level visions of influencing wider social or community behaviours, to very specific techniques applied to influence particular behaviours in a particular context; *patterns* (see section 2.6), perhaps in combination, facilitate re-use of techniques wherever a similar problem recurs
- Most patterns involve either the physical arrangement of building elements—positioning, angling, splitting up, hiding, etc—or a change in material properties, either to change people's perceptions of what behaviour is possible or to force certain behaviour to occur or not occur
- There are also patterns around aspects of surveillance—designing layouts which facilitate or prevent visibility of activity between groups of people
- There is potential for 'paving the cowpaths' strategically through design, identifying the paths of particular users—perhaps a group which is already performing the desired behaviour—and then, by formalising this, making it easier or more salient or in some way obviously normative, encourage other users to follow suit
- By affecting so completely the way in which people spend their lives, political or police attempts to control behaviour through the design of environments can be controversial

Affordances

> "The *affordances* of the environment are what it *offers* the animal, what it *provides* or *furnishes*, either for good or ill. The verb *to afford* is found in the dictionary, but the noun *affordance* is not. I have made it up. I mean by it

[11] In some cultures this is more explicitly recognised, e.g. the Japanese concept of *ba*—"associated with the... belief that a person's behaviour is induced or actually caused by the place in which that person is situated. Thus, *ba* not only indicates a physical space, but also illuminates the Japanese notion of accountability" (Kawayama, 2007).

> something that refers to both the environment and the animal in a way that no existing term does. It implies the complementarity of the animal and the environment."
>
> James J. Gibson, *The Ecological Approach to Visual Perception*, 1979, p.127 of 1985 edition

Affordances are an important concept in interaction design, popularised primarily by the impact of Norman's (1988) *The Psychology of Everyday Things* (later republished as *The Design of Everyday Things*). The concept draws on Gibson's (1979) work in ecological psychology and perception. Much of Norman's book concentrates on affordances as being something like 'the function or capability that is perceived by the user', focusing primarily on users' perceptions of the affordances available to them, and how to improve product and interface usability by understanding this aspect of design.

However, as many have noted (e.g. Flach, 1995; McGrenere & Ho, 2000), Norman's treatment of affordances, or at least the way the concept was adopted by HCI and interaction design, diverges somewhat from Gibson's original concept, which was that affordances existed *whether or not they were perceived correctly* by an animal in its environment—as Zaff (1995, p.240) puts it, "[t]he individual's continued existence may depend on an ability to detect the available affordances, but the existence of those affordances cannot be said to depend on their felicitous detection". In Gibsonian terms, "a hard, flat, narrow surface may afford walking for me but not for a rhinoceros, and a horizontal surface at the height of my knees may afford sitting for me, but not for a small child" (Warren, 1995, p.211).

Norman (1999) recognises the difference and suggests that what matters in design is really *perceived* affordance—whether a user perceives and understands, correctly, what actions are possible or not. Krippendorff (2006, p.112) suggests that perceived affordances are "the meanings of artefacts in use... a unit of perceptual fit". Some users will perceive different affordances to others—inventive or apparently spontaneous perceptions of opportunities for new behaviours in their environment—powerfully illustrated by Fulton Suri and IDEO (2005) and Brandes and Erlhoff (2006) who have compiled collections of images of objects being used in ways their designers would not have expected.

[F4] reviews the relevance of affordances (and similar perspectives) to design for behaviour change, considering that they are a fundamental concept in thinking about how behaviour is influenced by design:

- Manipulating perceptions of what actions are possible, or not possible, can be a large component of influencing behaviour
- Hiding or revealing affordances, or deliberately creating false affordances, are additional techniques available to designers
- The term *choice architecture* as used in behavioural economics has some overlap with the concept of affordances: choice architecture is about deciding which choices to make available (or not) to the user, and this process is something designers are necessarily engaged in
- Choice architecture approached from the designer's domain will probably emphasise the contextual aspects, although the dominant cognitive psychology perspective (unsurprisingly) favours investigating cognitive processes

How digital architecture influences behaviour

Digital architecture, the structure of software, and of systems such as the Internet, is associated with influencing human behaviour in a number of ways. Aside from the societal effects which mass communication, distribution of information, and social networking have facilitated, most work on this subject focuses on how the affordances and constraints designed into the Internet, communications, computer systems and software applications—or which have the potential to be applied to these systems—could be used to influence user behaviour for commercial or political reasons.

As more consumer appliances ('digital' or otherwise) incorporate networked capability, and everyday life becomes increasingly affected by the nature of these capabilities, it makes less sense to consider digital architecture in isolation: it is relevant to many areas of behaviour change. Drawing on authors including Lessig (1999) and Zittrain (2008), **[F9]** considers some of the relevant implications for designers:

- The affordances and constraints designed into digital systems necessarily influence or have the potential to influence user behaviour
- While the law is a substantial regulator of behaviour offline, online it is 'code' (i.e. software, and the hardware architecture of the Internet) that structures what people can and cannot do
- 'Tethered appliances' and DRM permit restriction and control of users' behaviour in ways which go beyond what is easily done offline, for example enforcing business models and enabling more complete surveillance
- Perspectives on behaviour arising from the *security design* context of many digital systems, such as identifying certain user characteristics to give them access to certain functions, could also be applicable to many other situations
- The Internet can be seen as a generative system, which does not itself seek to influence behaviour, but it does enable services to be built on top of it which in turn enable lots of new behaviours—such as *sousveillance* by the public—as well as changing the ease with which certain behaviours can be influenced
- There are parallels between physical architecture and digital architecture and their influence on behaviour, but also new and different affordances emerging from ubiquitous computing and similar fields

Environmental, ecological and Gestalt psychology

[F8] covers perspectives from environmental and ecological psychology (aside from affordances, considered in section 2.2.8 above) and Gestalt psychology which are relevant to design for behaviour change.

Environmental psychology "deals with the reciprocal relationships between humans and the built and natural environment" (Bell et al, 1996, p. v), which is broad enough a definition to encompass a range of areas of research. Of the fields covered in this review, most of what has been organised along the 'context' blade of Simon's scissors—with the probable exception of the digital architecture and social context discussions—would be considered to be within environmental psychology's scope. Ecological psychology is usually defined more narrowly, with its treatment of behaviour arising from two main (separate) origins: Barker's work on *behaviour settings* and Gibson's on *affordances*.

Gestalt psychology is an approach to perception which emerged in the early 20th century, not specifically focused on behaviour, but with many implications for, and applications in, design. According to Köhler (1930, p.148), "[i]n the German language. . . the

noun 'gestalt' has two meanings: besides the connotation of 'shape' or 'form' as a property of things, it has the meaning of a concrete individual and characteristic entity, existing as something detached and having a shape or form as one of its attributes." Gestalt psychology thus deals with "what is perceived [as] the whole, whether an object, a person, an event, or a physical setting... Any event, object, behaviour or experience consists of the patterned relationship among the various parts" (Ittelson et al, 1974, p. 67-8).

Within the scope of the review, only certain ideas from environmental, ecological and Gestalt psychology were considered, where they were felt to be directly applicable to a design context:

- Interface design could help users understand the affordances and constraints available in their environment, in a way where users "feel as if they are working directly with the object and not with the interface".
- Designers should ensure that the cues present in a situation are consistent or aligned in a way that suggest they are matched to the behaviour that it is intended to influence.
- The concept of *behaviour settings* suggests the possibility of redesigning particular settings to elicit particular behaviours, if the new setting is similar to ones in which the desired behaviours are normally expressed.
- Design can support users' inferences about a situation and give them confidence in their decision-making when engaged in new behaviours.
- Gestalt principles could be used to influence users' perceptions, e.g. deliberately using visual similarity to suggest that two controls should be operated together.
- The *law of prägnanz* suggests that users will identify patterns where they are present, in whichever way is simplest or most concise, thus the designer should try to ensure that these patterns are the ones intended.

The social context

The social context in which behaviour occurs is 'environmental', but not about the physical environment. Concepts relevant to design for behaviour change here can be seen in social psychology, sociology and some sub-fields of these. Social psychology "especially involves the scientific study of the behaviour of individuals as a function of social stimuli" (Jones & Gerard, 1967). While not the exact terminology currently used in the field, this definition allows comparisons to be made with some of the other disciplines addressed in reviewing the 'context blade' of Simon's scissors. Sociology is broader, in the sense of being the study of society in general.

When considering behaviour in a social context, it is important to recognise the extent to which it *affects* and in turn is *affected by* society: social context may affect behaviour, but behaviour also affects social context. Rather than considering each discipline separately, **[F7]** concentrates on specific concepts considered especially applicable to design for behaviour change, including the following:

- *Social proof* is already widely applied as a technique to influence behaviour—two kinds of social norms, descriptive and injunctive, can be involved, and the designer can choose to emphasise the one which aligns best with the intended behaviour (Cialdini 2007).

- Normative comparisons need to be structured carefully to use appropriate comparison groups, and avoid boomerang effects (Schultz et al 2007).
- The tendency for people to 'role-play' (Goffman, 1959) could be applied deliberately, designing systems or situations which provoke certain behaviours from people in order to be consistent with their role.
- The same people, in different situations, may behave apparently inconsistently from an external point of view (e.g. attitudinally) but consistently within the expectations of the situation.
- There may be opportunities for design to support people in impression management—allowing them to maintain some control over the way they and their behaviour are presented to others.
- A situation will inevitably be framed in a certain way by participants, drawing on social cues and previous experience—design can deliberately try to influence this framing.

Poka-yoke, forcing functions and constraints

As is apparent from the earlier discussion of physical architecture and behaviour, many situations where design has been used to influence behaviour involve the layout, positioning and fixing (in one way or another) of objects in space. From a human factors and safety perspective, *barriers* are a major subset of this—Hollnagel (2004, p.69) uses the term to mean "something that stops the passage of something or someone, usually in a physical sense".

As **[F4]** discusses, a key point about this perspective is that it effectively treats accidents as 'unwanted behaviour' which can be affected beforehand (reduced or eliminated) through design.

A similar view is seen (with errors rather than accidents) in the concept of *poka-yoke* (Japanese: 'mistake-proofing'), in manufacturing engineering—defensive design techniques originally developed by Shigeo Shingo in the context of the Toyota Production System, intended to ensure 'zero defects' in assembly processes (Shingo, 1986). What perhaps sounds like a harsh approach to worker error is nothing of the sort: the poka-yoke approach aims to design out possible errors by making it easier for the 'right' behaviour to occur, and more difficult or impossible for the 'wrong' behaviour: "Too often, we blame people for making mistakes. Especially in the workplace, this attitude not only discourages workers and lowers morale, but it does not solve the problem. Poka-yoke is a technique for avoiding simple human error at work." (Nikkan Kogyo Shimbun, Ltd. & Factory Magazine, 1989).

There is a parallel between Shingo's 'control' poka-yokes and what Norman has called *forcing functions*, "something that prevents the behaviour from continuing until the problem has been corrected" (Lewis & Norman, 1986, p.420).

Norman (1988/2002) identified three types of forcing function—*interlocks*, *lockins* and *lockouts*—all of which essentially force a user to carry out operations in a certain order. Norman considers forcing functions within a wider field of behaviour-shaping constraints, alongside affordances. Sometimes this is about "deliberately making [certain] things difficult" (Norman, 1988/2002, p. 203) in order to constrain users' behaviour to what is desired; Krippendorff (2006, p.108) notes that this is simply because "[t]he range of possible uses of artefacts is usually far larger than anticipated by its [*sic.*] designers".

[F4] summarises some relevant insights for design for behaviour change:

- The poka-yoke, forcing function and barrier perspectives effectively treat errors and accidents as 'unwanted behaviour' which can be reduced or eliminated through design; it is not a major leap to consider inefficient or non-optimal user behaviour as an 'error' and design accordingly.
- Design can make it easier for the 'right' behaviour to occur, and more difficult or impossible for the 'wrong' behaviour.
- Real, simulated, perceived or self-applied constraints can be seen alongside affordances as important components of design to influence behaviour.

2.2.3 Cognitive approaches to behaviour

These approaches model (and try to change) people's thinking processes, attitudes, emotions, motivation or reasoning, so that they do or don't behave in particular ways.

Attitudes, persuasion and behaviour

An assumption often found in the literature on behaviour (and influencing it) is that attitudes are the main determinant of behaviour, and that they precede behaviours. 'Changing minds' will lead to 'changing deeds'; attitude change is to some extent conflated with behaviour change. Petty and Cacioppo (1981, p.7) note "the presumed ability of attitudes to direct (and thus allow prediction of) behaviours." Attitudes "tend to be conceived as the product of a deliberative calculation weighing an individual's beliefs about a behaviour with the value they attach to those characteristics" (Darnton, 2008, p.12).

However, much research has found that attitudes may *result from behaviour* rather than necessarily preceding it, through mechanisms explained by *self-perception theory* (Bem, 1972) or *cognitive dissonance* (Festinger et al, 1956).

Winter and Koger (2004, p.59-60), specifically considering attitudes towards the environment, suggest that "[w]e think we recycle cans because we believe it is important to save resources; if someone told us we think it is important to save resources because we recycle cans, we would think that explanation was bizarre... [yet] research on the relation between environmental attitudes and behaviours has shown inconsistent results. Sometimes pro-environmental attitudes correlate with pro-environmental behaviour (e.g., people who think recycling is important are more likely to recycle). Sometimes pro-environmental attitudes are unrelated to behaviour (e.g., people who think use of fossil fuels should be reduced do not necessarily drive less than others)."

The concept of *persuasion* is important to discussions of attitudes and behaviour. Fogg's use of the term *persuasive technology* and the field that has developed as a result will be covered in a subsequent section, but it is useful to consider persuasion here, in the context of attitudes and how persuasive messages are constructed and delivered.

Petty and Cacioppo's (1981) *elaboration likelihood model* (ELM) proposes two 'routes' through which persuasion can be effected. The elaboration likelihood is essentially "how likely is it that the... person will be motivated and able to think about the message [being presented]?" (p. 268). If the likelihood is high—the audience motivated and able to think—it is worth trying to pursue the 'central route', presenting an argued explanation of why the message is correct.

On the other hand, Petty and Cacioppo's 'peripheral route'—to use if the elaboration likelihood is judged to be low, or if the actual message being presented is weaker—involves persuasion that occurs through less thought, attention or effort on the part of the persuadee: "persuasion is determined by simple cues, such as the attractiveness of the communicator, whether or not the people around you agree with the position presented,

or the pleasure or pain associated with agreeing with the position, or whether a reason is given (no matter how bogus) for complying with a request" (Pratkanis and Aronson, 2007, p.35).

[F5] reviews implications for designers from academic work on the links between attitudes, persuasion and behaviour, including:

- There is often an assumption that attitudes are the main determinant of behaviours, and that they precede behaviours, but this is not necessarily the case—attitudes can also be the result of behaviours. Thus while design for attitude change may lead to behaviour change, design for behaviour change may also lead to attitude change.
- As well as deliberately provoking cognitive dissonance in an attempt to change attitudes, redesign could directly lead to behaviour changes, potentially shifting public attitudes as a result.
- From a design perspective, portraying new behaviours as being 'like' existing familiar ones (perhaps metaphorically) might be effective in driving a 'positive spillover' effect.
- Techniques drawing on the Theory of Planned Behaviour (Ajzen, 1985) applicable in a design context include providing information on consequences and others' approval, and prompting intention formation.
- However, TPB's emphasis on intentions and 'planned' behaviour rather than situational factors suggests that it does not provide a complete picture in an interaction design context. Other models, such as the Theory of Interpersonal Behaviour (Triandis, 1977) are more comprehensive, with each element—social, affective and rational factors, habits, and situational constraints—potentially addressable via design.
- Design can address either *peripheral* or *central* route persuasion. Although the central route is more usually associated with longer-term, enduring attitude change, the peripheral route can lead directly to behaviour change.

Motivation and design

Ryan and Deci (2000, p.54) define motivation thus: "To be motivated means to be moved to do something. A person who feels no impetus or inspiration to act is thus characterized as unmotivated, whereas someone who is energized or activated toward an end is considered motivated."

The basic distinction commonly drawn is between *intrinsic* and *extrinsic* motivation: intrinsic "refers to doing something because it is inherently interesting or enjoyable," while extrinsic "refers to doing something because it leads to a separable outcome" (Ryan and Deci, 2000, p.55). Extrinsic motivation often implies the promise of rewards (or avoiding punishment), and thus has some parallels with aspects of operant conditioning and peripheral route persuasion, particularly the shorter-term level of engagement which results.

Bisset (2011) has explored the potential of 'intrinsically motivating design' for socially beneficial behaviour change via services and products, with the designer helping support the user's motivation: "One way of conceptualising the role of a designer in this situation is by comparison with a sports coach or film director, working with the athlete or actor, supporting and guiding him towards reaching your shared performance goals, or in less ambitious cases, simply ensuring that they do not produce a low-quality performance"

(Bisset, 2010, p.303-5). **[F5]** summarises some insights around motivation which are relevant for designers working on behaviour change:

- Motivation can be influenced via design—including internalisation or reframing of extrinsic motivation to intrinsic motivation.
- Deci & Ryan (1985) and Pink (2010) suggest needs that should be fulfilled to achieve intrinsic motivation, including autonomy, competence / mastery, social relatedness and purpose, thus providing a potential checklist for designers.
- Design has the potential to support motivation through offering tailored 'coaching' as a user moves through a process of engagement, much like the concept of a 'user journey' in service design (Bisset, 2010).

Interpersonal influence

While the fields are less well-founded academically, a review of what influences behaviour would be incomplete without brief consideration of some of the practical 'interpersonal influence' and 'self-help' techniques which have been popularised, often with the aim of helping people progress in their career, develop confidence in dealing with others, or change others' worldviews. **[F7]** considers the applicability of some of these perspectives to design for behaviour change: the more practical techniques are, the easier it is to see how they might be applied through design.

One of the best-known works in this field is Dale Carnegie's *How to Win Friends and Influence People* (1936/1981), which offers readers "fundamental techniques in handling people," "ways to make people like you," advice on "how to win people to your way of thinking" and "how to change people without giving offense or arousing resentment." The stated aim is not directly to manipulate people for one's own ends, but sincerely to develop empathy, to seek to understand other people and learn how to deal with them. Some of the basic politeness principles Carnegie discusses are arguably central to user-centred design and user experience (as noted by Cummings, 2009), and so are relevant to design for behaviour change.

[F7] also briefly covers techniques for influencing behaviour within organisations, and explores the relevance to design of some ideas from neuro-linguistic programming (NLP), which, while largely discredited scientifically, includes some interesting perspectives:

- Some of the basic principles which Dale Carnegie (1936/1981) discusses in *How to Win Friends and Influence People* are arguably central to user-centred design and user experience, and indeed are relevant to design for behaviour change.
- Examples include techniques such as tailoring, polite and gentle ways of handling behavioural 'errors', working with users' existing understanding of a situation, and using challenges, storytelling and dramatisation to make concepts more salient.
- Similar techniques with potential design applicability are found in other work on interpersonal influence, including Kipnis et al's (1984) concept of *coalition*—perhaps using a product or system to help 'mobilise' other people, e.g. someone's peers or friends, to influence him or her to change behaviour.
- Some ideas which have been popularised through NLP could have design applicability, especially where their use has also been described in other fields—in particular the concepts of trying to match users' mental models of a system, and using mimicry or mirroring to build rapport with a user.

Cognitive biases, heuristics & decision-making

Much human behaviour can be seen as *decision-making*, and so understanding and influencing those decision-making processes could be an important component in design for behaviour change. 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 adaptive strategies.

The area of decision-making research focused on understanding *heuristics and biases* (Tversky and Kahneman, 1974) arose in particular from studying people's judgement under conditions of uncertainty, such as common subjective assessments of probability, but because of the wider societal implications of the effects uncovered, the study has since developed into fields such as behavioural economics and, in recent years, gained significant political attention.

A cognitive bias is assumed to be, essentially, a systematic bias in the outcomes of decisions people make, arising from the application of one or more heuristics[12]: "rules of thumb" (Thaler and Sunstein, 2008, p.22) or "inference mechanisms" (Gigerenzer et al, 1999, p.vii)—simple 'shortcut' strategies for making decisions or judgements. For example, if we are in an unfamiliar city in the evening, looking for somewhere to eat, a quick heuristic might be to go for a restaurant that looks popular—meaning our decisions are potentially 'biased' in favour of restaurants who seat diners near the windows—while a more detailed heuristic might involve looking up information on the different restaurants in the city and comparing relative distances, prices, and so on.

[F6] considers the relevance of insights from the academic study of cognitive biases and decision-making in design for behaviour change:

- Much human behaviour can be seen as *decision-making*, and so understanding and influencing those decision-making processes could be an important component in design for behaviour change.

- A range of heuristics and biases have been identified; it is possible to see a 'design' application for many of them. It does not seem essential to distinguish between heuristics (which may cause the biases) and biases themselves from a design point of view: they are either effects useful for design because they could be *exploited* to influence people's behaviour, or because there is an opportunity to *counter* them to help people make better decisions, hence influencing the desired behaviour.

- Effects which may have significance for design include the *confirmation bias*, *framing*, the *status quo bias* (particularly in relation to default choices or settings), *salience biases* and *serial position effects*. Cialdini's (2007) 'weapons of influence' are six cognitive bias-related strategies for influencing behaviour which are particularly easy to consider applying in a design context.

- Alternatively, or in parallel, 'fast and frugal' heuristics could be exploited via design: for example, the *recognition heuristic* would suggest that giving people a choice they recognise as being similar to something they already know could be a way of transitioning them to a desired new behaviour.

- Habits may arise over time simply through the precedent that one action sets for future ones. A design intervention which can easily become a habit, or modify an

[12] The wider definition of heuristics as "methods that are sometimes useful in solving a problem—useful enough to try even when it is not clear that they will help" (Baron, 1994, p.70) derives from Pólya's (1945) *How to Solve It*, a handbook of mathematical techniques which will be discussed further (for its format and approach) in section 2.5.3

existing everyday habit, could be effective; equally, if a designed system makes it easier for some actions to occur without imposing too much cognitive load, then it is probably more likely to be able to establish those actions as habits.

Information flows

In section 2.1.4, Meadows' (1999) classification of leverage points was introduced, and the idea of working with *information flows* was extracted as a potentially relevant approach for designers seeking to influence behaviour. These interventions involve changing what information about a system is available, and to whom, at different times. It is the principle of "delivering information to a place it wasn't going before" which is central to many designed interventions, but there is a further useful distinction here: *antecedent* information, delivered before any action has taken place, and *consequence* information, delivered afterwards (Tuso & Geller, 1976).

[F4] explores the literature on information flows and behaviour change (particular around energy use) for its potential applicability to design. Many of same principles can be seen in information-based interventions for a range of social benefit behaviour changes beyond energy use, such as encouraging exercise or healthier eating:

- Information flows involve changing what information about a system is available, and to whom, at different times. The principle of "delivering information to a place it wasn't going before" (Meadows, 1999) is central to many designed interventions. Antecedent information is delivered before any action has taken place, and consequence information is delivered afterwards. Different design considerations are relevant in each case.

- There are a number of different kinds of feedback which it is possible to design, from the ultra-simple to more complex 'closed-loop' systems which automatically correct 'errors'.

- The most effective information campaigns (for home energy efficiency at least) present the information in simple, vivid and personally relevant ways, with the source being perceived as credible.

- More frequent feedback seems to be more effective at influencing users to save energy, but a single piece of feedback evoking surprise (in turn, cognitive dissonance) can also be effective.

- Systems which either set a goal for users, or allow users to set their own goals, in conjunction with feedback, can be effective, and may involve commitments, social proof and other mechanisms.

- The kinds of units or type of information used in feedback need to match the understanding and literacy that users have in relation to the situation being monitored.

- Designing *feedforward*—presenting the user with a simulation, preview or suggestion of the outcomes of an action—may require more data to be available, but offers a new set of possibilities hitherto underexplored.

Persuasive Technology

> "[A]s computers have migrated from research labs onto desktops and into everyday life, they have become more persuasive by design. Today computers are taking on a variety of roles as persuaders, including roles of influence that

> traditionally were filled by teachers, coaches, clergy, therapists, doctors and salespeople, among others."
>
> B.J. Fogg, *Persuasive Technology: Using Computers to Change What We Think and Do*, Morgan Kaufman, 2003, p.1

The field of *Persuasive Technology*—approaching behaviour change from a primarily HCI background—arguably represents the closest 'established' academic field for work seeking to use design to influence behaviour. B.J. Fogg's 2003 book *Persuasive Technology: Using Computers to Change What We Think and Do* (Fogg, 2003), together with the work of his team at the Persuasive Technology Lab at Stanford, has inspired a series of international conferences and diverse groups of researchers from around the world to develop their work under this banner.

Fogg's work builds on Reeves and Nass's (1996) concept of *computers as social actors*—the idea that people instinctively respond to computers (and media more generally) *as if they are other people*, attributing personalities, motivations and attitudes to inanimate devices, even if the interfaces are not specifically designed to be anthropomorphic. Via work on the credibility of different websites, Fogg came to focus on the aspects of interaction with technology intended to change people's attitudes[13], behaviours, or both, coining the term *captology* to describe 'computers as persuasive technologies'.

In Fogg's (2003) analysis, computer systems offer a number of advantages over more 'traditional' persuaders: unlike broadcast or print media, computers afford interactivity: they "can adjust what they do based on user inputs, needs and situations" (p.6). Unlike human persuaders, computers also have the ability to be relentlessly persistent, potentially offer users anonymity, deal with large volumes of data and scale easily, "use many modalities to influence", and "go where humans cannot go or may not be welcome" (p.7).

[F9] extracts some implications for designers, drawing also on the more recent work of Fogg and his team at Stanford:

- Persuasive Technology brings together context and cognition, the environment and the person, including consideration of personal aspects such as motivation alongside environmental aspects such as 'triggers'
- People may respond to computers (and media more generally) as if they are other people, attributing personalities, motivations and attitudes to inanimate devices, even if the interfaces are not specifically designed to be anthropomorphic; this effect could be used to influence behaviour in a variety of ways
- Computer systems offer some advantages in terms of persuasion, affording interactivity, tailored responses, persistence, anonymity, multiple modes of operation and adaptability to different contexts
- Fogg's 'seven tools'—*reduction, tunnelling, tailoring, suggestion* (at the right moment: *kairos*), *self-monitoring, surveillance* and *operant conditioning* can all easily be adapted for use in design contexts
- Increasing computational power and widespread adoption of mobile devices could lead to new 'persuasive faculties'—technology could enable better reasoning abilities, such as allowing someone to simulate or 'rehearse' the results of different courses of action

[13] While Fogg (2003) discusses changing both attitudes and behaviours, most recent work in the Persuasive Technology field seems to have concentrated on behaviours.

- The Fogg Behaviour Model—comprising motivation, ability, and trigger—is a simple way of analysing situations to assess which elements need to be addressed to influence behaviour. Design can deal with all three elements, though often concentrating on triggers

Games and gamification

Over the duration of this PhD, *gamification* (Deterding et al, 2011) has arisen as a significant phenomenon in digital media: using elements from game design in (traditionally) non-game contexts, particularly on social networking services, to engage users and influence behaviour.

The elements or game mechanics adopted include the idea of 'levels' and scores, 'badges' for achievement, leaderboards, escalating challenges matched to skill levels (drawing on Csíkszentmihályi's *Flow* (1990)), and unpredictable reinforcement. The thinking is that since games (physical and digital) are able to engage and motivate players for long periods of time, giving them feelings of challenge, achievement and satisfaction, some of the elements which make games successful in these situations could be adapted for use elsewhere.

Alternatively, other tasks or behaviours could be effectively 'turned into games' themselves, making an interaction 'playful' or adding variety so that each time it is performed, there is something new or exciting to experience. McGonigal (2011) suggests that compared to the satisfying, often exhilarating world of games, "reality is broken"; she offers examples such as Kevan Davis's *Chore Wars*, a game "to help you track how much housework people are doing—and to inspire everyone to do more housework, more cheerfully, than they would otherwise" (p.120) as possible 'fixes' for the 'broken' elements of everyday life which mean that we do not always behave as we would like to.

Despite the current vogue for gamification of often superficial behaviours, as an extension of companies' advertising campaigns—e.g. Bogost (2011) describes it as "invented by consultants as a means to capture the wild, coveted beast that is videogames and to domesticate it for use in the grey, hopeless wasteland of big business"—there is a parallel, more academically established field of *serious games* (e.g. Zyda, 2005), which seek to use games as an educational or training tool, and indeed *persuasive games* (Bogost, 2007).

[F9] considers some relevant insights from games and gamification for design for behaviour change more widely:

- Games work at intersection of the 'context' and 'cognition' blades of Simon's scissors—effectively *creating artificial contexts* structured to lead to certain cognitive processes
- The rules, affordances and constraints designed into games can influence players' attitudes and behaviours, both inside and outside the games
- Game elements and mechanics can be used to influence behaviour in (traditionally) non-game contexts, particularly on social networking services, to engage users and influence behaviour, e.g. levels and scores, 'badges' for achievement, escalating challenges matched to skill levels and unpredictable reinforcement
- Alternatively, tasks or behaviours could be effectively 'turned into games' themselves, making an interaction 'playful', more engaging or adding variety so that each time it is performed, there is something new or exciting to experience

Product semantics and design for emotion

Krippendorff (2006) provides an introduction to the study of *product semantics*—that is, "how people attribute meanings to artefacts and interact with them accordingly" and, simultaneously, a "vocabulary and methodology for designing artefacts in view of the meanings they could acquire for their users and the communities of their stakeholders" (p.2). Many of the elements of product semantics which Krippendorff describes could have direct relevance for influencing user behaviour.

Elements of product semantics adopted in industry often relate to provoking emotional or *affective* responses from users, or satisfying emotional needs when they have been uncovered through market research—part of what Jordan (2000) calls "designing pleasurable products" rather than simply meeting basic functionality and usability needs. In HCI, the field of *affective computing* (Picard, 1997) covers the development of computer systems which make use of emotion, both recognising it and emulating it (enabling 'empathy'); there are also approaches such as *kansei engineering* (Nagamachi, 1995), defined as "translating... a consumer's feeling and image for a product into design elements" (p.3) and *emotional design* or *design for emotion* (Desmet, 2002). **[F5]** summarises some relevant insights for design for behaviour change:

- At the intersection of context and cognition, product semantics concerns how users read meaning into the products they use, and hence interact with them accordingly
- Visual metaphors or intentional similarity can enable users to understand a 'new' product in the way that they understood a previous one
- Colour can be used to signify meaning or to connote moods
- Discontinuity in appearance can draw attention to differences in function between elements
- Strategic use of portions or size framing could influence quantity of consumption
- Maps of possibilities can show users the behaviours available
- 'Semantic layers' can reveal different meanings as appropriate in different contexts, perhaps revealing 'how products work' where understanding is important to behaviour
- Design for emotion and affective computing deal with both recognising users' emotional responses and responding to, emulating or eliciting them appropriately, where computers or products become 'social actors'
- There is the potential to influence user behaviour via emotional interaction, e.g. through empathy (displaying or engendering) or through triggering particular associations or personal significance for users

2.2.4 Summary of implications for designers

Physical and social contexts affect people's behaviour—from the simple layout of environments, to the affordances and constraints designed into digital systems, to the structure of social situations.

Context can shape behaviour both before and after actions, in terms of the consequences experienced; how people perceive the actions available to them is something designers are extremely well-placed to influence, through techniques and effects including:

- Physical or metaphorical arrangement of elements, or changes in material properties
- Manipulating the affordances, constraints, patterns and choices perceived by users
- Making the 'right' behaviour easier, and the 'wrong' harder
- Strategic use of security and surveillance techniques or their variants
- Recognising particular behaviours and making them easier—'paving the cowpaths' literally or metaphorically
- Using social proof to show users how other people behave
- Encouraging users to 'role play', behaving consistently with the role adopted
- Reinforcing or conditioning particular behaviours
- Using feedforward or simulation to help users build up weightings for the choices in front of them
- Enabling new behaviours to develop by making it easy for users to build on a system

Many of these approaches involve *recognising* factors which influence behaviour in analogous contexts—intentional or not—and then *translating* them to be applicable intentionally through design in the context under consideration.

As well as context itself, behaviour is influenced by the cognition—thinking, understanding, and making decisions about what to do—which happens in that context. While it is often assumed that *attitudes* determine behaviour, this is not necessarily the case—attitudes can also be the result of behaviours, so the situation is more complex than simply 'changing people's attitudes so they behave differently'. Nevertheless, designers again have a range of opportunities to influence cognition through design; some relevant techniques include:

- Changing what information about a system is available, and to whom, at different times
- Providing both antecedent and consequence information (feedback of different kinds, matched to users' understanding and needs)
- Addressing both 'peripheral' and 'central' route persuasion
- Motivating users and supporting continued engagement, e.g. via setting goals
- Using game elements to increase engagement
- Using affective or emotional design elements
- Using product semantics strategically so users 'read' the intended meaning

- Exploiting or countering heuristics and biases, including the confirmation bias, framing, the status quo bias (particularly in relation to defaults), salience biases and serial position effects
- Portraying new behaviours as being 'like' familiar ones (perhaps metaphorically); making use of recognition heuristic
- Cialdini's 'six weapons': reciprocation, commitment & consistency, social proof, liking, authority and scarcity
- Fogg's 'seven tools': reduction, tunnelling, tailoring, suggestion (at the right moment: *kairos*), self-monitoring, surveillance and operant conditioning and 'motivation, ability, trigger' model
- Designing interventions which can become habits, or modify existing habits
- Polite and useful error-handling
- Provoking cognitive dissonance in an attempt to change attitudes

Chapter 4 describes 'what to do' with these insights—the development process of incorporating them into an idea generation 'toolkit' for designers working on behaviour change. The following sections (2.3 and 2.4) explain the background to that toolkit—the need for it, the opportunity identified, and literature informing possible formats for it.

2.3 Identifying research questions

Section 2.1 introduced a range of taxonomies for 'design for sustainable behaviour', while section 2.2 extracted insights from a review of behaviour change concepts and principles from other disciplines, which could be applicable by designers seeking to influence behaviour through design.

Taxonomies such Lilley's and Wever's, and the various axes and spectra of influence and control, are useful for analysing and classifying *existing* ideas and approaches along different dimensions—including, potentially, many of the concepts in 2.2—but they are not primarily presented in a form which suggests they are intended to be used for the *activity of designing*. They are not creative tools; they do not encourage divergent production (section 2.4.2) which is considered to be a major factor in creativity (Getzels, 1987).

While designers' work inevitably influences human behaviour (section 1.1), they are generally not experts on it.[14]But when designing with the intention to influence behaviour, it is evident that designers need to be able to draw on—and understand the applicability of—concepts from other disciplines, including a number of different areas of psychology. As Lilley (2007, p.37-38) notes, appropriation and "transferring theory from disciplines such as science and technology studies, computer studies or sociology into design appears to be a relatively new research agenda for designers" working on behaviour change; she comments that the author's previous work on architectures of control

[14]Kelley & Littman (2005) comment that some of IDEO's "most valuable" people are what they call 'T-shaped', "[t]hat is, they enjoy a breadth of knowledge in many fields, but they also have depth in at least one area of expertise." Being π-shaped is another variant noted recently ("deep knowledge in a few areas, broad knowledge in a few": Varnum, 2012)

(see Preface; Lockton, 2005) "demonstrates the value of horizontal knowledge transfer between disciplines", but lacks practical applicability in a design process for behaviour change.

2.3.1 The "fuzzy front end": early stages of the design process

A design process which focuses on behaviour change will clearly need to consider at least one method[15] (and probably a number of them) for influencing behaviour, and this will most sensibly take place early in the process—in the "fuzzy front end" (Khurana and Rosenthal, 1997) which often involves an idea generation, ideation or brainstorming phase of some kind.

At later stages in the design process, it is more likely that the potentially behaviour-influencing elements of products and services will have already been defined—while the oft-repeated claim that "design determines 70% of cost" may not be accurate (Barton et al, 2001), early design decisions (whether for hardware, software, environments or services) will in many cases determine the potential scope addressable by later decisions, even if a product or service is planned as a 'platform' which can enable multiple variants to be produced. Thus, it makes sense to address the early stages of the process.

In Dubberly's (2005) comprehensive compendium of reported design processes and models, *How do you design?*, the idea generation phase is represented by names (some nouns, some imperative verbs) such as 'ideate' (Koberg and Bagnall, 1981), 'brainstorming', 'genesis', 'divergence' (Banathy, 1996), 'generation' (Cross, 2000), 'conceptual design', 'inventory alternatives' (Buckminster Fuller, explained in Brown et al, 1978), 'invention and judgement' or 'generate product concepts' (Eppinger and Ulrich, 1995). Essentially, the phase involves the generation of multiple alternative ways of solving a problem, as a precursor to selecting among them which one(s), if any, to develop further, combine or refine.[16]

This can happen individually or in groups (or both), and can be done following formal rules or very informally; solely by designers or with other stakeholders or subject matter experts from other domains which are relevant. It can be done 'off the top of the head' (with no stimulus material), using an early idea as a 'primary generator' (Lawson, 1997), or by using a form of structured idea generation method such as TRIZ (e.g. Altshuller, 1994).

How, then, are designers to do this when briefed with *influencing behaviour*? Despite design's growing role in the area of behaviour change, there is little available as a resource to assist designers working on 'new' problems, or new ways of addressing existing behaviour problems.

2.3.2 The gap: an opportunity

> "We are all inclined to see the whole world through our own professional spectacles, and thus to see it distortedly. The lawyer, dealing daily as he is with divorces and separations, often seems to suppose that the family is held together only by the constraint of the law... The physicist is apt to suppose that the world could be run much better if only scientists were in charge; the psychologist, that the assumptions about rat behaviour that are helpful in the lab are equally valid as general principles of human conduct.

[15] Even if only one behaviour change approach is considered, this decision has to come from somewhere.

[16] Simon (1969/1981, p.149) uses the term "The Generator-Test Cycle", referring to, "first, the generation of alternatives and, then, the testing of these alternatives against a wide array of requirements and constraints".

> By the same token, the designer may easily come to believe that his work will achieve the social objectives which not only his client, but he himself, wishes to promote."
>
> Maurice Broady, 'Social theory in Architectural Design', 1966, p.176

There is not much design-focused guidance for designers facing 'behavioural' briefs—guidance which can be applied during the early stages of a project where discussions with clients and other stakeholders are likely to influence the approach taken. This is not simply to avoid 're-inventing the wheel', but also to make use of knowledge and insights developed in other contexts which could influence behaviour more effectively—facilitating the "horizontal knowledge transfer between disciplines" as Lilley (2007; p.38) puts it.

One approach is to provide an inspiration guide, enabling *cross-domain mapping* (e.g. Zbikowski, 1997), bringing together examples and insights from different disciplines relevant to influencing behaviour. As Eckert & Stacey (2000, p.525) suggest, "sources of inspiration play a number of important roles in design thinking, as definitions of context, triggers for idea generation, and as anchors for structuring designers' mental representations of designs."

At the idea generation stage, this could involve using sets of examples, guidelines or other forms of insight around what influences behaviour, extracted from relevant disciplines and presented in a form designed to help with idea generation in workshops or other contexts. Using these insights would also lead to greater familiarity with the ideas, such that designers develop a broad (if inevitably shallow) repertoire of possible 'gambits' (Lawson, 2004) relating to behaviour.

There are thus opportunities for guides which can help designers explore and think about how to apply and transpose research and practice from many disciplines in general. Particularly in web and interaction design, there is clear current demand for psychological insights to be made available in forms usable by designers, with authors such as Weinschenk (2009, 2011) and Anderson (2010, 2011) extending, in the form of practically applicable guidebooks, a trail blazed by Norman (1988); can something be done which focuses specifically on influencing behaviour, for designers with a variety of specialisms?

This, then, is the gap identified as the first research question of this thesis:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

The form in which the ideas are brought together to answer the question–a toolkit (see below)–will be an output of the research, along with this thesis. Considering the 'of use' aspect of the first question, suggests also focusing on investigating the effects of the toolkit on designers working on behaviour-related briefs:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

2.3.3 Toolkits in design

The gap—and thus the opportunity—identified is for something which can help designers explore ideas around influencing behaviour from other disciplines, making it easier to transpose applicable insights during the idea generation phase of the design process. One element of this will necessarily involve developing a way of presenting the transferable insights from the literature review on behaviour (section 2.2) which might be most applicable in the design of products, services or environments.[17]This is explored directly in Chapter 4.

The gap is most obviously addressed through creating a guide or *design toolkit*, which brings together the insights in the form of 'tools' which can be applied to different situations, much like a physical toolkit contains tools relevant for different jobs and tasks[18]. The 'toolkit' concept is increasingly common in design—for example, Cambridge's i~design Inclusive Design toolkit (Clarkson et al, 2007; Dong and Clarkson, 2005), IDEO's (2009) Human-Centred Design toolkit (mainly intended for use by NGOs and social enterprises), the King's Fund's (2011) Experience-Based Co-Design toolkit for cancer patient care, Zamarato's (2008) Narrative Design toolkit and Namahn's (2010) Service Design toolkit for public services.

Each of these is essentially a collection of 'ways of doing things' during the design process in the context concerned, such as templates for particular methods, suggested activities, and examples of implementing particular principles in practice. It is easy to conceive of a guide or toolkit along these lines for behaviour change and design, including certain elements as appropriate.

Taking Clarkson et al (2007)—the Inclusive Design toolkit—as an example, it is presented in the form of a 160-page book and a website (with the website allowing interactive content such as a Flash-based 'exclusion calculator'), divided into sections introducing inclusive design (what it is, and why it is worthwhile), the inclusive design process (how the approach fits into existing design processes), knowledge and tools (which explains in detail methods such as task analysis, personas, and segmentation) and user capabilities (giving detailed recommendations, suggestions and examples for design taking into account specific sensory, cognitive and physical user capabilities). Each double-page spread covers a single concept: the discrete division into these potentially stand-alone units enables easier use of the toolkit in a non-linear form, choosing particular sections as appropriate (this property is discussed further in section 2.4.4).

Dong and Clarkson (2005) demonstrate that in some cases at least, toolkits have been developed in response to direct requests or capture of requirements from particular industries or stakeholders, or as part of large projects involving a number of partner organisations. In other cases, toolkits have been co-developed with input from potential users, refining them as they are used in practice.

Given the relatively 'new' focus on behaviour change as a design goal, organising a large-scale industry collaboration was considered unrealistic, at least at the time this PhD started in 2007, but the opportunities raised by, for example, Lilley's (2007) suggestion

[17]There is an assumption here that the differences in design approach between products, services and environments (e.g. as noted by Lawson, 1997) are, to a significant extent, due to how the disciplines have evolved and how practitioners have been trained. All can be considered designed *systems*, and many of the same techniques, or analogues of them, can be applied in each context.

[18]The toolkit metaphor may have reached design practice through the use of the term in computer science, particularly in HCI and interaction design where toolkits such as GTK+, Qt and jQuery UI comprise collections of graphical user interface 'widgets', with the associated code, which can be used by developers to build a variety of applications, often cross-platform. A toolkit in this sense is directly deployable, providing an API (application programming interface) which can be called by applications, compared with interface design pattern libraries (see section 2.4.3) which are more akin to collections of 'ways to solve' particular common problems.

for a practical realisation of "horizontal knowledge transfer between disciplines" in design for behaviour change, suggested that there might at least be scope for practical industry input into a toolkit during its development. This is the approach it was decided to take in this PhD.

The author acknowledges that the 'need' for the toolkit was not based on a survey or direct call from industry, but rather identification of the need for designers to be able to engage with behaviour change (Chapter 1), and thus a recognition of an opportunity for a guide or toolkit to address this. This can be seen as a limitation of the work, but any PhD that is initiated by the researcher him or herself, as opposed to being commissioned by an external funding body, is to some extent an exploratory exercise, identifying an opportunity to contribute to a discipline and seeing what results. Consistent with action research methodology (section 3.4.4), the development, 'release' and evaluation of the toolkit-in-use represents a research programme which contributes to the area of focus. The first research question identified in section 2.3.2 will be answered with a toolkit as an output, together with analysis of how it is used by designers answering the second research question.

A toolkit developed for use at the idea generation stage of a design process will need to focus on *divergent production* (Guilford, 1967; Getzels, 1987; see section 2.4.2.8), inspiring and helping designers explore the field of possibilities rather than converging immediately on a single solution. In addition, since 'best practice' in design for behaviour change has not yet become established (either in terms of measured effectiveness, or ethically), there is little scope for the toolkit to codify the 'right' way to do things at this stage. This is a key difference between a toolkit intended for early stage use and one including tools applicable later in the process, where evaluating and refining ideas which have already been developed may be the goal.[19]

With this vision in mind for the design for behaviour change toolkit, a further review of literature is required, examining tools, design methods and idea generation processes, to help define the possible *structure* of the toolkit. The following sections thus explore a range of methods for generating ideas, solving problems, and transposing solutions—mostly from design, but also drawing on practice from other fields such as architecture and software engineering. The aim is to uncover factors, questions and possible formats which are relevant to the development of an idea generation toolkit focusing on design for behaviour change, so that these insights can inform the process.

2.4 Tools for idea generation and problem solving

> "Engineers are not the only professional designers. Everyone designs who devises courses of action aimed at changing existing situations into preferred ones. The intellectual activity that produces material artefacts is no different fundamentally from the one that prescribes remedies for a sick patient or the one that devises a new sales plan for a company or a social welfare policy for a state."
>
> Herbert A. Simon, *The Sciences of the Artificial*, 1969 (p.129 of 1981 MIT press 2nd edition)

[19] Such tools could be included in the design for behaviour change toolkit—for example, helping designers evaluate the possible range of effects on behaviour of their design—and would equally comprise a useful piece of work.

Designers solve problems, but they are by no means alone in that.[20] Design is not, then, identical to problem-solving, but it certainly involves addressing issues that are seen (by someone) as problems and developing new or changed products, services or environments (seen by someone as solutions) in response.

This review is not going to fall into the 'What is design?' rabbit-hole, since that has been more than adequately explored by other authors, but it is important to understand how design processes can work, in order to identify the most useful characteristics for the proposed toolkit.

The view of design as being entirely about 'problem-solving'—which, at its most mechanistic, is "basically a form of means-ends analysis that aims at discovering a process description of the path that leads to a desired goal"—as espoused by Simon (1969/1981, p.223, and to some extent in the above quote)[21], has become unfashionable in design research, and not just because of the implied lack of creativity in the process.[22]

In particular, the reaction against the 'problem-solving' view follows Schön's (1983) concept of *The Reflective Practitioner*, whose "inquiry is not limited to a deliberation about means which depends on a prior agreement about ends. He does not keep means and ends separate, but defines them interactively as he frames a problematic situation" (p.68).

Thus, design is seen as being as much about *problem-framing* as problem-solving, an exploration and co-evolution of both the problem and solution 'spaces' (Maher et al, 1996), questioning and refining the problem, changing focus and the boundaries of the problem as part of the process of generating solutions. [23] [24]

Dorst and Cross (2001) give the example of a workshop participant asked to redesign in-train litter bins for Dutch Railways (NS) who asks whether simply making a hole in the floor for litter to be dropped through (or combining it with the toilet flush which works in a similar way) is valid within the scope of the brief. They use Cross's (1997) idea of the formation of 'bridges' between problem and solution as the 'creative leap' which pairs one representation of the problem with a solution, suggesting that "creative design involves a period of exploration in which problem and solution spaces are evolving and are unstable until (temporarily) fixed by an emergent bridge which identifies a problem-solution pairing. A creative event occurs as the moment of insight at which a problem-solution pair is framed" (Dorst and Cross, 2001).

Pragmatically—and dependent on the semantic preferences of those involved—it is arguable that problem-framing is *part* of problem-solving. The process of interrogating a brief, stretching and testing the boundaries of what is being asked and what will count as a solution, is an integral part of addressing the problem, rather than being a distinct activity.

Paul Rand said that "[i]deas may also grow out of the problem itself, which in turn becomes part of the solution" (Heller et al, 1998), and this is a proposition also found within TRIZ (see section 2.5.5), 'systems thinking' in general, and specifically within Edward de Bono's work. Alexander (1964, p.17), using the (re)design of a kettle as an example, notes the fluidity of the boundaries of design problems:

[20] As Jack Schulze of BERG comments, "so do dentists" (Kicker Studio, 2009).

[21] Developed in detail in the context of artificial intelligence research by Newell and Simon (1972).

[22] Hey (2008, p.15) makes an additional criticism, referencing on the frequent use of rule-based games such as chess by researchers such as Simon as contexts for understanding problem solving: "an ideation session for an NPD [new product development] project can never claim to have exhausted every possible option, in contrast to, for example, determining what next moves are possible in a game of chess (a classic problem solving challenge)."

[23] **[G2]** explores some of the implications of this viewpoint for designers involved in behaviour change.

[24] Hey (2008) explores designers' framing in detail in his PhD thesis, in the context of new product development, in particular how design teams negotiate a common frame for their design situation, and how this is matched to the needs of their potential users.

> "If I say that the kettle is the wrong way to heat domestic drinking water anyway, I can quickly be involved in the redesign of the entire house, and thereby push the context back to those things outside the house which influence the house's form. Alternatively I may claim that it is not the kettle which needs to be redesigned, but the method of heating kettles. In this case the kettle becomes part of the context, while the stove perhaps is form."

Many more human-related design problems (including those relating to behaviour change) may be characterised as 'wicked problems' (Buchanan, 1992; Rittel and Webber, 1973), perhaps particularly exhibiting the characteristic expressed by Conklin (2009) in his restatement of some of Rittel and Webber's principles: "You don't understand the problem until you have developed a solution. Every solution that is offered exposes new aspects of the problem, requiring further adjustments to the potential solutions. There is no definitive statement of 'the problem': these problems are ill-structured and feature an evolving set of interlocking issues and constraints."

2.4.1 Generating ideas

Both within and without 'design', a variety of 'creative thinking' techniques are commonly used to generate novel ideas as part of problem-solving processes, often in group workshops, but also individually. While this review cannot hope to do more than scratch the surface, some which potentially offer relevant insights to the subject at hand will be discussed.

The field comprises a mixture of academic and popular literature, and many techniques have become generally familiar, and evolved through use, without their 'authorship' remaining clear. As Gray et al (2010, p.xvi) put it, "[t]he practices live in a mostly oral culture, passed along from person to person by word of mouth. For example, a consultant uses an approach with a client, and the client begins to employ that approach internally. Over time... it evolves into something quite different, and... the source of the original idea or approach may be lost".

One of the most comprehensive online resources on the subject, Jack Martin Leith's *Compendium of idea generation methods*, is no longer available, but a version of the site (Leith, 2005) retained on the Internet Archive, contains over a hundred categorised methods. Most of the methods considered relevant to this thesis are what Leith calls 'springboards' (drawing on the use of the term in Synectics)—those which "involve the use of an external stimulus to trigger new thinking".

Lateral thinking

Over more than forty years, Edward de Bono has produced a series of popular books and training courses on creative thinking and innovation methods. The full range of his work cannot be covered here, but some concepts relevant to design and idea generation can be extracted.

'Lateral thinking', which de Bono (1993, p.52) explains via the maxim "You cannot dig a hole in a different place by digging the same hole deeper," contrasting it with linear 'vertical thinking', comprises four principles (de Bono, 1971, p.68): "1. Recognition of dominant polarizing ideas; 2. The search for different ways of looking at things; 3. A relaxation of the rigid control of vertical thinking; 4. The use of chance."

It is noteworthy that a number of the lateral thinking examples de Bono gives across his books are specifically concerned with influencing people's behaviour and addressing a wide range of societal issues. For example, influencing behaviour for commercial benefit is embodied in the the anecdote (de Bono, 1993, p.6) about an Australian payphone

operator which needed to offer fixed-cost local calls to remain competitive with rival operators, but wanted callers to spend less time on those calls so that the telephones were made available for other customers; so the story goes, the operator decided to increase the weight of the telephone handsets so that longer calls became tiring (subconsciously or otherwise), limiting the length of calls made. Corporate behaviour change for environmental benefit is also included, for example with the idea (e.g. de Bono, 1976, p.146) that a factory taking in river water and discharging (dirty) water back into the river "should be downstream of itself", i.e. planners should force the water intake pipe to be downstream of the water outlet pipe, thus making it in the factory's best interests not to discharge polluted water.

Among the methods de Bono suggests for lateral thinking, including particularly those suited for finding "different ways of looking at things" are: *simple focus*, "a deliberate effort to pick out a new focus point" for a problem (de Bono, 1993, p.92); the *creative challenge*, a forced questioning of the current way things are done; and the *concept fan*, a method of repeatedly 'pulling back', abstracting the problem implied by a search for alternative solutions,[25] such that the *need for a ladder* is restated as the *need to be raised above the ground*, in turn restated as the *need to reduce the distance between the person and the ceiling*, and so on, with each abstraction suggesting a greater range of possible solutions (de Bono, 1993, p.129). Straker and Rawlinson (2002, p.4) call a similar approach 'chunking up', asking "What is the *real* problem here?" at each level; it also recalls aspects of Alexander's (1964) *functional decomposition* and the *abstraction hierarchies* used in cognitive ergonomics and ecological interface design (e.g. Rasmussen, 1985).

Provocation

Many of de Bono's techniques centre on the idea of *provocation*, in particular, finding ways of intentionally provoking new ideas through methods ranging from the simple *random input* (juxtaposing two seemingly unconnected concepts[26] to trigger new ideas as a connection emerges—this is an expression of 'the use of chance' as mentioned above (de Bono, 1993)) to more structured methods such as using reversal, exaggeration and distortion of ideas as part of a *stepping-stone* process to examine and alter the given problem. The concept of PO (de Bono, 1972) was introduced as a marker to signify that a deliberately provocative (perhaps superficially absurd) suggestion follows, not necessarily to be adopted as a valid solution in itself, but as a trigger to help think of alternative solutions. For example, "PO, cars should have square wheels" leads to thinking about the possibilities of adaptive suspension systems (de Bono, 1993).

This kind of prompt potentially has application in helping designers shift problem frames (see section 2.4) implied by a brief: "[e]ven if an idea is wrong in itself it can serve as a starting point for a new line of thought or as a stepping-stone to get from one idea to a new one" (de Bono, 1976, p.146). In some circumstances, it is easy to imagine that it could suggest behaviour change (rather than solely technology change) as an approach in the first place, by introducing the idea that *people* should change rather than a *product* changing.

[25] Compare elements of TRIZ

[26] One is usually related to the problem under consideration, but the other is randomly drawn, e.g. from a dictionary. Straker and Rawlinson (2002) recount that King Gillette used an 'Alphabet System' where he listed every product he could think of beginning with each letter, as a way of triggering new ideas about improving them. Eno and Schmidt's *Oblique Strategies* (1975) are considered in section 2.7.2.

Table 2.2: The 'Six Thinking Hats' (adapted from de Bono, 1990). Later versions modify the emphasis slightly, e.g. the Black Hat becomes more about judgement, acting as a 'Devil's Advocate'.

HAT COLOUR	CHARACTERISTICS OF POINT OF VIEW
White Hat	Neutral, objective, concerned only with establishing facts
Red Hat	Emotional perspective
Black Hat	Negative, looking to find reasons why something can't be done
Yellow Hat	Positive and optimistic
Green Hat	Creative, searching for new ideas
Blue Hat	Concerned with control and organisation of the thinking process

Six Thinking Hats

One of the most structured creativity techniques applicable to idea generation described by de Bono is *Six Thinking Hats* (de Bono, 1990[27]). The idea here is to put members of a group—as part of a meeting or workshop—into a *role-playing* context, where the coloured hats (put on literally or figuratively) each enable the group's attention to be directed to different points of view and aspects of the problems and ideas under discussion, and to "switch gears" between ways of thinking about a problem ('parallel thinking').

The role-playing context also allows participants to say things they might otherwise[28] not feel comfortable expressing—"[w]earing the clown costume gives you full permission to play the clown" (de Bono, 1990, p.29)—including asking others to consider changing their point of view, since "[y]ou can ask someone to 'take off the black hat for a moment' more easily than you can ask that person to stop being so negative" (p.33). Table 2.2 summarises very briefly the characteristics of each hat.

The details of the different perspectives triggered by the hats are general enough to apply to a wide range of meetings, workshops, idea generation and decision-making situations. Independently, though, the concept of introducing a deliberate 'prop' to encourage taking different perspectives on a problem could be valuable for idea generation, particularly where there are issues which ought to be debated but which might not otherwise be raised.

For example, an 'ethical' hat might be of value when considering behaviour change interventions. It might also be feasible for hats to represent the points of view of different stakeholders—a particular hat being put on to represent the 'voice of the user', a different one to represent the 'voice of the shareholders' and so on. For Baron (1994, p.72), an additional advantage of deliberately taking multiple viewpoints on a problem is that "it is more likely to remind you of the critical information that you need to solve it", i.e. that multiple views also help ensure that relevant information is not missed.

Perhaps one of the most useful implications of the concept for an idea generation process which seeks to generate a large quantity of ideas (see section 2.5.4) is that

[27] See also Hewitt-Gleason (2008) for a statement on the origins of the concept, the sole authorship of which is disputed

[28] There are some parallels with Goffman (1959)—see **[F7]**.

Table 2.3: Elements of the SCAMPER method (Eberle, 1971), drawing on phrasing by Passuello (n.d.)

VERB	HOW IT MIGHT BE APPLIED
Substitute	Can you replace part of your problem (product, service, etc) with something else which offers benefits?
Combine	Can you combine parts of your problem to solve it, or create a new product or service?
Adapt	Can you adapt an existing solution which works in some other context?
Modify	Can you change elements of your product? Can you magnify or 'minify' certain characteristics so that they bring desirable benefits?
Put to other uses	Can you find other uses for your product, in different contexts?
Eliminate	Can you eliminate elements of your product or service?
Rearrange	Can you change the order of the way your product or service works, perhaps reversing some elements?

switching hats (of whatever form) could re-start the inspiration process when it starts to dry up, explicitly introducing alternative sets of ideas or viewpoints. The Design with Intent 'lenses' (Chapter 4) follow this approach.

SCAMPER and Rosenman and Gero's processes

Moving more specifically towards product design, two verb-based idea generation techniques are particularly relevant. While arising from different contexts, they overlap in content.

SCAMPER (Eberle, 1971) was developed as a simplified form of some of Osborn's (1953) brainstorming recommendations, intended originally for classroom use. It comprises seven verbs (Table 2.3) describing operations which could be carried out on a product or concept (potentially including even people themselves) to generate new variants or improvements.[29][30]

Rosenman and Gero (1993) and Gero (2000) arrive at a partially similar list of processes (Table 2.4), but from the perspective of examining idea generation behaviour by designers and extracting descriptions of the processes (also presented as applicable in

[29] Another more general method, Morphological Analysis (Zwicky, 1969; Ritchey, 1998) may be relevant here. It "is a method for identifying and investigating the total set of possible relationships or 'configurations' contained in a given problem complex" (Ritchey, 1998, p.3), dividing a problem into "major parameters, components or problem dimensions and then systematically allow[ing] the user to identify all the combinations possible with those elements... [and] find all the theoretically conceivable solutions to a problem" (Jones 2003, p.130). Elias (2009) used a Morphological Chart to generate concepts for redesigned refrigerators.

[30] Straker and Rawlinson (2002) suggest a range of other verbs which could be used to extend the process, similar to the (longer) lists used in methods such as Synectics (e.g. Nolan, 2003).

Table 2.4: Rosenman and Gero's 'Creative design processes' (Rosenman and Gero, 1993; Gero, 2000; Cross, 1997)

PROCESS	COMMENTS
Combination	Design by "importing parts from various designs and combining them into a new design" (Rosenman and Gero, 1993, p.127).
Mutation	Design by "modifying the form of some particular feature, or features, of an existing design" (Cross, 1997, p.435).
Analogy	"The product of processes in which specific coherent aspects of the conceptual structure of one problem or domain are matched with and transferred to another problem or domain" (Gero, 2000, p.16).
First principles	"There is a recognizable mapping from function to behaviour and from behaviour to structure... given a required function or behavioural attribute there is a recognizable appropriate structure that will satisfy it" (Rosenman and Gero, 1993, p.130-2).
Emergence	"The process by which new, previously unrecognised properties are perceived as lying within an existing design" (Cross, 1997, p.438).

an artificial intelligence context), rather than offering them explicitly as inspirational triggers. Gero's (2000) definition of *analogy* is somewhat similar to what was identified in Chapter 1 as *transposition of design principles between disciplines.*

From the author's perspective, the active provocations offered by Eberle's approach are more immediately suited to triggering idea generation, but formal descriptions of principles as given by Rosenman and Gero have value in providing a reference of techniques which could be consulted as a reflective part of the idea generation process, in a similar way to Alexander et al's patterns (see section 2.4.2). Hence, both of these possible approaches are worth considering as relevant directions for the guide.

Aside from the form of the processes, the content itself may have direct relevance to the behavioural context. If "people's behaviours" rather than a product's features are considered as the focus of each SCAMPER verb, what sorts of ideas might be suggested? Can you design a product which 'substitutes' an undesired behaviour with a desired one? One which combines behaviours to avoid an unwanted harm? One which adapts a behaviour which a person expresses in another context to the context for which you are designing?

Do you know a related problem? Analogies and metaphors

> "We can scarcely imagine a problem absolutely new, unlike and unrelated to any formerly solved problem; but, if such a problem could exist, it would be insoluble. In fact, when solving a problem, we always profit from previously solved problems, using their result, or their method, or the experience we acquired solving them. And, of course, the problems from which we profit must be in some way related to our present problem. Hence the question: *Do you know a related problem?*"
>
> George Pólya, *How to Solve It*, Princeton University Press, 1945 (p.98 of 2nd edition, 1971)

Pólya's *How to Solve It* (1945) is a guidebook for addressing mathematical problems, best known for popularising the term *heuristic* in the sense of a 'rule of thumb' in problem-solving. The 'Short Dictionary of Heuristic', comprising the main part of the book, offers 67 entries on aspects of, and approaches to, solving problems. The use of questions—"Do you know...? Could you imagine...?" and so on—is reminiscent of some of the provocation techniques mentioned earlier.

A theme which recurs in a number of Pólya's heuristic approaches relates to the use of *analogies*, including solving a "simpler analogous problem", and finding related problems which have been solved in other contexts. As Baron (1994, p.73) puts it, "[h]euristic methods allow us to search our memories for possibilities and evidence that are already there".[31]

While Pólya's work deals explicitly with mathematical problem-solving rather than creative design, the use of analogies, similes and metaphors is widely recommended as

[31] An additional aspect is Simon's (1969/1981) suggestion that "[i]n problem solving, a partial result that represents recognizable progress towards the goal plays the role of stable subassembly" (p.206), and that "[o]ne way to solve a complex problem is to reduce it to a problem previously solved—to show what steps lead from the earlier solution to a solution of the new problem" (p.226). Hence, perhaps, the joke: "A mathematician wants to read a book, but the room he is in is dark, and the light is off. In order to read, he turns on the light. The next day, the mathematician wants to read a book, and the light is on in the room. He first turns off the light, reducing the problem to the one he solved the previous day" (The Daily WTF, 2012).

a method in idea generation for design (as well as a design technique itself). Saffer (2005, p.6) highlights the role of metaphors in cross-domain, interdisciplinary mapping for designers—"[t]he way we understand new things is to conceive of them in terms of things we already know. Metaphors become natural models that allow us to take familiar, concrete objects and experiences and re-cast them onto unknown or abstract concepts or things, giving them structure and meaning."[32]

Seelig (2009, p.129) recommends the use of similes and metaphors to trigger new perspectives on a problem, using an exercise where teams are asked to come up with multiple versions of a statement in the form, "[concept under discussion] IS LIKE [an unrelated concept, usually a concrete noun] BECAUSE [of some characteristic of the second concept] THEREFORE [implications for the first concept]". For example, "Ideas are like babies because everyone thinks theirs is cute, therefore be objective when judging your own ideas."

Saffer (2005, p.10) sees metaphor use in idea generation as being about *juxtaposition*: "this is probably the easiest and one of the most fruitful way for designers to embrace metaphor use. All metaphors are, in a sense, juxtapositions in that two different things are put together to form a construct that highlights (and hides) different characteristics of each. Finding any inherent metaphors in the problem space is therefore probably a useful activity." This last point about helping to define and structure the problem space is echoed by Leclercq & Heylighen (2002, p.287), who suggest that drawing analogies "can bring forth valuable knowledge from a known situation... to the ill-defined design situation at hand".

Learning from biomimetics

> "[W]e often find quite different inner environments accomplishing identical or similar goals in identical or similar outer environments—airplanes and birds, dolphins and tunafish, weight-driven clocks and spring-driven clocks, electrical relays and transistors."
>
> Herbert A. Simon, *The Sciences of the Artificial*, 1969 (p.7 of 1981 MIT press 2nd edition)

One design approach where analogical transfer is commonly applied in idea generation and problem-solving is *biomimetics* or *biomimicry*—making use of biological systems as models and inspiration for technology. Combining biomimetics with TRIZ (section 2.5.5) to produce BioTRIZ offers a structured way of generating possible biologically inspired solutions for problems (Vincent and Mann, 2002; Craig et al, 2008), but there are also other idea generation methods based on applying biomimetics, such as Volstad and Boks' (2008) 'Biomimicry Card Deck', intended to help packaging designers generate ideas for novel packaging concepts drawing on biological principles.

It is conceivable, if a somewhat romantic vision, that the biomimetic approach to design—learning from a vast reservoir of solutions to problems, and finding ways to apply them in other contexts—could be seen as a model for how to develop 'design for

[32] Hey and Agogino (2007) studied the use of metaphor across the entire design process, including extracting and coding designers' use of terms such as "bounc[ing] ideas off each other". In particular, one of their codings has some parallels with the SCAMPER methodology discussed above—the idea that "PROBLEMS ARE OBJECTS: They can be assembled, viewed from a different angle, divided, decomposed, be hard, big, well-structured or ill-structured, transformed, patterned, complex, broken down into sub-problems, refined, clarified, broken into parts, and stable" (p.6).

sustainable behaviour' as a field, treating human history and culture as a reservoir of behavioural insight to adapt and transpose to a design context.

It does, however, seem reasonable to suggest that "idea creation by analogical transfer" (Stacey et al 2009, p.362; Tseng et al 2008) might be most effective where the examples used make it easy for designers to see how the principles can be applied elsewhere—in a similar way to biomimetics—enabling "the ability mentally to stand back from the specifics of the accumulated examples, and form more abstract conceptualizations pertinent to their domain of expertise" (Cross, 2004, p.432).

As part of the idea generation guide, an emphasis on example implementations of principles—"previous instances of design elements in a variety of different situations" (Eckert & Stacey, 2000, p.527)—rather than simply descriptions of the principles themselves, should allow designers to explore the ideas and relate them to the problem at hand, even where the terminology is unfamiliar. Thus, if the guide is to help designers make use of metaphor and analogy, these need to be clearly illustrated through examples which are quickly understandable.

Divergent production and brainstorming

A key concept in idea generation is the notion of *divergent production*, which Guilford (1967, p.213) defines as "generation of information from given information, where the emphasis is upon variety and quantity of output from the same source; likely to involve transfer," as opposed to convergent production which would involve reaching a single 'right' solution to a problem.

While the 'output from the same source' criterion might be interpreted in a number of ways, the approach of trying to generate as many different ideas as possible is familiar from the process of *brainstorming*. Osborn (1953)[33] introduced the process as "a formal and systematized approach to a fuller utilization of the creative imagination" (p. vii), offering a set of rules and recommendations for how to 'ideate' in group conferences or workshops which have been widely adopted (and mutated) since, to the extent that 'brainstorming' has become a generic term for many different kinds of idea generation, both in groups and individually.

A significant part of the appeal of Osborn's work must be his optimism and confidence that *everyone* can be creative: the book (*Applied Imagination*) makes the "universality of imaginative talent" clear and exhorts everyone to develop his or her creativity via exercises, games and puzzles. The book is somewhat reminiscent of Dale Carnegie's *How to Win Friends and Influence People* (see **[F7]**) in its mixture of anecdotes, positive encouragement and rules to follow.

Those rules and recommendations will not be covered here in detail, but the "four basics" for "idea-producing conferences" in groups are:

1. *"Judicial judgment is ruled out.* Criticism of ideas must be withheld until later.

2. *'Free-wheeling' is welcomed.* The wilder the idea, the better; it is easier to tame down than to think up.

3. *Quantity is wanted.* The greater the number of ideas, the more the likelihood of winners.

4. *Combination and improvement are sought.* In addition to contributing ideas of their own, participants should suggest how ideas of others can be turned into *better* ideas, or how two or more ideas can be joined into still another idea" (Osborn, 1953, p.300-1).

[33] A co-founder of advertising agency BBDO.

Figure 2.7: 'The Rules of Brainstorming' as displayed in a meeting room at IDEO London, December 2009

As Baron (1994, p.120) notes, much of Osborn's approach centres on the argument that "a major impediment to creation is insufficient search for possibilities. If we are too self-critical during the phase of idea generation, it has been argued, we inhibit ourselves from thinking of our best ideas. We must overcome our inhibitions and 'brainstorm' before we criticize and select".

In the design industry, the most high-profile proponent of the brainstorming approach has been IDEO, which has evolved and tuned Osborn's recommendations into its own set of 'rules for brainstorming', prominently displayed in company meeting rooms (e.g. Figure 2.7).

It is difficult to assess formally how much use any idea generation method is, since most such methods are, in practice, used in contexts in which there can be no comparable control group. Few organisations are able to bring competing projects to fruition in parallel, and few of the ideas generated by any brainstorming process will ever be directly realised as a product or service, but as Sutton and Hargadon (1996) suggested in a major ethnographic study of IDEO's brainstorming processes, the process provides the organisation with less quantifiable benefits, including providing *skill variety* for participants by exposing them to a diversity of ideas and approaches, and supporting the *attitude of wisdom* by providing a non-judgemental forum "for getting unstuck" through collaborative endeavour.

They suggest that attempts to assess effectiveness of idea generation in terms purely of quantity of ideas generated are too simplistic; nevertheless, IDEO's rules of brainstorming are at least partly geared towards generating as many ideas as possible (including "Go for quantity (not quality): Set an outrageous goal and surpass it")—drawing directly from Osborn's recommendations. This implies that while not a direct proxy for effectiveness, quantity can be an important step on the way. Hence, comparison of the quantity of concepts generated using different methods can still be considered worth studying.

The academic literature on the 'productivity' of brainstorming suggests that Osborn's focus on groups 'outperforming' individuals may have been erroneous (Furnham, 2000). Interaction effects within differently constituted groups can be responsible for their col-

lectively producing fewer ideas as a result of brainstorming than the individuals would have produced on their own. Phenomena such as *production blocking* (Diehl & Stroebe, 1987), and *social loafing* (Robbins, 1995) may lead to less productive sessions. It is also worth noting that recommendations for successful brainstorming (e.g. Wilson, 2006) often include the idea of a 'warm-up exercise' using a problem not directly related to the one intended for the main exercise, suggesting that participants may need some time to become 'fluent' in their idea generation.

However, as Sutton and Hargadon imply, there are other benefits from group brainstorming that may be desirable for the situation at hand. Expertise may be transferred between participants with different specialisms (which may be particularly important in a design context where the designers are not necessarily subject matter experts on the domain they are addressing). Group activity may be a chance for other stakeholders' perspectives to be heard (and feel that they have been heard). For example, in urban planning, a *design charrette* refers to a session where multiple stakeholders (including members of the public) are brought together to address an issue (e.g. Condon 2008), including brainstorming. The implications of these issues for the development of the idea generation guide are probably that such a guide needs, ideally, to be usable either individually or in a group situation, and, again ideally, needs to be flexible enough to allow different groups of stakeholders to make use of it on an 'equal footing' with each other, rather than being focused entirely on one group as the users.

Although Osborn recommended the use of questions to spur ideation as part of the brainstorming process (some of his example questions were developed into SCAMPER—see section 2.5.2), many brainstorming exercises, at least in the author's experience, do not use any explicit stimulus or provocation material beyond the problem itself and whatever background information is available. In this sense, an idea generation guide or toolkit is already enabling a slightly different form of brainstorming, although whether it would be more likely to increase the productivity of a session or restrict the ideas generated to only those derived from the guide is something that would need to be investigated.

TRIZ

> "We live in an 'Era of Technical Revolution'. The main point is that this revolution lies not in the appearance of new machines—that has happened before. The method of developing new machines is changing. organised ways of thinking replace the old chaotic ones. Every step in the thinking process should be as accurate as the movements of a pilot flying an airplane."
>
> Genrich Altshuller, *And Suddenly the Inventor Appeared* (trans. Lev Shulyak), Technical Innovation Center, 1994, p.160

One of the most structured systems for idea generation and technological problem solving that is available to designers is TRIZ (*teoriya resheniya izobretatelskikh zadatch:* theory of inventive problem solving). Developed in the early post-war Soviet Union by Genrich Altshuller and colleagues—and publicised in the West mainly from the early 1990s onwards (e.g. Altshuller, 1994)—TRIZ comprises a family of tools which draw on a database of principles and relationships extracted through analysis of, initially, tens of thousands, and by now, "millions" of patents (Gadd, 2011, p.101). The idea is that "[s]omebody someplace has already solved this problem (or one very similar to it.) Creativity is now finding that solution and adapting it to this particular problem" (Barry et al, n.d.).

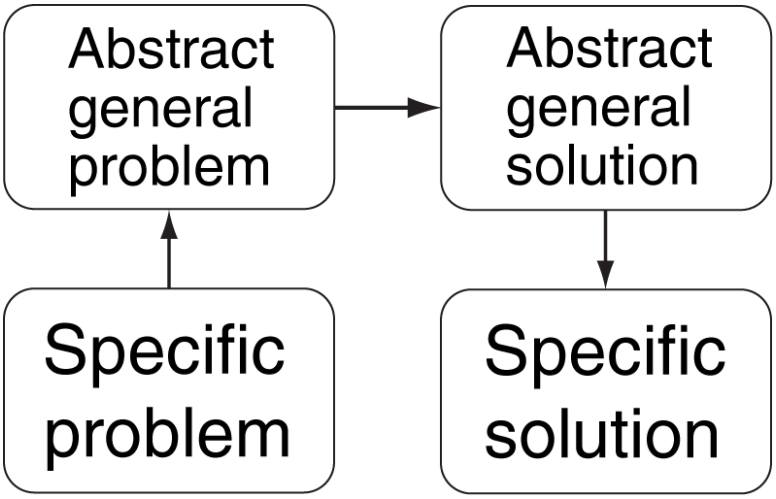

Figure 2.8: The 'Prism of TRIZ'.

Jones (2003, p.140) provides a 'Map of TRIZ', grouping a variety of TRIZ tools according to their function within the innovation process. She distinguishes between problem analysis (or situation analysis) tools (such as working out what kinds of contradictions are occurring) and solution tools (such as the Contradiction Matrix itself—see below).

Following the 'Prism of TRIZ', the problem analysis tools are used to generalise the problem, abstracting it to a form to which TRIZ offers generic solutions—the 40 'Inventive Principles', such as SEGMENTATION, PERIODIC ACTION, PHASE TRANSITION and THE OTHER WAY ROUND, which are 'suggested' by the contradiction matrix or table of 'separation principles'.[34]In this section, only a few elements of TRIZ will be covered which seem most directly relevant to the behaviour change context.

The Prism of TRIZ

One of the most fundamental ideas in TRIZ is what Gadd (2011) calls the 'Prism of TRIZ' (Figure 2.8), although it goes by a number of other names (e.g. Straker and Rawlinson, 2002, call it 'Getting over the invention wall').

The diagram represents a process of translating a specific problem into a more abstract general problem for which general solutions are known, then re-translating that general solution into the context of your problem, resulting in a specific solution.

The specific problems may be disparate, but on some level they are instances of general, recurring problems which exist in the world, and which someone has solved. Straker and Rawlinson (2002, p.78) suggest that this is in fact "similar to how people normally approach many situations", but the explicit step of abstracting a specific problem into a more general one is not necessarily a common way to think in everyday life. The first step is not simply Pólya's "Do you know a related problem?" (see section 2.5.3) but something more like "Can you describe the problem in an abstracted form?"—essentially a process of *modelling* a situation.

[34]Of the 40 TRIZ Inventive Principles, a number which could potentially be more easily applied to behaviour have—indirectly—inspired or influenced patterns in the DwI toolkit. In particular, by the stage of DwI v.1.0 (see section 4.4), SEGMENTATION, ASYMMETRY, PARTIAL OR EXCESSIVE ACTION and FEEDBACK are all represented in some form, though usually not described in quite the same way as in TRIZ.

Contradictions

TRIZ has many principles and themes running through the family of tools, but one which dominates is the idea of *contradictions*.[35]

Altshuller's approach—which Craig (2008) suggests has much in common with Marxist dialectic—was to see all problems as arising from contradictions between desired states. In TRIZ these are classified as technical contradictions (where "[w]e think of a solution to improve something *but* something else gets worse"), for example making a structure stronger makes it heavier, and physical contradictions, where "[w]e want opposite solutions—for example, high and low" (Gadd, 2011, p.102-4), such as a blacksmith wanting a horseshoe to be hot enough for the metal to be worked, but cold enough to be able to hold and manipulate it (Straker and Rawlinson, 2002, p.82). Solving physical contradictions involves separating when and where each condition or solution is present—in time, space, scale or on particular conditions—and this is done via consulting a table of 'separation principles' which suggests particular relevant Inventive Principles.

Each technical contradiction is described in terms of two of 39 abstract 'technical parameters', for example 'strength' (no. 14) and 'weight of stationary object' (no. 2)—as we make something stronger, it is becoming heavier, but we don't want this—and then the Contradiction Matrix, a 39×39 matrix is consulted. This suggests, for each intersecting cell, up to four Inventive Principles that are relevant. For improving strength without worsening the weight of a stationary object, the matrix suggests COMPOSITE MATERIALS, COPYING, CHEAP SHORT-LIVING OBJECTS and SEGMENTATION. Each of these principles can then be considered in more detail (with examples) to see how it might be applied to the specific problem.

The process of abstracting the problem to understand the contradiction(s) present, and hence selecting the parameters, can start in a number of different ways. For example, Jones and Harrison (2000) mapped TRIZ technical parameters to the five axes from Fussler and James' Eco-Compass (1996), a commonly used tool for mapping changes in environmental impact of new and existing products, to enable this to be used as a starting point for the process (as well as to uncover whether TRIZ could be usefully applied in this context).

Ideality

As Craig (2008, p.40) puts it, in Altshuller's view "a trade-off was resolved not by optimizing between two conflicting features, but by changing or adapting the system in some way so that both features could improve. For instance, a device may be made stronger and lighter by applying the principle 'composite materials'".

In TRIZ, "[t]the Ideal describes the perfect state, a perfect result... Whatever problem we are tackling, if we begin by imagining the Ideal version of the thing we want... then we get quick understanding of the best possible outcomes" (Gadd, 2011, p.177). A word equation is used to explain the concept:

$$Ideality = \frac{benefits}{costs + harms}$$

A solution tends towards *ideality* when the benefits achieved are greater than the 'costs' and 'harms' entailed in the solution; ultimately, the system disappears entirely, the benefits tending to infinity as the costs and harms tend to zero. This implies the functions being delivered without the system existing at all—there are parallels here with the idea

[35] Pickering (2010, p.176) links Bateson's concept of the *double bind* (see **[F1]** for its behaviour change context) to the idea of the Zen *koan*, an apparently self-contradictory, paradoxical or unresolvable question or statement. It is intriguing to consider the possible parallels with contradictions in TRIZ.

of *dematerialisation* in product-service systems, where a product is replaced augmented by a service which provides the same benefits without needing the same physical form. Mann and Jones (2002) apply TRIZ tools to the example of portable generators in this context. More generally, "[i]nnovation following this law of ideality could contribute to sustainable development, through the delivery of the functions without the environmental impacts associated with current systems of production" (Jones and Harrison, 2000).

What can be usefully applied from triz?

What useful insights from (or features of) TRIZ can be applied to the 'design for behaviour change' guide?

- The notion of a method—systematic but not formulaic, to use a phrase applied by Sato (2009) to 'design thinking' in general—which helps 'prescribe' a range of possible solutions drawing on knowledge and experience with analogous situations, is an appealing one.
- The specific–abstract–abstract–specific arc (the Prism of TRIZ) perhaps provides a more formal description of the kind of analogical transfer discussed in a number of other idea generation and problem solving processes.
- The 'lookup table' form of the contradiction matrix is interesting because it expressly *suggests* relevant Inventive Principles, building in a creative element, rather than stating unequivocally that there is a single right answer.
- Craig (2008, p.45) notes that the Inventive Principles, being derived from analysis of patents across a number of technology domains, necessarily "resemble elements of the individual strategies used by expert designers in various disciplines." This parallels the opportunity for the idea generation guide identified in section 2.3.2—that of a tool which can help designers learn from practice in other disciplines. Referencing Schön's concept of *problem-framing* (see section 2.4) and Lawson's 'gambits' (section 2.3.2), Craig goes on to suggest that "[d]ialectical 'contradiction-thinking' can be seen as an explicit method for problem-framing, just as the Inventive Principles can be understood as a sophisticated set of 'gambits'".
- On the other hand, the 'certainty' that may be implied by the philosophy of TRIZ—that there are definitely solutions to all problems, and that those solutions do not need to involve any compromises—does not sit easily with the notion of wicked problems in design (section 2.4), which may make it an uncomfortable perspective to designers working on social problems.

The TRIZ Inventive Principles are all technological, mostly based on physical sciences, although in many cases they can be seen as descriptions of *system properties*, at different levels (sub-systems, system and super-systems) so some at least could potentially be applied to systems involving human behaviour. Gadd (2011) includes a number of examples of solutions (many via the use of cartoons) illustrating TRIZ principles, which could be seen as 'design for social behaviour change', including:

- a target painted on a urinal to "Give the messy devils something to aim at" (p.163)
- a bakery deliberately piping its 'fresh bread' aroma into the street to attract customers (p.183)
- the use of a deceptive 'Beware of the Bull' sign to scare away trespassers (p.204)

- "Separate on condition with music for older people which repels young people"—playing Frank Sinatra's songs in a public square at night to discourage younger people from 'hanging around' (p.125)
- using scarcity to make misprinted football shirts appear valuable rather than wasting them (p.161)
- a police officer giving drunken brawlers chocolate bars to stop them fighting rather than hitting them with a truncheon (p.47)
- a group of mothers forming a group to use social pressure to deal with street violence (p.83)

While a number of these are familiar examples, not necessarily created using TRIZ, the implication is that they *could* have been, i.e. the method potentially provides for the creation of these kinds of solutions.

However, *people*, and the different ways that people think and act, are not included explicitly in mainstream TRIZ. There is certainly the opportunity for a *BehaviourTRIZ* to be developed, but we are to some extent lacking the body of formally recorded knowledge about behaviour equivalent to the patents that informed the development of TRIZ. We have no 'patent database' of human behaviour and the 'solutions' for influencing it. Human history, literature, politics—indeed, the entire sum of all cultures—is the resource we have, but it is not formalised through the use of claims as patents are, and is thus difficult to interrogate in this way.

A vast meta-analysis of meta-analyses, drawing together everything learned from human history that could be extracted as a 'principle' would be a significantly larger project than a PhD. Extracting insights from a limited number of mainly psychological disciplines, that have direct relevance to design (as it is intended that **[F1-9]** have done), is probably the most that can be hoped for, at least initially, together with limited use of some of the features of the TRIZ method identified above, where they are appropriate.

2.4.2 Patterns

> "It is frightening (or exciting) to contemplate how many new ideas are lying dormant in already collected information that is now put together in one way and could be rearranged in a better way."
>
> Edward de Bono, *The Use of Lateral Thinking*, 1971 (p.18)

Many of the approaches to idea generation and problem solving discussed in section 2.5 have emphasised the process of recognising that a 'new' problem situation is similar or analogous to one encountered (and solved) previously elsewhere, even in a different discipline. Highly structured methods such as TRIZ can help a designer find those solutions where the links may not be obvious or where he or she does not have expertise in other disciplines; other methods simply try to 'prompt' the recognition of the situation.

Expertise and pattern recognition

Much academic research on 'expert' decision-making suggests that it is this recognition of a similar situation—a *pattern*—which "sometimes allow[s] the expert to arrive immediately at the answer that the novice can find (if at all) only after protracted search... most intuitive leaps are acts of recognition" (Simon, 1969/1981, p. 105).

Klein (1999), a founder of the field of *naturalistic decision making* research, studied experts making decisions in a variety of pressured situations (including chess players, nurses, firefighters, nuclear power station operators and military personnel) and developed the *recognition-primed decision* model. This models both how "decision makers size up the situation to recognise which course of action makes sense, and the way they evaluate that course of action by imagining it" (Klein, 1999, p.24): essentially, a stage of *pattern recognition*, and a stage (if necessary) of rapid mental simulation before deciding to carry out the action or modify it.

While designers engaged in idea generation are rarely under the same time pressure as firefighters, the pattern recognition component of the model, and to some extent, the mental simulation component[36], both surely play a part in idea generation, even if one of the points Klein makes is that experts do not need to generate large sets of options (indeed, it is counter-productive under time pressure), and it is only novices who need to do this. The expert is, in some ways, defined by being able to use "experience to recognise key patterns that indicate the dynamics of the situation" (Klein, 1999, p.31).

Some research in naturalistic decision making concerns, effectively, how to help novices become 'more like' experts in their pattern recognition and decision making ability, through the development of 'decision aids' (often software)—e.g. Hayes and Akhavi (2009) tested software decision aids for mechanical design engineers. There are some parallels here with methods such as TRIZ, although the details of the implementations are very different.

In academic design research, work on 'expert' designing has suggested that "a key competency of an expert is the ability mentally to stand back from the specifics of the accumulated examples, and form more abstract conceptualisations pertinent to their domain of expertise. Experts... recognise underlying principles, rather than focussing on the surface features of problems" (Cross, 2004).

Lawson (2004) has used the term *gambit* to describe the 'repertoire of tricks' that experienced designers (and architects) are able to bring to bear on a problem, drawing from chess terminology. The key is pattern recognition of the problem, and quick matching to possible moves to address it. A similar point is made by Perkins (1986), in reference to experts' ability to draw on a repertoire of mental models to explain situations encountered and propose (often 'designed') solutions.

Pattern languages and libraries

In architecture, software engineering, HCI and some other fields, the term *pattern* may have more to it than simply describing a recurring situation. It describes a form of presenting that situation, and/or possible solutions, in a structured way, stemming ultimately from Alexander et al's (1977) *A Pattern Language*, which covers the design and layout of buildings, towns and communities, on scales ranging from the placement of interior features right up to geographical regions.

In **[F2]**, example extracts from *A Pattern Language* are presented specifically in relation to influencing people's behaviour through architecture and planning, but outside architecture, the form and philosophy of Alexander et al's work has inspired people from a number of different disciplines to apply the format to their own areas of expertise.[37]

Each of Alexander et al's 253 original patterns describes "a problem which occurs over and over again in our environment, and then describes the core of the solution to that

[36] Brainstorming rules based on Osborn's, such as IDEO's (see section 2.4.3) emphasise deferring judgement until a later stage, but some degree of rapid mental simulation is difficult to avoid at the point of generation. Cross (2004) refers to 'solution conjectures'.

[37] The practice in this thesis of using small caps for the titles of patterns, techniques and so on derives from Alexander et al's style.

problem, in such a way that you can use this solution a million times over, without ever doing it the same way twice" (Alexander et al, 1977, p.x). The 'Alexandrian pattern form' can be described as:

- Pattern title, e.g. POSITIVE OUTDOOR SPACE (p.106)
- Picture "which shows an archetypal example of that pattern" (p.x)
- Explanation of the context of the pattern in relation to other patterns 'above' it in scale
- As a sub-heading, the problem the pattern is addressing, e.g. "Where paths cross roads, the cars have power to frighten and subdue the people walking, even when the people walking have the legal right-of-way" (p.281)
- The "body of the problem"—"the empirical background of the pattern, the evidence for its validity, the range of different ways the pattern can be manifested in a building, and so on" (p.xi)
- As a sub-heading, the solution, in the form of an instruction, e.g. "Whenever you build a balcony, a porch, a gallery or a terrace always make it at least six feet deep. If possible, recess at least a part of it into the building so that it is not cantilevered out and separated from the building by a simple line, and enclose it partially" (p.784)
- A diagram of the solution
- Explanation of how the pattern relates to the 'smaller' scale patterns below it

Alexander et al's patterns are very much part of a *language*, as is made clear by the ways in which the contexts are continually cross-referenced throughout the text. They are not intended to be used in isolation, but employed together at their appropriate scale, to create "the web of nature, as you make it" (1977, p. xiii).[38] The pattern descriptions are relatively long—often three or four pages—and presented in the form of a nearly 1,200-page book. When read together with its companion volumes (Alexander et al, 1975; Alexander, 1979), this forms a substantial body of work, expressing (via examples) a philosophy of design, architecture, life and 'the nature of things' which Alexander has developed further in his more recent work (e.g. Alexander, 2002).

Making a significant disciplinary leap, the format of the patterns was adapted and transposed by Beck and Cunningham (1987) to object-oriented programming, initially with an example set of five patterns (e.g. WINDOW PER TASK) relating to coding the design of windows in Smalltalk. They note that the style and order of the pattern presentation "leads a designer to ask (and answer) the right questions at the right time."

The approach was rapidly adopted in software engineering, most notably by Gamma et al (1995) with the book *Design Patterns: Elements of Reusable Object-Oriented Software* (often known as the 'Gang of Four' book). The idea of *anti-patterns* also arose in the software engineering context (Brown et al, 1998)—common software design mistakes, how to identify them, how to avoid them, and how to 'refactor' them. Many of the (anti-)patterns identified were about project management processes, e.g. DEATH BY PLANNING (p.221), further extending the scope of the domains covered by pattern forms.

[38] Reminiscent of a quote attributed to Eliel Saarinen, "Always design a thing by considering it in its next larger context—a chair in a room, a room in a house, a house in an environment, an environment in a city plan."

Figure 2.9: A double-page spread from Tidwell (2005), showing the pattern COLOR-CODED SECTIONS

Patterns in HCI and interaction design

Hooper (1986, p.22) drew parallels between architecture and HCI, including suggesting *A Pattern Language* as a model for "set[ting] forth a limited number of design principles which are so well-documented, or so compelling, that people will rush to adopt them. This would provide for quality as well as diversity in design". She contrasted this approach with full standardisation of interface design, which would potentially retard innovation, enshrining one view of *current* practice rather than evolving *best* practice.

Patterns are 'compelling' because they emerge as successful solutions to problems, applied multiple times by multiple designers who learn from each other's implementations.[39]

A substantial adoption of the pattern approach in HCI was made by Tidwell (1999) with her 'Common Ground' website, collecting patterns for interface design, such as PROGRESS INDICATOR and COLOR-CODED SECTIONS. Among the benefits she articulates are:

- "Capturing the collective wisdom of other designers in a way that can be immediately used, even by less-experienced designers. When difficult design problems arise, and there are conflicts between basic design principles, a pattern solution may be found that is appropriate for that particular context."
- "Giving us a common language that we can speak with our fellow designers, with our interdisciplinary design teams, and with our customers."
- "Allowing one to think 'outside the toolkit,' by creatively applying familiar patterns in new ways... By constraining a designer to work within the pattern, but with flexibility in visual appearance and interaction details, new specific solutions may emerge that are better than those commonly found in today's software" (Tidwell, 1999)

[39] It is clichéd to quote Kuhn, but his statement that "[p]aradigms gain their status because they are more successful than their competitors in solving a few problems that the group of practitioners has come to recognize as acute." (Kuhn, 1962/1996, p.23) has some resonance here. 'Successful' design patterns spread as other designers adopt them—they are *memetic* (Dawkins, 1976; Blackmore, 1999)—in much the same way as it has been suggested that in economics, "successful algorithms may be borrowed by one firm from another... successful mutations can be transferred from one firm to another" (Simon, 1969/1981, p.57).

Tidwell developed the Common Ground pattern approach into the book *Designing Interfaces* (Tidwell, 2005), which provides a simple but detailed model for how to present design patterns (e.g. Figure 2.9). Each double-page spread (mostly; some patterns warrant more or less space, or slightly different forms of explanation) comprises:

- Pattern title, e.g. COLOR-CODED SECTIONS (p.82)
- Screenshot(s) or diagram(s) illustrating a very clear or prototypical example of the pattern
- What—a short description of the pattern
- Use when—a description of the circumstances or situations when the pattern is useful
- Why—the reasoning behind the use of the pattern, often drawing on the psychology of HCI or the evolution of interface design
- How—details of implementation and problems or issues which might arise
- Further illustrated examples showing different implementations of the pattern, often on a different device (e.g. a phone), operating system or type of website to that illustrated in the first example

A similar pattern form has been used by Crumlish and Malone (2009) for their *Designing Social Interfaces*, also published by O'Reilly, drawing on their work creating the Yahoo! Design Pattern Library website (accessed 2010). Other websites covering interaction and web design patterns, such as van Welie's 'Patterns in Interaction Design' and Toxboe's 'UI Patterns' (both accessed 2010), also use a form along the lines of Tidwell's[40]; online collections have the advantage of allowing interactivity, as well as hyperlinks to live examples of the patterns 'in the wild'.

Fincher (2009) provides a review of the structure of a wide range of pattern collections in her 'Pattern Gallery'.[41] She notes the evolution of pattern collections as 'libraries' rather than necessarily claiming to be 'languages', together with a number of much more minimal or otherwise different forms which do not necessarily claim inheritance from Alexander et al.

The pattern form, whether Alexandrian or not, usually resolves into: a succinct and (hopefully) memorable *title*; a statement and description of a *problem* (in a much less abstract, more domain-specific form than might be obtained in TRIZ, for example); and a statement and description of a *solution*, often in the form of an instruction. Both problem and solution may be illustrated using examples; if only one is illustrated, it is usually the solution. Fincher (2003) ran a workshop at CHI 2003 to develop a 'pattern language markup language', PLML (pronounced "pell mell"), which also comprises some additional elements including: *alias* (a memorable phrase or name describing the pattern, in addition to its 'official' name); *forces* (describing the system of forces which give rise to the problem and which might affect the solution—compare the contradictions in TRIZ); *evidence* (for the efficacy of the solution); *confidence* (that the solution really works); and *related patterns*.

[40] Borchers (2001), on the other hand, uses a form very close to Alexander et al's original for his book *A Pattern Approach to Interaction Design*.

[41] Including v.0.9 of the Design with Intent toolkit (see Chapter 4)

Some related forms

> "In the work of designing machinery the draughtsman has to rely mainly on his memory for inspiration; and, for lack of an idea, has frequently to wade through numerous volumes to find a detail to effect a particular purpose. Hence, as a rule, every man's work runs in a groove, his productions generally having the stamp of his particular experience and training clearly marked upon them."
>
> Thomas W. Barber, *The Engineer's Sketch-Book*, 1890 (7th edition, 1940), p.v

There are other collections of solutions which share similar forms while not being described as patterns. Fincher (2007) draws our attention to Barber's *The Engineer's Sketch-Book* (1890/1940), a collection of "Mechanical movements, devices, appliances, contrivances and details" (p.iii), which are presented in a form reminiscent of both patterns and elements of TRIZ, grouped (and illustrated) by function, or, effectively, 'problem'. So, for example, Section 72: "Sifting, Riddling and Screening" (p.226-228) illustrates simple wire mesh gauze alongside rotary screens, shaking screens with air blasts and even "Edison's magnetic sizing apparatus". For each function, abstractly described, numerous existing solutions are presented, often increasing in complexity.[42]

Another somewhat *sui generis* collection is *The de Bono Code Book* (de Bono, 2000), an ambitious attempt to create a set of patterns for spoken (and written) language. The book comprises more than 250 numbered 'codes' which each represent a recurring meaning, problem, situation, question, expression or feeling, such as "7/4 This information is intended to be an honest, objective description of or comment on some matter. At the same time, it is an individual who is doing the describing" (p.124) or "15/20 Are there matters which have been left out? Have we covered all the points? Is there a need to tidy up?" (p.274).

The idea is that by abstracting this set of common concepts into numerical codes, people (speaking different languages) can quote the code numbers ("an 'inter-language"'—p. 13) rather than struggling to understand the phrasing in each other's language.

Regardless of the merits of the system itself (de Bono makes clear that he is aware it is likely to be controversial), the concept of abstracting recurring situations into a system of elements (grouped according to a taxonomy based on purpose or context of use) which can then be re-deployed in similar situations whenever they occur, and by people with different languages and cultural backgrounds, has many parallels with patterns, pattern recognition and interdisciplinary transposition. Indeed, code 2/10 asks "Can you recognize this as a standard situation? How would you analyse this? Can we divide this up to make it easier to think about?" (p. 68). The concept is fascinating and

[42] The idea of 'devices' suggests also *plot devices*, recurring elements or constructions used in storytelling. While the concept of a *trope* has particular meanings within philosophy and literature, the collaborative 'TV Tropes' wiki (accessed 2010) comprises something of a 'pattern language' for storytelling (mainly cinema and television, but extending into literature, comics and other elements of popular culture). The densely hyperlinked resource—"a catalog of the tricks of the trade for writing fiction"—makes use of a range of classifications. The context is very different to that of design patterns—tropes are defined as "devices and conventions that a writer can reasonably rely on as being present in the audience members' minds and expectations"—but the wiki format (open to any reader who wishes to register to edit or add material) provides an interesting example. A precursor of sorts is Cook's (1928/2011) *Plotto: The Master Book of All Plots*, a manual for devising plots for novelists, which uses something of a pattern-like form.

audacious; while not described as such, it could be considered a kind of rough prototype of a pattern language for everyday situations.

Insights from the pattern form

> "A tool, to paraphrase George Pólya, is a trick I use twice"
>
> Sanjoy Mahajan, *Street-Fighting Mathematics*, 2010, p.xiii

Mahajan's quote references Pólya's (1945) statement that "[a] method is a device which you use twice", but it could equally well be applied to the pattern concept. Whether seen as 'tricks' or 'best practice', they are repeatable solutions to recurring problems. 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.

Patterns are *not* primarily about idea generation, at least not in the forms generally presented. However, where there are multiple possible solutions to a problem, and they are abstract enough to require some adaptation or translation to see how they might be applied to the problem in question, sets of patterns could be part of an idea generation process.

In a field such as design for behaviour change, where there are not yet widely accepted 'solutions' for different behavioural problems (hence this PhD), a tool based on the pattern form would necessarily be something which suggested possible solutions rather than matching them confidently to the problem. What this means is that elements of the pattern form may be usefully applied where they offer advantages, even if the resulting idea generation guide or tool is not quite a 'pattern library' in the same way that the term is commonly used.

Something along the lines of the form used by Tidwell (2005), or the general form including title, problem, solution and examples, could be a clear way of explaining and setting the context for behaviour change techniques. The guide could be presented in the form of 'gambits', following Lawson's terminology—a library or *toolkit* of strategies for influencing behaviour through design, with notes on the possible implementation of each, when it could be used, what the results might be, and how the idea might be transposed form one context to another.

2.4.3 Cards and guides

A number of the pattern libraries and languages discussed above are presented in book form, essentially guidebooks to possible problems and solutions in particular disciplines.

There is perhaps a blurred line between what constitutes a highly structured guidebook and a kind of pattern collection—for example, Colborne's *Simple and Usable* (2010; a guide to 'simplicity' in web and mobile design), Lidwell et al's *Universal Principles of Design* (2003), a cross-disciplinary reference of principles relevant to design, Clarkson et al's *Inclusive Design Toolkit* (2007) as discussed in section 2.3.3, and Frederick's *101 Things I Learned in Architecture School* (2007) all use a format where each major idea or principle has a double-page spread, with the text on one page and either a single image or a number of images of examples on the other. This format is similar to that used by the IDEO method cards (see below) and some similar packs of cards, with explanatory text on one side and an image on the other.

Other guidebooks taking similar approaches—which may be relevant as example formats in addition to their contents themselves being relevant to understanding behaviour—include Schell's (2008) *The Art of Game Design* and Armstrong's (2010) *Persuasive Advertising*. In some particular domains dealing with influencing behaviour, theory and practice have been developed enough to allow the production of 'how-to' guides (e.g. Grout, 2007 in medical design; Crowe, 2000 in architectural design against crime; and Chak, 2003 in persuasive website design).

A novel format of guidebook worth mentioning in passing is Osterwalder & Pigneur's *Business Model Generation* (2009), a practical guide to understanding and creating business models for startups or changing existing organisations (with an overall 'design thinking' perspective). This uses annotated variants of the same diagram, a 'Business Model Canvas', throughout the book, which allows focus on each of the 'building blocks' of business models in each section, showing in particular how the different elements of a business fit together as a system, and how different business models concentrate on the elements in different ways (five 'business model patterns' are identified, referencing Alexander (see section 2.4.2). It is possible to imagine something similar—a 'Design and Behaviour Canvas', relating different elements of human behaviour and social and environmental impact, with opportunities for designers to intervene.

Design method cards

Where guides are intended to spur idea generation, they often take the form of packs of cards, or *ideation decks* (Golembewski, 2010; Golembewski and Selby, 2010). As Golembewski (2010, p.3) notes, currently "[t]he use of card-based tools is relatively common in creative practice," but this was not always the case—the format seems to have become especially common in design following the publication of *IDEO Method Cards* (IDEO, 2003), a set of 51 cards explaining methods that IDEO uses during the design process, such as DRAW THE EXPERIENCE, COMPETITIVE PRODUCT SURVEY and BE YOUR CUSTOMER.

The cards are divided into four suits—Learn, Look, Ask and Try—representing different forms of engagement, and each features a photograph, diagram or montage on one side and brief paragraphs explaining 'How' and 'Why' the method should be used on the other, together with a caption for the image (Figure 2.10). The methods are techniques for possible use during the design process rather than for idea generation, although many of them would result in insights relevant to idea generation.

Nevertheless, the form has been influential: card collections such as nForm's *User Experience Trading Cards* (2007), Burghardt's *Working Through Screens Idea Cards* (2010), the AT-ONE *Customer Experience Touchpoint Cards* (Han, 2010b), Quesenbery & Brooks' *UX Story Cards* (2010), Volstad and Boks' *Biomimicry Card Deck* (2008; discussed in section 2.4.1), van Kuijk's *Recommendations for Usability in Practice* (2010), Evans and Pei's *ID Cards* (2010), and the Social Innovation Lab for Kent and Engine's *SILK Method Deck* (2010) all follow a similar pattern to the IDEO cards, though variously combine design methods, principles and prompts for use during stakeholder interviews, as well as some specific elements intended to assist idea generation. [43]

The origin of the 'card deck' format in playing cards suggests their use as part of an 'idea generation' game. One interesting design-based example of this is *Play Rethink*, an "eco-design game" produced by Rethink Games (2007). The 7½" square cards each comprise a large blank 'drawing area', together with a 'design challenge' requiring the use of various ecodesign strategies—for example, "Rethink how to make a bike rack that is

[43] Since the DwI v.1.0 cards were released (see chapter 5), the author has become aware of two more card collections focusing on influencing behaviour (to some extent) through design—the *Mental Notes* cards (Anderson, 2010) and the *Brains, Behaviour & Design Toolkit* (Pfarr et al, 2010).

Figure 2.10: IDEO Method Cards

inspired by nature's own designs and creations, also known as biomimicry" and "Rethink how to make a coat hanger that is multifunctional, i.e. that has more than one use or function". Players are assigned the challenges at random by using a spinner to choose the category of card, and an accompanying website features sketches sent in by users of the game. The 'challenge' element could be particularly relevant for the idea generation guide, whether explicitly framed as a game or simply as a provocation.

Other card collections

A slightly different approach is taken with collections such as the Design Council's *Agenda* cards (2005), developed with diabetes patients for Bolton Primary Care Trust and Bolton Hospitals' NHS Trust. In this case the cards are intended to be used by patients themselves, rather than designers, to make it easier to tackle issues around their condition and talking about their feelings with health professionals. Each card carries a statement such as MY BLOOD TEST RESULTS ARE CONFUSING or I FEEL LIKE I'M A BURDEN—something which it is perhaps easier to say when the statement already exists in a pre-written, pre-expressed form (there is a degree of social proof, since each statement has arisen from something another diabetic patient has already said, at some point). In this sense the concept has some parallels with *The de Bono Code Book* (de Bono, 2000)—see section 2.6.2.

A similar format is used by Research in Practice for Adults' *Change Cards* (2010), which cover changes to adult social care (from care management to self-directed support), each card summarising feelings that care practitioners have expressed. These cards, together with a number of other collections, include some which are intentionally blank, encouraging users (designers, patients or other parties) to write their own to add to the pack or for the particular project being worked on. Golembewski and Selby (2010, p.1) discuss the development of bespoke ideation decks for individual design projects, which "allows for the inclusion of parameters directly relevant to a given design brief, and thus

aids in project-specific ideation."

Random provocations

Some of the best-known early form collections which may have inspired the format include Marshall McLuhan's *Distant Early Warning* cards (1969) and Brian Eno and Peter Schmidt's *Oblique Strategies: Over One Hundred Worthwhile Dilemmas* (1975, and more recent editions). Both of these are based on the idea of random provocation, somewhat akin to the way the Chinese *I Ching* is consulted as an 'oracle' for statements of 'advice' about what to do next in a problematic situation. McLuhan's cards (52 plus two 'jokers') are based on a conventional pack of playing cards, but with the addition of aphorisms, maxims, and provocative statements, such as PROPAGANDA IS ANY CULTURE IN ACTION and WHEN ALL IS SAID AND DONE MORE WILL HAVE BEEN SAID THAN DONE.

Eno and Schmidt's cards are more directly intended to be used for ideation—specifically, resolving creative dilemmas or providing inspiration during a creative process (including art, music and design) via suggestions about how to treat the problem. For example, YOU ARE AN ENGINEER, WHAT WOULD YOUR CLOSEST FRIEND DO? and WHICH ELEMENTS CAN BE GROUPED?—all presented as simple lines of text.

While the abstract nature of the Oblique Strategies makes them difficult to categorise specifically as a 'design tool', designers are among those who have adopted them as an inspiration or 'unblocking' method, and various web and mobile applications based on the strategies have been developed, providing a provocative suggestion when needed. Similarly to de Bono's PO (section 2.5.1), the strategies can be seen as deliberate provocations: perhaps superficially absurd suggestions, not necessarily to be adopted as valid solutions in themselves, but as triggers to help think of alternative solutions.

Drivers of Change

A final card collection which must be mentioned here is Arup's *Drivers of Change* (2009), a comprehensive and detailed set of 175 double-sided cards created by Arup's Foresight team and developed over a number of years through iterative workshops with stakeholders in different fields. The cards deal with social, technological, economic, environmental and political (together: STEEP) factors which are driving global change in poverty, urbanisation, demographics, water, climate change, waste and energy, and are framed as questions to trigger discussion or the exploration of possible scenarios—e.g. WHO CONTROLS WHAT WE EAT? and HOW MUCH WATER DID YOU USE YESTERDAY? One side of each card features an image with a caption, while the other has quite a detailed discussion of the issue, including relevant graphs and diagrams. [44]

The versatility of the Drivers of Change cards is interesting from the perspective of this review: the accompanying booklet describes a wide range of possible uses, from "trivia game night" to "reception areas", ice-breaking, use as a teaching tool in schools[45] or for running workshops in a number of different formats. Among these, one which may be particularly relevant to the idea generation context is the 'STEEP brainstorm', where

[44] The author was invited to take part in one of Arup's Drivers of Change workshops in early 2011 on the subject of the 'Campus of the Future', and observed at first-hand the use of the cards in the workshop context, which was not so much about idea generation as about identifying the drivers which the participants considered important to the issue.

The large number of cards means that only a subset were used, but the questions were provocative enough to generate a lot of discussion. One interesting phenomenon was many participants' use of the 'extra' blank cards provided to write their own statements and questions, some of which effectively already existed in the pack but would have needed more time to find.

[45] Similarly to the *Democs* cards developed by the New Economics Foundation, "a conversation card activity... to promote discussion of controversial topics in science" (Smith, 2007).

participants receive cards from one of the categories each, and have to choose what they feel are five key issues relevant to the subject under discussion. The group then convenes and the choices from each participant are discussed and an attempt made to rank or prioritise them.

Characteristics of the card format

The main benefits of the card format centre on the affordances provided by discrete nature of individual cards compared with the affordances of a book: cards can be grouped in different ways, spread among a group of people in a workshop, shuffled and re-ordered, and provide a 'consistent' format for the ideas or patterns described.

The disadvantages are that they are inherently unstructured—even divided into 'suits' or categories, they do not naturally retain an order or an obvious flow from one to the next, which would be important in a more structured innovation method such as TRIZ.

It seems sensible to consider the use of cards as a possible format for the idea generation toolkit, alongside other formats, enabling a wide range of possible use-cases.

2.4.4 Summary of insights from the review of idea-generation and problem-solving

To answer the first research question (section 2.3)—

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

—the idea developed through the literature review in sections 2.4.1–2.4.3 is to produce a 'gambit' toolkit or library of strategies and mechanisms for influencing behaviour through design, with examples for each. This should allow designers to explore the ideas and relate them to the problem at hand, trigger new thinking and find different ways of looking at problems as well as solutions, helping to generate ideas during a brainstorming-type process. Analysis of this will answer the second research question:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

Further specification points and aspects to consider include the following:

- It would be usable both individually and in group brainstorming sessions, with different activities possible; it could allow group members to take different perspectives, both to ensure multiple viewpoints and to keep the inspiration process flowing
- Different formats, including cards, should be tried to establish what is most of use in different circumstances
- It could use elements of the pattern form, with varying degrees of detail. This could allow it to be a reference guide as well as an idea generation toolkit
- It could take a more structured 'prescription' process, along the lines of the Prism of TRIZ, or be a less structured (even random) provocation method such as *Oblique Strategies* or de Bono's PO (not necessarily mutually exclusive—it could be designed to be used in a number of different ways)

- It would make it easier to transpose concepts across disciplines, enabling pattern recognition via the use of metaphor or analogy where possible
- The level of detail—more or less text, more or fewer examples, and so on—is a variable to adjust

Not all of these possible characteristics and formats can be explored in this thesis, but the concept of a *toolkit* (section 2.3.3), implies a collection of tools and ideas rather than something with a single mode of use. The iterative development and testing process described in Chapters 4 and 5 returns to the specification points outlined above, drawing on them as appropriate.

2.5 Drawing conclusions from the literature review

Following the identification of the challenge of influencing more sustainable behaviour through design in Chapter 1, this literature review first examined the field of approaches to influencing behaviour, through a summary of an extensive review **[F1-9]** of behaviour change concepts and principles from multiple disciplines, with their implications for designers.

A set of insights around using context and cognition to influence behaviour through design was outlined (section 2.2.4).

2.5.1 The gap in knowledge and the research questions

Supported by a point made by Lilley (2007), regarding the need for inter-disciplinary knowledge transfer in design for behaviour change, an opportunity was identified for a guide, or 'toolkit', which brings together these insights around behaviour change in a form which is of use to designers during the idea generation phase of design processes, leading to the research questions outlined in section 2.3:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*
>
> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

2.5.2 Idea generation and problem-solving

The literature review continued by investigating design toolkits, idea generation methods and problem-solving in design, to uncover formats and elements which could be useful in structuring the 'design for behaviour change' toolkit—and answering the research questions.

A possible specification for the toolkit was elaborated (section 2.4.4), focused on developing a 'library' of gambits, strategies and mechanisms for influencing behaviour through design, with examples for each. The plan is that this should allow designers to explore ideas around behaviour change, and relate them to the problem at hand. This will trigger creative thinking, enabling different ways of looking at problems as well as solutions, and help designers to generate ideas during a brainstorming-type process.

2.5.3 The research programme

The research programme undertaken will thus centre on the development and trialling of a design toolkit for behaviour change. Chapter 3 explores and develops the appropriate research methodology for this, while Chapters 4 and 5 cover the development of the toolkit and evaluation of its use.

3 Research methodology

This chapter discusses design research methodologies and the relevant epistemological stances, theoretical perspectives, methodology and methods applied in the research described in this thesis. A four-element model based on Crotty (1998) is used to explore the relevance of different perspectives and approaches, and a mainly constructionist, interpretivist, action research methodology is considered most appropriate. The research methods used in the studies described in Chapters 4 and 5 are then outlined, including workshops, surveys, case studies and worked examples, and the naturalistic nature of the sampling employed is discussed.

3.1 Design research as application of multidisciplinary approaches

According to Archer (1995, p.6), writing on the nature of design research:

> "Research is systematic enquiry whose goal is communicable knowledge:
>
> • systematic because it is pursued according to some plan;
> • an enquiry because it is seeks to find answers to questions;
> • goal-directed because the objects of the enquiry are posed by the task description;
> • knowledge-directed because the findings of the enquiry must go beyond providing mere information; and
> • communicable because the findings must be intelligible to, and located within some framework of understanding for, an appropriate audience."

An attempt has been made to follow these criteria in this PhD: all elements are present, but particular attention has been paid to making the DwI toolkit itself communicable in a "framework of understanding" which is appropriate for use by design practitioners. Chapter 6 reflects on the extent to which the PhD has fulfilled these and other criteria for research.

It is important to note, however, that academic design research draws on—and is often situated in—a range of traditions, from art schools to business schools, manufacturing engineering to education, computer science to human factors, architecture to craft, as well as various social sciences. Despite efforts to define design's approach and establish it more clearly as a research discipline in its own right (e.g. Friedman, 2008[1]), there remains little consensus on the boundaries of what counts as 'design methodology' in an academic sense (e.g. Kimbell, 2011).

This thesis is not the place to expand this discussion, but it is important to note the issue, along with an additional aspect which may not be so apparent in academic disciplines without practical industrial counterparts: in selecting research methods and

[1] "[D]esign is becoming a generalisable discipline that may as readily be applied to processes, media interfaces or information artefacts as to tools, clothing, furniture or advertisements. To understand design as a discipline that can function within any of these frames means developing a general theory of design."

methodological approaches, design researchers have not only the existing academic literature on which to draw, but *design practice itself*: there are consultancies developing, applying and refining a wide range of practical research methods, in real-world contexts, which do not necessarily embody considered epistemological stances. Techniques may have become evolved through use, without their 'authorship' or disciplinary situatedness remaining clear. As Gray et al (2010, p.xvi) put it, "[t]he practices live in a mostly oral culture, passed along from person to person by word of mouth. For example, a consultant uses an approach with a client, and the client begins to employ that approach internally. Over time... it evolves into something quite different, and... the source of the original idea or approach may be lost".

Hence—as with the content of the toolkit itself—the methods used in this PhD and explained in this chapter have necessarily drawn from a number of fields and research paradigms, academic and from real design practice, rather than being exclusively situated within one tradition; while most come within the broad ambit of *action research* (section 3.4.4), their heritage is diverse. Yee (2009) examines six recent design PhD theses and characterises them according to the methodology and approaches used. By her definitions (p.14), this thesis uses a "'pick and mix' [approach] ...which often combines methods from the social sciences, humanities and hard sciences to derive a suitable model of inquiry." Yee notes that "[t]he necessity of this approach is not surprising considering the lack of an established research framework for design... perhaps... methodological innovation emerges from the way a researcher combines established research methods with practice-based methods."[2]

3.2 Characteristics of research: Crotty's framework

Research can be characterised in a variety of ways, according to a number of dimensions of classification. One approach which has seen some application in discourse on design research (e.g. Feast and Melles, 2010) is that of Crotty (1998), who characterises the research process in terms of four elements, "scaffolding, not an edifice" (p.2-3):

> "• *Methods*: the techniques or procedures used to gather and analyse data related to some research question or hypothesis.
>
> • *Methodology*: the strategy, plan of action, process or design lying behind the choice and use of particular methods and linking the choice and use of methods to the desired outcomes.
>
> • *Theoretical perspective*: the philosophical stance informing the methodology and thus providing a context for the process and grounding its logic and criteria.
>
> • *Epistemology*: the theory of knowledge embedded in the theoretical perspective and thereby in the methodology."

In this chapter, it perhaps makes sense to consider these in the reverse of the order given above, since epistemology should inform the theoretical perspective, in turn informing the methodology, which in turn informs the choice of methods. In practice, however, the realities of the contexts in which research can be done mean that, for example, the epistemological stance may have to be extracted from a reflection on what was done (and what it was possible to investigate) rather than being decided upon in advance—see the discussion on grounded theory in section 3.4.5.

[2] Also—concerning the more specific subject of the thesis itself—Tang (2010, p.48) notes, "[d]esign for sustainable behaviour is a relatively new area that has not yet been addressed in detail by either the social-psychological theories or by sustainable design research practically or theoretically."

Table 3.1: Crotty's (1998) epistemological stances mapped onto perspectives on design research by Feast and Melles (2010).

EPISTEMOLOGICAL STANCE	RELEVANT PERSPECTIVE IN DESIGN RESEARCH
Objectivism	Design research as "rational problem-solving"; "The objectivist position emphasizes the logical construction of theories based on discrete empirical facts (Friedman 2003)". The aim here is to explain phenomena objectively, solving problems in universally applicable ways.
Constructionism	Design research as "reflective practice"; "The constructionist position holds that designing in itself is not research unless it is also accompanied by reflection upon the process of making (Cross 2001; Dorst 2008)". Phenomena—such as design practices—are artefacts of the social context in which they develop.
Subjectivism	Design research as "direct making"; "The subjectivist position is shown for example by those within the community of art and design researchers who argue that all practice is research and that a thesis (written text) is unnecessary as knowledge produced through the research may be read in the artefact (Frayling 1993-4; see section 3.4.1 below)". The artefact re-constructs the understanding and perceptions of the practitioner.

3.3 Epistemology and theoretical perspectives

For Crotty, possible epistemological stances for research are *objectivism*, *constructionism* and *subjectivism* and their variants. Feast and Melles (2010, p.1) map these stances onto different perspectives on design research (Table 3.1), while recognising that any such simplification is a "caricature [which] necessarily hides much of the complexity of the issue".

In this PhD, elements of all three epistemological stances are present:

- A constructionist stance arguably dominates (at least in terms of the methods and methodology employed: see sections 3.4 and 3.5) in the iterative development of the DwI toolkit through workshops
- An objectivist stance is perhaps apparent in the early attempts to create something approaching a *BehaviourTRIZ* (see sections 2.4.5 and 4.1)—and probably also in the notion of a repeatedly of use, transposable design pattern library itself (compare Friedman's (2003, p.516) definition of a theory as "an ordered set of assertions that describes a generic behaviour or structure in a valid and verifiable way that holds throughout a significantly broad range of specific instances")
- A subjectivist stance is perhaps superficially apparent in the focus on 'making' the artefact of the toolkit, but as discussed in footnote 3 (section 3.4.1), the development process for the toolkit is central to the work, rather than the toolkit itself being the main research output

Theoretical perspectives (which elsewhere may be synonymous with *paradigms*) are, in Crotty's framework, philosophical stances which inform the methodology, including: *positivism* and *post-positivism* (associated with objectivist epistemological stances: "social

science should mirror, as near as possible, procedures of the natural sciences... objective and detached from the objects of research" (Hughes, n.d.)); *interpretivism* (associated with constructionist epistemological stances: understanding process rather than 'explaining' facts (Hughes, n.d.)); and critical and postmodern perspectives which challenge the legitimacy of other stances. From the point of view of this thesis, the theoretical perspectives employed are largely interpretivist (and possibly partially postpositivist), recognising the part the researcher (and the researcher's biases) play in the research process.

3.4 Methodology

In this section, design research methodologies relevant to the epistemological stance and theoretical perspectives adopted (section 3.3) will be examined.

3.4.1 Frayling's categories

Frayling (1993-4), although approaching the issue of design research from an 'art and design' perspective, distinguishes between research *into* (art and) design, research *through* (art and) design, and research *for* (art and) design.

Research through design...

By his definition, research *through* design (what Archer (1995) calls 'research through practice') describes much of the work undertaken for this PhD, in particular the use of action research (see section 3.4.4): as Pontis (2010) puts it, "research through design involves both understanding the process of design itself and developing new design actions, artefacts or methods".

This is contrasted with research *into* design (comprising theoretical, critical or historical investigations) and research *for* design (comprising "the development of new artefacts of which the goal is to visually communicate new knowledge" (Pontis, 2010) but not led by design practice itself).

Zimmerman et al (2007, p.5) combine Frayling's term with one of Simon's (1969/1981) notions (see frontispiece of this thesis), characterising "research through design [as being] where design researchers focus on making the *right* thing; artefacts intended to transform the world from the current state to a preferred state". Archer (1995, p.11) suggests that "[t]here are circumstances where the best or only way to shed light on a proposition, a principle, a material, a process or a function is to attempt to construct something, or to enact something, calculated to explore, embody or test it," and together with both Pontis's and Zimmerman et al's extensions of Frayling's idea, this fits the development and trials of the DwI toolkit examined in this thesis: the project investigated aspects of the design process and iteratively constructed, developed and explored the impact of a new tool intended to help change the way that designers address problems relating to behaviour.

...and research for design

It could also be argued that the 'artefact' of the toolkit makes this PhD also about research *for* design, since "the [research] thinking is, so to speak, *embodied in the artefact*" (Frayling, 1993-4, p.5, emphasis in original), produced for use by designers. However, the iterative development process for the toolkit—with designers—discussed in this thesis, is central to the work, rather than the toolkit being the main research output. Designers

were not just consulted about "what they need", but involved in the action research process throughout.

Research through design, for design

Hence, research *through* design and research *for* design are both possible descriptions for parts of this work: the author does not consider the toolkit to be something simply developed *for* designers, but something developed *with* designers. The idea of research *with* design might be a more accurate description combining both approaches. In any case, this is research *through* design, for design.

Frayling's categorisation is not without its critics (in particular, Friedman, 2008), but others have developed his concepts into a wider field of research approaches, some of which also match the approach taken in this PhD. For example, according to Keyson and Bruns (2009, p.4548):

> "Research through design focuses on the role of the product prototype as an instrument of design knowledge enquiry. The prototype can evolve in degrees of granularity, from interactive mockups to fully functional prototypes, as a means to formulate, develop and validate design knowledge.
>
> The designer-researcher can begin to explore complex product interaction issues in a realistic user context and reflect back on the design process and decisions made based on actual user-interaction with the test prototype. Observations of how the prototype was experienced may be used to guide research through design as an iterative process, helping to evolve the product prototype."

In the case of this thesis, the 'product prototype' is itself a design tool, the DwI toolkit—developed *for* designers, but also *with* them, with the workshop participants and other early adopters of the toolkit (Chapters 4–6) as the users.[3]

3.4.2 Practice-led research

The term *practice-led* is common in discussions of design research methodology. It does not necessarily imply research done by practitioners *outside* of academia, but rather, as Rust et al (2007, p.11) put it, "[r]esearch in which the professional and/or creative practices of art, design or architecture play an instrumental part in an inquiry," which can be undertaken by "practitioner-researchers" (Robson, 1993) who may have one foot in practice and one in academia. The author considers that his ongoing practical application of the DwI toolkit during its development, in consultancy (paid and unpaid) and industry conference contexts, alongside his role as a PhD student, places himself into this category for the purpose of this thesis.

Pontis (2010) equates practice-led research with Frayling's research *through* design (Figure 3.1), contrasting it with practice-based research (which equates to Frayling's

[3] There are other ways of classifying design research. For example, according to Blessing and Chakrabarti's (2009, p.61-62) 'Design Research Methodology' framework, the development of the toolkit might be classified as a "Type 3: Development of Support" or "Type 6: Development of Support and Comprehensive Evaluation" project. These categorisations, at least in the way they are phrased in the book, are arguably more rigidly cast in a research *for* design mould, and do not fully capture the characteristics of research *through* design.

It is, however, true that—had the book actually been available when this PhD work started in 2007—adopting its more formally constituted, pre-defined methodologies could have provided usefully defensible methodological structures around which to build elements of the action research process, as well as suggesting ways of collecting data, selecting the research methods and presenting the research outcomes.

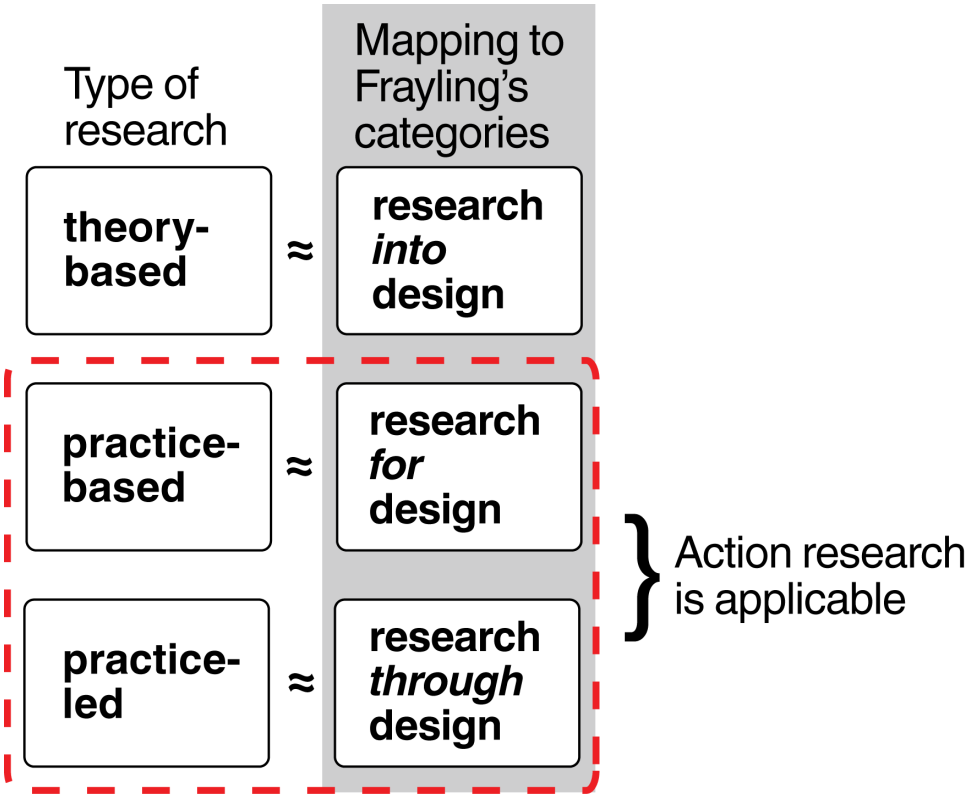

Figure 3.1: Mapping types of research to Frayling's (1993-4) categories, following Pontis (2010). The research described in this thesis is primarily as outlined in red.

research *for* design) and theory-based research (research *into* design). Following both Frayling and Archer, she considers action research to be an appropriate methodology for practice-led research (as well as practice-based research). This helps clarify further that the research described in this thesis is *practice-led action research through design, for design*, in the sense that design practice—understanding and influencing it, and working with designers to develop the tool—is central to the enquiry.

3.4.3 Cross's design knowledge domains

It is worth also noting here Cross's (1999) notions of design epistemology (studying "designerly ways of knowing"), design praxiology (studying design practice, and the strategies and techniques used by designers), and design phenomenology (studying how the outputs of design—artefacts or services—are configured and used in context).

To some extent, each of these elements is present in this thesis: there is a degree of design phenomenology present in both the background research on how design influences behaviour (Chapter 2) and the evaluation of how the toolkit is used in practice (Chapter 5); design praxiology comes into both the idea of the toolkit as a collection of patterns (Chapters 2 and 4) and the background research on idea generation methods and toolkits (Chapter 2); while the iterative development and evaluation of the toolkit via workshops with practitioners (Chapters 4–6) is perhaps primarily design epistemology.

3.4.4 Action research methodology

Action research as a methodology (Crotty, 1998, p.5) has been mentioned a number of times in section 3.3. As introduced by Lewin (1946, p.35), in a social psychology context,

> "research needed for social practice can best be characterised as research for social management or social engineering. It is a type of action-research, a comparative research on the conditions and effects of various forms of social action, and research leading to social action. Research that produces nothing but books will not suffice."

Lewin's methodology involves researchers being involved in action themselves—creating or promoting change rather than solely "to describe, understand and explain" as Robson (1993, p.438) suggests is the aim of "conventional pure scientific research". The action researcher does not attempt to be a detached observer, but instead takes an active—perhaps even political—stance; he or she:

> "attempts to develop results or a solution that is of practical value to the people with whom the research is working, and at the same time developing theoretical knowledge. Through direct intervention in problems, the researcher aims to create practical, often emancipatory, outcomes while also aiming to reinform existing theory in the domain studied" (Davison, 1998, p.3.6).

Lewin (1946, p.38) described action research as "proceed[ing] in a spiral of steps each of which is composed of a circle of planning, action, and fact-finding about the result of the action." The *plan–act–observe–reflect* cycle (Robson, 1993, p.438) is necessarily situation-specific; the plans made and actions taken will differ depending on context, "findings [will] only reliably apply to the place, time, persons and circumstances in which that action took place" (Archer, 1995, p.11). It is thus essential for action researchers to make clear the circumstances of the action taken, and to explain the reasoning and positions taken. Action research is unlikely to be entirely objective, but with the context, circumstances and research particulars well described for the situations involved, the findings can "advance practice and... provide material for the conduct of later, more generalisable, studies, provided the research is methodologically sound, the qualifications are clearly stated and the record is complete" (Archer, 1995, p.12).

The 'spiral' process will sensibly also include a 'Model II' approach (Argyris & Schön, 1974) where, if possible, the research plan includes provision for its assumptions to be challenged, and the problem perhaps reframed, with each iteration (see also section 2.4 on problem-framing). This should lead to *double-loop learning* (Argyris & Schön, 1978), where the goals of the research (and hence plan, and actions) are modified based on what is learned in the previous cycle (Figure 3.2); the plans and actions evolve with each iteration following reflection on the effects of the actions. This *reflective practice* model of action (Schön, 1983) fits closely the way in which the DwI toolkit and workshops were iterated (Chapters 4 and 5): for the reflective practitioner, "[b]ecause his experimenting is a kind of action, implementation is built into his inquiry" (Schön, 1983, p.68).

The method of *case studies* (e.g. Yin, 1981) may often be conflated with action research (Robson, 1993) but—quite apart from the method / methodology distinction—as Davison (1998) points out, there is something of a spectrum of how much 'intervention' the researcher makes, from cases where the researcher attempts to take no action other than reporting events, to cases where the researcher is wholly responsible for the actions taken which make the case the focus of the study. There is plenty of space in between these extremes, and in this thesis, all practical studies undertaken (other than surveys) involved the researcher (the author) acting to at least the extent of facilitating workshop sessions; in most cases action also included introducing the DwI toolkit.

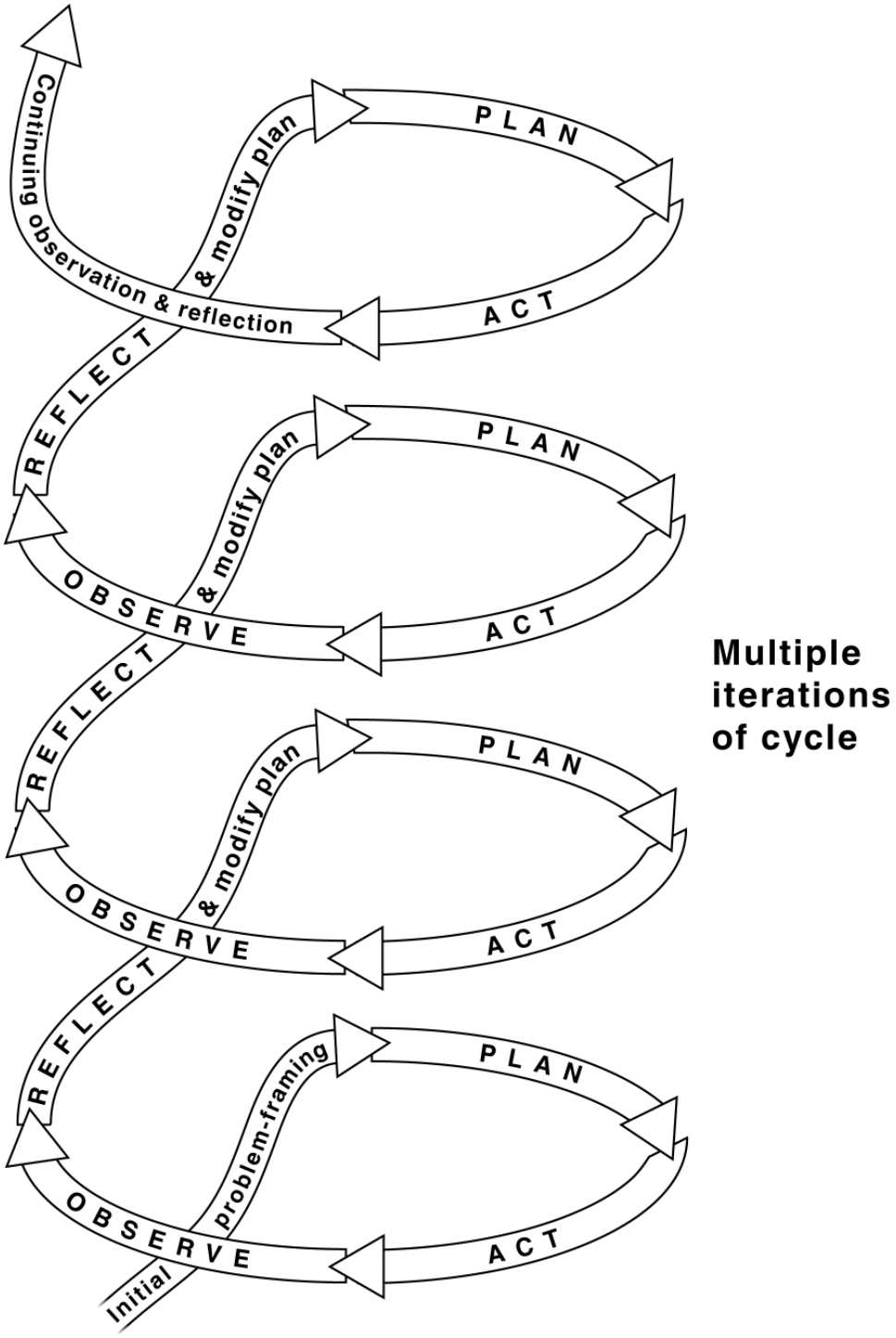

Figure 3.2: A synthesis of Lewin's (1946) action research methodology spiral, Robson's (1993, p.438) *plan–act–observe–reflect* cycle and Argyris & Schön's (1978) *double-loop learning*, to represent the iterative development of the DwI toolkit described in Chapters 4–6 of this thesis.

3.4.5 A note on flexibility and grounded theory

Grounded theory is a methodological approach emphasising the generation of "inductive theory emerging or rising from the ground of direct, empirical experience" (Friedman, 2008, p.154): researchers develop theory from the data collected, as they proceed, continuously re-framing and re-orienting their research questions and methods to help construct theory.

As originally developed (Glaser and Strauss, 1967; Corbin and Strauss, 1990), a formal process of multiple stages of coding and re-coding of data is involved, but the general approach of extracting theory (hypotheses) from real-life data, and then re-planning the next stage of research to probe and investigate the theory, is common among many forms of 'real-world' research, including much design research even though the theoretical development stage may not be strongly emphasised (Friedman, 2008). Denef et al (2011) draw some parallels between grounded theory and Alexander et al's (1977) development of *A Pattern Language* (see section 2.4.2) (and design patterns more generally), in the sense of researchers "look[ing] for patterns in ethnographic data that they collect through observations and interviews" (Denef et al, 2011, p.52). The point is well-argued—and to some extent fits aspects of the initial development of the DwI toolkit patterns too—but this kind of pattern-seeking behaviour is probably general enough to be inherent to many research practices.

One value of grounded theory in design research seems to be that the methodology legitimises flexibility in approach: the ability to modify the focus and goals of a study as it progresses. This is something familiar from design practice—where, as Hey (2008) found, design teams will re-frame problem / solution spaces repeatedly over the course of a project, negotiating an evolving 'common' frame which aims to reconcile the perspectives and needs of clients and users—but rarer in scientific research. Within design for sustainable behaviour, for example, both Lilley (2007) and Tang (2010) state that their research strategies have used a grounded theory methodology because it "enabl[es] the details of the research to evolve, develop and unfold as the research proceeds" (Tang, 2010, p.48).

In a sense, the adaptive nature of a grounded theory approach makes it not dissimilar to double-loop learning (see Figure 3.2), except that in 'strong' grounded theory the 'initial problem-framing' may be, intentionally, almost evanescent, with the problem-frame emerging from the data collected. As others have noted, this can make it difficult to know where to start in the first place. Robson (1993) quotes Winter's (1989) point that "data gathering cannot begin without a perceived problem to give it relevance and direction", and this is probably closest to the perspective adopted in this thesis in relation to grounded theory: while the flexibility in approach has facilitated the research plan to evolve, based on reflection on the results of the previous stage (see section 3.4.4), a fully grounded approach has not been adopted.

3.5 Research methods

This section describes the three main research methods used in the studies in this thesis: *workshops*, *worked examples* and *surveys*. The author also used an additional method, *card-sorting*, in a Design with Intent study which has been published separately **[B3]** from this thesis[4].

Crotty (1998) makes the important point that 'qualitative' and 'quantitative' are characteristics of specific implementations of research methods in execution, rather than being a higher-level 'type of research': a survey can generate qualitative and quantitative data,

[4]This study and its contributions to toolkit development are discussed in section 4.4.2

as can a workshop. This is the case in this PhD: the data collected from the studies undertaken are a mix of quantitative and qualitative information, which helped inform multiple aspects of the evolving research plan (Figure 3.2).

As asked by the research questions (section 2.3)—

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*
>
> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

—the research methods aimed to address how techniques and examples could be brought together (answered by the toolkit, in its evolving format) in a form which was of use for idea generation.

Assessing whether the toolkit was 'of use' was done directly, both quantitatively and qualitatively, by surveying early users of the toolkit (see section 3.5.3), including (quantitatively) breaking this down into a number of elements based on the Kirkpatrick model, a recognised model for evaluating training programmes, and soliciting qualitative information on how practitioners had used the toolkit and incorporated it into their own practice. Qualitative perspectives were also obtained through the workshops, focusing on the characteristics of participants' idea generation process using the toolkit.

3.5.1 Workshops

The main practical research method employed in this thesis is the *workshop*, mainly in the form of brainstorming, idea-generation or ideation sessions where participants are asked to generate concepts, individually or together, in response to a design problem or brief. The format is loosely based on that used by IDEO (section 2.4.4; e.g. Sutton & Hargadon 1996), differing primarily in the explicit use of a toolkit (in its multiple versions) as an inspiration tool. This places the workshop method definitively into the domain of *action research* (section 3.4.4) as the researcher introduces an artefact and procedure which attempts to change the way the participants act.

The use of inspiration material such as card decks in workshops is established in design research (e.g. Davis, 2010; Golembewski and Selby, 2010; Clatworthy, 2011), and indeed idea generation workshops in various forms are relatively common (e.g. Dorst and Cross, 2001; Jones, 2003; Lilley, 2007; Condon, 2008; Arup, 2009; Steen et al, 2011; Ozkaramanli and Desmet, 2012), sometimes with designers (or design students) as participants, sometimes with multidisciplinary teams, and sometimes with potential 'users' or other stakeholders as part of a participatory co-design process.

The term 'workshop' has been used in this thesis, to provide familiarity for the participants and continuity with other design research, but many sessions could equally be characterised as informal guided brainstorming (Osborn, 1953; see section 2.4.1) or *ideation* sessions. Jonson (2005) sees "design ideation... as a matter of generating, developing and communicating ideas, where 'idea' is understood as a basic element of thought that can be either visual, concrete or abstract," which is a sufficiently broad definition to include much early-stage work in any design process, so 'brainstorming' is probably a more useful description.

The author facilitated the sessions—and 'acted' in the sense of introducing the toolkit—but unlike some variants of 'workshop' practice, did not take part in any presentation or 'teaching' elements beyond introducing the procedures, answering clarification questions and discussing the ideas generated by the participants afterwards. In only one

case, the workshop with West Sussex County Council (section 5.4), was the author a full participant in a workshop acting on an equal footing with the other participants.

The term *design charrette*[5] has been used for time-constrained problem-solving sessions, e.g. by Lee et al (2003), but in architecture and urban planning, a charrette generally refers to such a session where stakeholders and experts from different fields and backgrounds (including members of the public) are intentionally brought together to address an issue (e.g. Condon, 2008). This was not directly the case in most of these exercises, although in the sense that most participants probably were also users of the products and systems referred to in the briefs, and in many cases were intended to be potential users of the DwI toolkit in practice, a participatory 'stakeholder' element was certainly present.

Advantages and limitations of workshops as a research method

Used as part of an action research methodology, workshop exercises are necessarily a context-specific research method: the researcher is involved in 'action' him- or herself, facilitating a situation where a particular group of participants are actively encouraged to work on a particular problem, rather than the researcher aiming to "describe, understand and explain" (Robson, 1993, p.438) some kind of 'naturally arising' responses to a problem. This could be seen as a limitation of workshops as a method—the ideas and outcomes generated in an 'artificial' setting may not have *ecological validity*, or may not be generally applicable outside of the context in which they were created—but from a reflective practice perspective (section 3.4.4), workshops fit well the focus on iterative development around particular forms of action (Halskov and Dalsgaard, 2006).

Some of the basic characteristics of workshops can again be seen as advantages or limitations depending on perspective (epistemologically, or indeed practically).

The effect of having multiple participants exploring a problem will increase the possible diversity of approaches and ideas generated—and potentially the range of stakeholder perspectives present—and allow participants to build on each other's ideas in a way which would not occur if participants contributed individually. However, group effects (such as: *production blocking*—the more participants, the less chance each person has to contribute; *social loafing*—the more participants, the less accountability each person may feel; and *evaluation apprehension*—the more participants, the greater the worry that ideas will be poorly received, hence they are suppressed) have been identified in group brainstorming research (e.g. Diehl & Stroebe, 1987) and may act to *reduce* the diversity or quantity of ideas generated. Initially, it was hoped that an element of the 'controlled trial' could be included in workshops, with their output following use of the DwI toolkit compared statistically with their output prior to using the toolkit. While the quantitative data were generated (section 5.3.2), it was recognised that the limitations of the context (diversity and limited numbers of participants, potential exposure to elements of the toolkit before participating, and so on) made statistical analysis unsafe. As such, primarily qualitative assessments were used.

Participants who have chosen to take part in research workshops around a subject of interest to themselves may well be highly motivated to contribute, which may lead to a 'successful' workshop, but be unrepresentative of 'real-world' situations where participants may be selected for attendance by line managers or others, and lack the same motivation. The inclusion of 'real-world' applied workshops with industrial and public sector partners (sections 5.4) and surveys of 'real-world' early users of the toolkit (section 5.4.4) was considered vital to compensate for this.

[5] Arup (2009) uses 'charrette' for sessions where a facilitator acts as a 'client', giving each team selected *Drivers of Change* cards (section 2.4.3) to represent drivers and constraints relevant to a particular industry.

The format of the workshop exercises used in this thesis evolved with the development of the toolkit; the following subsections elaborate on this evolution.

Pilot study sessions with DwI v.0.8 (Chapter 4)

The first 'workshops' using the DwI toolkit, described in section 4.3, were quick pilot studies, primarily intended to investigate the *usability* of the DwI toolkit in its then-current form (v.0.8).

Four recent design graduates and product design students with industrial experience and an interest in environmentally sensitive design were chosen to participate in the initial pilot studies. The full procedure is explained in section 5.2.1.

Brunel workshops with DwI v.0.9 (Chapter 5)

With the next version of the toolkit, a series of 48 workshop exercises were run at Brunel with 16 designers and students (participants are discussed in section 5.3.2), individually and in pairs, applying DwI v.0.9, in poster format, to four sustainable behaviour briefs. The details of the procedure are discussed in section 5.3.2. The briefs addressed (section 5.3.2) related to using electric kettles efficiently, closing curtains at night to conserve heat, helping users print documents more efficiently, and influencing people to turn off the tap while brushing their teeth. Michl (2002) contends that most commercial design is really redesign of one form or another, and this is the premise on which the briefs given in the workshops were presented: *redesigning everyday products to help users use them more efficiently.*

Analysis

The research questions addressed by the workshops were mainly focused on exploring how participants made use of the toolkit, empirically, with the aim of uncovering insights which would be useful for improving it:

- How did participants apply the patterns to the different briefs?
- Which aspects were well-understood and which were not?
- How were the inspiration and prescription modes used in practice, compared with 'conventional' brainstorming?

In generating concepts addressing the four briefs provided, the workshops also contributed to widening the 'solution space' for the particular problems concerned.

In conventional brainstorming (see section 2.4.1), common practice is to urge participants to generate as many ideas as possible in the time available, even if unrealistic. IDEO's 'Rules of Brainstorming', prominently displayed in company meeting rooms, are at least partly geared towards generating as many ideas as possible (including "Go for quantity (not quality): Set an outrageous goal and surpass it")—drawing directly from Osborn's recommendations for brainstorming, 'Quantity is wanted. The greater the number of ideas, the more the likelihood of winners' (Osborn, 1953: p.301).

It was decided to follow this approach and ask participants to 'go for quantity' and record every idea. This also accords with the approach of Nemeth et al (2004, p.369), who used the instruction "Come up with as many good solutions as you can to the problem" in their brainstorming studies, counting the number of ideas generated by participants under different instructional conditions.

The emphasis on quantity made it likely that a large number of 'unrealistic' ideas would be generated, and so it was decided that in these workshops, the 'quality' of the

concepts would not be assessed formally: a quality assessment (e.g. by an 'expert panel') would simply not reflect what participants were actually being asked to do.[6] However, the nature and possibilities of the concepts generated were examined. The concepts generated by participants using the toolkit in different ways were compared to those generated using conventional brainstorming (without the toolkit), in both *quantity* and in aspects of the design techniques used, and *qualitative* details of the concepts were discussed (section 5.3.2).

Other observations relating to the usability of the toolkit in the workshop context suggested improvements to be incorporated in future versions.

'Applied trial' workshops with DwI v.0.9 and 1.0 (Chapter 5)

While the sessions described in sections 3.5.1 above (and fully in section 5.2) involved some practising designers alongside students, they were still carried out in an explicit 'research study' context. It was considered important to run workshops in 'applied' settings closer to the practical contexts where the toolkit was intended ultimately to be used: with design consultancies, with stakeholders (both designers and other interested parties), at industry events, and in design education, including a range of environmental and social briefs based on 'real' problems identified by participants or third parties.

A series of 'applied' workshops using DwI v.0.9 in card, worksheet and on-screen form, in 'inspiration mode' only (section 5.3.3) were thus carried out, facilitated by the author and by others. Section 5.3.3 covers: two workshops run with IDEO and the RSA for the National Policing Improvement Agency; and exercises run as part of BSc / BA and MSc design student classes at Brunel, the Design for Conversion 3 conference in Amsterdam, a student class at Hogeschool Utrecht, and an exercise run as part of a presentation at UFI Learndirect. The variations on the workshop method involved here are described in the sections concerned.

Applied trials were also carried out with the next version of the toolkit, v.1.0, covering a range of environmental and social briefs. Section 5.4 describes some of these in detail, and some in less detail for reasons of confidentiality. These workshops comprised an industry workshop for Philips Research in Eindhoven, a mixed design industry / student workshop at the University of Twente, further design student workshops at NTNU, Trondheim, and at Brunel, a (mainly) industry exercise at a Modern Built Environment KTN event, two workshops at the UX London 2010 industry conference, a session at the mainly academic Persuasive 2010 conference, a session with Brighton & Sussex University Hospitals NHS Trust at the Design Council, and a workshop for West Sussex County Council.

Analysis

The research questions addressed in the applied workshops were focused both on exploring how participants made use of the toolkit, empirically, with the aim of uncovering

[6] In Jones's (2003) workshop studies investigating the use of TRIZ for eco-innovation, she used an expert panel of judges (designers from industry and design academics) to assess concepts generated by participants—re-presented in a more consistent style to control for differences in participants' presentation quality—against a set of statements about the merits of the concepts, with which the judges could rate agreement or disagreement (or other ratings according to the statement). This followed the method used by Dorst and Cross (2001) using faculty members from TU Delft to assess ideas, and was considered as a method for the current workshops. However, again, given the emphasis on quantity of concepts, and the fact that participants were free to note down or sketch the ideas they generated in whichever format they liked, it was considered that asking judges to rate potentially hundreds of ideas (quite apart from the re-presentation process) would be fatiguing, overly subjective, and hence unsatisfactory.

insights which would be useful for improving it, and on evolving and refining the workshop format. Given the applied contexts, the briefs used were a mixture of real problems chosen by the organisations with whom the workshops were being carried out, and general problems within the scope of the participants' expertise, decided upon in discussion with representatives from the organisations concerned. Details of each brief are included in section 5.4.

Questions addressed included:

- How did participants apply the patterns to different briefs?—specifically, aspects such as how the lenses were used, what kinds of idea generation process different groups practised, and how participants recorded their ideas.
- Which aspects were well-understood and which were not?
- Qualitative aspects of group interaction and dynamics—is there a 'right' number of participants for a workshop of this kind?
- Using the toolkit with groups of different sizes and specialisms—how can the toolkit be used most effectively? Should it be split into smaller sections? (by lens or otherwise)

Section 5.4 gives details of the procedure for each workshop, with some briefly summarised and others described in more depth.

3.5.2 Worked examples and case studies (Chapters 4 and 5)

Throughout this thesis, worked examples have been used as a method of demonstrating how the toolkit can be used or how particular design patterns can be applied to problems. These describe the process used by the author to generate concepts using the version of the toolkit under discussion at that point, and so are largely subjective, including reflection on the process and the nature and suitability of the concepts generated—very much *research through design, for design.* In some cases the briefs addressed are self-generated; in others they are set by an external party (see particularly the treatment of improving financial decision-making in section 5.4–a brief set for the author by Harvard's ideas42 think-tank). The analysis here comprised comments by ideas42 staff in response to the suggestions.

In this thesis, the majority of uses of worked examples are followed by an application by others (e.g. workshop sessions); in some cases the author used his own worked examples at the start of workshop sessions to introduce the DwI toolkit to participants.The use of worked examples in this manner is common in research where authors are introducing a new method or procedure, for example in guides for designers (e.g. Alexander, 1964; Stanton et al, 2005; Schell, 2008).

Three brief case studies describing how others have used the DwI toolkit (v.1.0) to address their own briefs have also been included, in section 5.10. These are descriptive rather than explanatory cases, included as demonstrations of how the toolkit can be applied, with insights derived from users' experiences also informing further development of the toolkit.

Advantages and limitations of worked examples as a research method

The main purpose of using examples in this way is to 'work through' problems using the toolkit—both to demonstrate the use of the toolkit to others, and to explore and refine the intended procedures for using the toolkit. Different kinds of briefs for worked examples offer different advantages: those which are 'known problems' in design (such

as the ATM example in section 5.3.1) allow a degree of validation of the toolkit against existing solutions, while those which are novel problems, in particular those set by external partners (such as those addressed for ideas42) enable the generation of entirely new concepts.

As noted above, worked examples carried out by the author are necessarily subjective; they also have the limitation that the selection of the examples themselves is determined by some interest or expected likelihood of 'interesting' concepts being generated, whether by the author himself or by external partners.

3.5.3 Surveys and interviews (Chapters 4 and 5)

Surveys and informal interviews are also used within the thesis. The few interviews and requests for comments are mainly used to derive insights to inform the development of the next version of the toolkit, for example in chapter 4, a discussion with practitioners from the service design consultancy live|work provides useful pointers for the development of the toolkit from v.0.7 to v.0.8, while comments from IDEO in chapter 5 help the development from v.0.9 to v.1.0.

The two surveys carried out differ in their purpose and scope. Section 4.4.1 describes a small online survey (22 full responses) carried out to explore respondents' familiarity with the different design patterns for influencing behaviour contained in DwI v.0.9, which provided some input to the development of v.1.0.

The major survey carried out, covered in section 5.4.4, with 100 responses as of September 2011[7], dealt with the experiences of people who had used the toolkit (v.1.0) in practice in the context of their work or professional development. In January 2011, a survey was put online and announced via the blog and an email to all the purchasers (and those who had received free copies) of the printed packs at that stage. Throughout 2011, further emails and announcements were sent to draw the attention of subsequent downloaders and purchasers; in some cases, packs were given to particular people on condition that they provided feedback once they had used the toolkit. The main purposes of the survey were to find out how the toolkit was being used, and how it could be improved (in both usefulness and usability), and as such the questions were centred on exploring certain aspects of these questions.

The results of the survey (section 5.4.4) were both qualitative (in terms of comments, suggestions and answers to questions eliciting specific details about how the toolkit has been used), and quantitative in terms of giving figures for the percentages of toolkit users who have employed it in different ways, who would recommend it (the Net Promoter Score), and proportions for the elements of the Kirkpatrick Model surveyed.

Advantages and limitations of surveys as a research method

Surveys are a common method in academic design research. They offer advantages of potentially being easy to run (for example, online surveys require minimal intervention by the experimenter once posted), potentially reaching larger audiences than could realistically be individually interviewed, and, if structured correctly, allow the collection of data in ways which provide specific quantitative and qualitative answers to research questions.

In professional polling, well-designed surveys of specific population or demographic samples can achieve high levels of representativeness and validity. However, the kinds of surveys possible within the constraints of a PhD can have many limitations. Respondents are likely already to be interested in the subject (and may have strong opinions about

[7] At the time of the author's thesis corrections (September 2012), this figure had reached 153.

it, hence their desire to participate). In the author's experience, pleas on social media along the lines of "It would really help if you filled in my survey" are relatively common as research students struggle to recruit enough respondents. In general, there is also a tension between encouraging essay-type free-text responses (which generate quantitative insights, but may be onerous for participants) and using quicker multiple-choice questions which do not necessarily allow participants to give nuanced answers, or explain the reasoning behind their choices.

The author's major survey on early users of the DwI toolkit was designed to try to minimise these limitations, by concentrating on a particular group of respondents (people who had used the toolkit), and applying some simple thinking around behaviour to the design of the survey itself, to increase the likelihood of participation and the usefulness of the results.

Based both on the Design with Intent patterns (using some, and avoiding others) and the author's experience filling in many dozens of academic research surveys for other people's projects, the main principle was to respect respondents' time (Markey, 2011). Much of this was about influencing perceptions: giving some SIMULATION & FEEDFORWARD showing that the survey will be quick to fill in ('five minutes' was claimed) and making it clearly all fit on one page, so that the answers themselves act effectively as a PROGRESS BAR.

All questions were optional (including name and contact details) giving respondents a choice not to answer, to answer with multiple choices or to answer with their own free text rather than using required fields or exclusive radio buttons (effectively an INTERLOCK), which can force respondents into entering less-than-optimal responses simply to ensure a survey is submitted. No FORCED DICHOTOMY questions were used (including avoiding any even-numbered rating scales) and DEFAULT choices for any question were avoided, so that only actual choices made by respondents would be counted, rather than those perhaps accidentally left selected.

Analysis: evaluating whether the toolkit is 'of use'

Throughout this thesis, a key determinant of how much use a 'design toolkit' is in practice has been considered to be whether in the longer term it continues to be used and is adopted by users as part of their processes (in industry, academia or other sectors). Within the time constraints of a PhD it is difficult to do a longitudinal study of this kind, particularly where the tool has also been evolving, but this survey at least offered the opportunity to gain feedback on how early users of the toolkit (within the first 18 months after release) have made use of it—has it been used in ways that suggest it could become adopted in the longer term?

Another angle on evaluating the 'of use' question is provided by Kirkpatrick (1998) whose 'Kirkpatrick Model' (originally published in 1959) has been widely adopted as a method for evaluating corporate training programmes. It has also been applied to the evaluation of design tools—for example, Dong and Clarkson (2005) used questions based on the Kirkpatrick Model to assess the impact of their *i~design* inclusive design toolkit. While corporate training is not directly analogous to design toolkits, the 'four levels' of evaluation in Kirkpatrick's model (Table 3.2) all have applicability to the adoption of new processes or tools, whether those are methods established through training or through a toolkit or similar. Kirkpatrick explains that each level builds on the previous ones: participants' reaction to a training programme influence the degree of learning that occurs, in turn influencing the changes in behaviour that participants make, and ultimately the results that develop from these changes in behaviour.

As a result of the considerations discussed in Table 3.2, it was decided that of Kirkpatrick's levels, the first two (reaction and learning) were most suitable to be evaluated

Table 3.2: The four levels of the Kirkpatrick Model. All quotes are from Kirkpatrick (1998, pp. 19-24)

LEVEL	DEFINITION	POSSIBLE EVALUATION METHOD IN THE DwI SURVEY CONTEXT
1. Reaction	"[H]ow those who participate in the program react to it... a measure of customer satisfaction."	Ask questions about the respondents' satisfaction with the toolkit. See discussion below.
2. Learning	"[T]he extent to which participants change attitudes, improve knowledge, and/or increase skill as a result of attending the program."	Ask directly whether respondents': • attitudes • knowledge • skills have changed as a result of using the toolkit.
3. Behaviour	"[T]he extent to which change in behaviour has occurred because the participant attended the training program."	Really needs a longer-term evaluation, but some respondents may have changed their behaviour (e.g. ideation processes) through adoption of the toolkit. Therefore, include open questions relating to how the toolkit has been used.
4. Results	"[T]he final results that occurred because the participants attended the program."	Results in this context could include designed products or services using DwI patterns. Probably too early to evaluate at this stage.

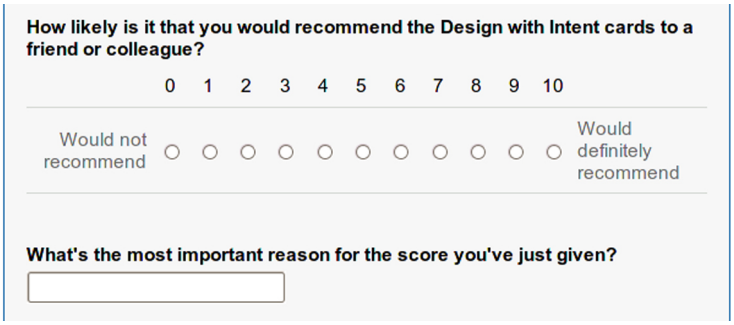

Figure 3.3: The 'Ultimate Question' as applied in the DwI v.1.0 survey

by the survey, with the third (behaviour) to be included via open questions about how the toolkit had been used, but that it was too early to attempt to evaluate the fourth level (results).

Reaction and the Net Promoter Score

Assessing reaction could have been done via a conventional 'How satisfied are you?' Likert scale or similar, but it was felt that this did not provide the depth of evaluation which would help improve the toolkit. Kirkpatrick (1998) recommends the use of detailed 'reaction sheets' and even matrices in which respondents rate their satisfaction with multiple aspects of a programme, but the onerous nature of these conflicted with the desire to make the DwI survey quick to complete.

An alternative approach was thus tried, based on Reichheld's (2006) 'Ultimate Question', developed in the context of customer loyalty, relationship management and user experience, and popularized in business through use by companies such as eBay, American Express and General Electric. The eponymous question is simply, "How likely is it that you would recommend [this product] to a friend or colleague?"—an 11-point scale, from 0 "Not at all likely" to 10 "Extremely likely" is used, followed with an optional "Why?" question.

The aggregated scores are used to determine what Reichheld calls the Net Promoter Score (NPS)—the percentage of respondents who are 'promoters' (answered with 9 or 10) minus the percentage who are 'detractors' (answered with 0 to 6). Those answering 7 or 8 are considered to be 'passives'. The contention is that a company (or product) with a high NPS will grow through word-of-mouth recommendations, which are a proxy not only for satisfaction, but active evangelism for the product—promoters "accounted for more than 80 percent of referrals" (Reichheld, 2006, p.30).

The NPS process involves a number of considered design decisions: treating both 9 and 10 together as a 'promoter' score captures respondents who will rarely rate anything as a '10' even when they are highly satisfied; the 11-point scale means that respondents with a very negative reaction can have the satisfaction of giving a product a 'zero'; the use of 0 rather than 1 for the worst rating also removes the possible confusion that a 1 represents a 'ranking' of first rather than a low score.

In the context of a new tool for which the measure of whether it is 'of use' is partly assessed by how widely it is adopted, the 'promotion' aspect of NPS seemed especially relevant as part of the process of evaluating participants' reaction to DwI. The 'Ultimate Question' was thus incorporated (Figure 3.3) into the DwI v.1.0 survey as a simple way not only of evaluating reaction to the toolkit, but also hinting at its potential (or otherwise) for growth.

Learning: attitudes, knowledge and skills

The 'learning' level of the Kirkpatrick Model was incorporated into the survey by the use of the question:

> As a result of using the cards, do you think your...
>
> —knowledge has increased?
>
> —skills have increased?
>
> —attitudes or perspectives have changed at all?

Drawing directly on Kirkpatrick's recommendations and terminology, the only difference was the use of 'perspectives' alongside 'attitudes', to reflect the aim of the DwI toolkit to introduce additional perspectives on behaviour change from different disciplines, rather than directly trying to change users' attitudes.

Other aspects evaluated

In keeping with the aim of a short survey, the other questions asked were brief while giving respondents the chance to give more details if desired. Thus, tick-boxes (allowing multiple selections, or none) were used to find out: the format in which respondents had used the toolkit (physical or on-screen); how respondents had made use of the toolkit (brainstorming, as a reference, etc); and the workplace or personal context in which they had used the toolkit (commercially, public sector, educational institution, personal interest, etc). Free text fields were used to ask respondents: how they had found out about the toolkit; what sort of problems they had used the toolkit to address; whether there were particular patterns or lenses that had proved of use (following somewhat the theme of the v.0.9 survey described in section 4.4.1); and what would make future versions of the toolkit of more use. As suggested in Table 3.2, a free text field was also included to capture any comments respondents had, for example about changes to their working processes as a result of using the toolkit.

3.6 Participant selection and research quality

The types of participants which it was possible (and desirable) to recruit for the studies described in this thesis meant that the samples were unlikely to be representative of the relevant populations as a whole, but were what could be termed *naturalistic* (Lincoln and Guba, 1985) or *stakeholder* samples. As Robson (1993, p.142) notes, "[t]he exigencies of carrying out real world studies can mean that the requirements for representative sampling are very difficult, if not impossible, to fulfil".

As such, the participants recruited followed, to some extent, what Robson terms *purposive sampling*, where "the researcher's judgement as to typicality or interest" (p.141) is used, although there were also elements of *convenience sampling*, not simply asking people nearby, but making use of groups of potential participants when opportunities were presented, all of whom potentially had an interest in the development of the toolkit as a possible *user* in one form or another.

Lincoln and Guba's (1985) concept of *naturalistic enquiry* has a great deal of resonance here, emphasising the use of "the natural setting or context of the entity studied"as the location for the research to take place, and "[r]esearch design emerg[ing] from the interaction with the study" (Robson, 1993, p.61), as noted in sections 3.4.4 and 3.4.5.

3.6.1 Naturalistic enquiry

For example, the use of undergraduate and postgraduate design students (as here in Chapters 4 and 5) in some workshops is not uncommon in design research (e.g. Lilley, 2007; Tang, 2010). The author would argue that this is not merely convenience sampling, since the participants were chosen because they were potential users of the toolkit, either in their own projects, or—as designers in training—in later projects once working in industry. This was a 'natural' setting, and the sample was a 'natural' sample for this activity. The decision was taken in the workshops described in section 5.3 to recruit practising designers from outside to participate alongside students, to broaden the scope of expertise and experience present, but this recruitment relied upon readers of the author's blog responding to the invitations, so (as with the internal workshops outside of actual course-based sessions) the sample was largely self-selecting: these were people interested in being involved in a workshop, learning from and contributing to the development of the toolkit.

With the 'applied' workshops run in industrial or other external contexts, the participants were mostly those who either heard about the events and decided to attend out of interest, or who were asked to attend by their own managers. This again is a self-selecting sample; likewise with the survey respondents in section 5.4.4 (who chose to take part in the survey after using the toolkit). Clearly, then, the samples used will be biased in a number of ways—people with time to participate, people who were already aware of the toolkit's development, and so on—and many were small (although larger numbers were obtained with the survey in section 5.4.4). Nevertheless, it was considered that in the sense that the participants all represented potential users of the toolkit, and could hardly be cajoled into participating in idea generation sessions around social and environmental problems without *some* degree of interest in the issues involved, it was legitimate to regard them all as potential *stakeholders* in the toolkit's development, and hence this fits a naturalistic approach.

3.6.2 Validity and reliability

'Research quality' can be defined in a number of ways: in the context of individual studies, this is commonly, in terms of *validity* and *reliability*. Validity is "concerned with whether the findings are 'really' about what they appear to be about" (Robson, 1993, p.66) while reliability concerns "[t]he extent to which results are consistent over time and an accurate representation of the total population under study" (Joppe, 2000, cited in Golafshani, 2003).

Golafshani (2003, p.597) notes that the concepts of "reliability and validity are rooted in [a] positivist perspective [therefore] they should be redefined for their use in a naturalistic approach", discussing the use of strategies such as *triangulation* to validate naturalistic research with a constructionist epistemology. This can mean "[e]ngaging multiple methods, such as, observation, interviews and recordings [to] lead to more valid, reliable and diverse construction of realities" (Golafshani, 2003, p.604), and this is the approach taken by the author in this thesis.

The multiple methods used—including workshops, surveys and case studies—help bring a plurality of perspectives on the issues being researched, and, especially in the case of the major survey described in section 5.9, the input of a large number of respondents, enabling the triangulation of important issues and insights.

The author has also made an effort to publish work continuously during the PhD, both at conferences and in journals (see front matter for full list), with the aim of receiving, effectively, an ongoing peer review of the research methodology and feedback on how the DwI toolkit fits into others' research and practice (via paying attention to who cites

the papers, and in what context). While these feedback loops are not as fast as might be desirable, they have informed the author's own acknowledgement of methodological limitations (e.g. in section 5.5).

3.7 Conclusions of research methodology chapter

This chapter has examined design research methodologies and relevant epistemological stances, theoretical perspectives, methodology and methods, and how they have been applied in the research described in this thesis. The naturalistic nature of the sampling employed has also been discussed.

A mainly constructionist, interpretivist, action research methodology was considered most appropriate; Figure 3.4 summarises how this action research methodology fits into the structure of this thesis, based on the outline in Figure 1.1 (in chapter 1). Chapters 4 and 5, on 'Toolkit development' and 'Understanding and evaluating the toolkit in use', describe the iterative process of developing and evaluating the toolkit through a 'spiral' plan–act–observe–reflect approach (section 3.4.4), with research methods including workshops, surveys, case studies and worked examples. The toolkit is an output of the research.

In summary:

- Research can be seen as "systematic enquiry whose goal is communicable knowledge" (Archer, 1995).
- Design research often draws upon and involves the application of approaches from multiple academic disciplines, as well as methods and methodologies from design practice itself.
- Methods used in this PhD have drawn from a number of fields and research paradigms, academic and from design practice, though most come within the broad ambit of *action research*
- Crotty's (1998) framework is used to characterise the research elements present in this thesis: epistemology, theoretical perspective, methodology and research methods.
- A constructionist stance is the main epistemology adopted in this thesis, but elements of objectivist and subjectivist stances are also present.
- The theoretical perspectives employed are largely interpretevist, recognising the part the researcher plays in the research process.
- The 'research through design, for design' methodology adopted is largely practice-led action research, using an iterative *plan–act–observe–reflect* cycle. A fully grounded approach has not been adopted, but the research plan has evolved based on reflection on the results of previous stages.
- The main research methods used are: workshops, mainly in the form of brainstorming, idea-generation or ideation sessions where multiple participants, from both industry (or the public sector) and academia are asked to generate concepts, individually or together, in response to a design problem or brief; worked examples and case studies; and surveys and interviews.

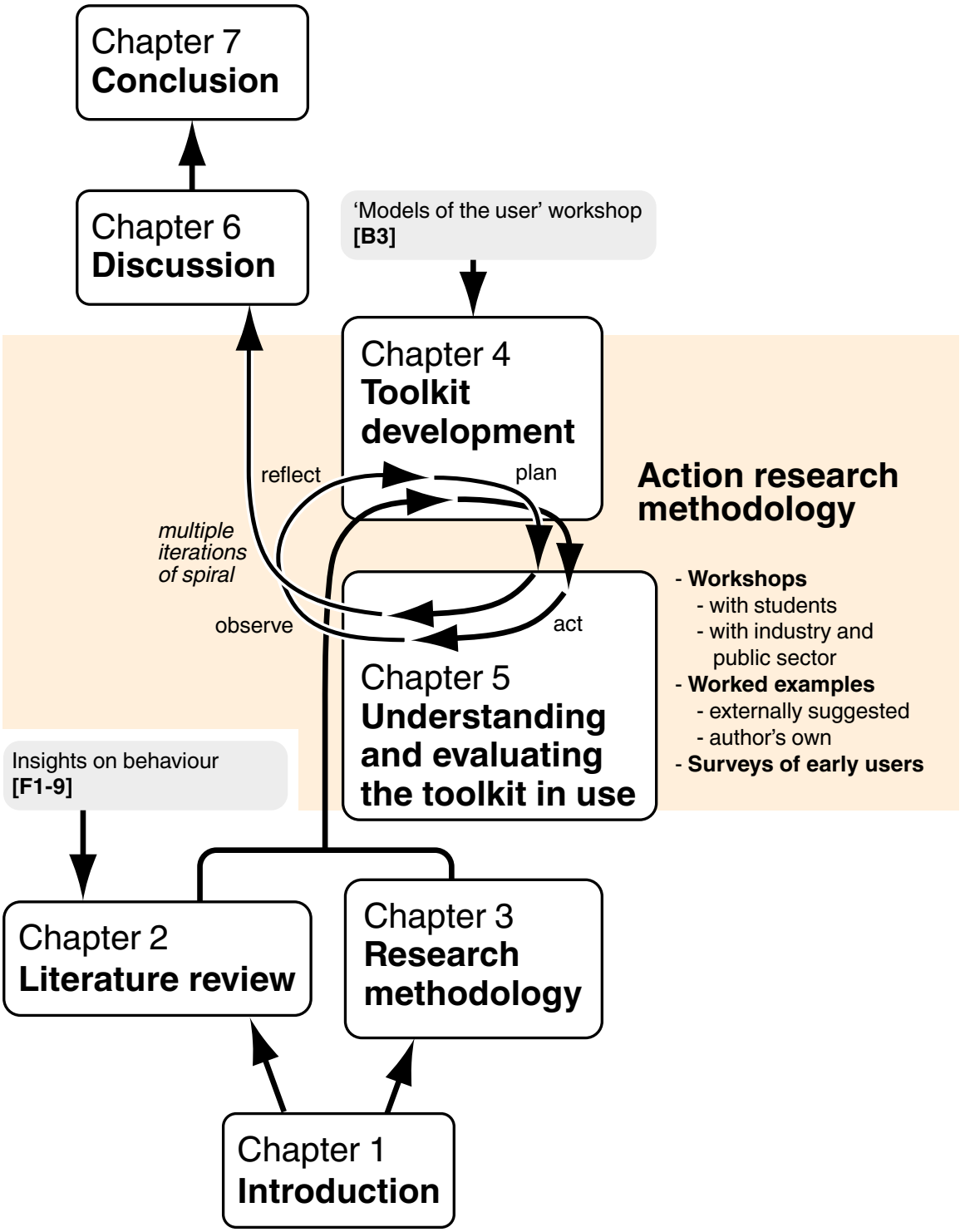

Figure 3.4: How action research methodology fits into the thesis structure.

- The research methods aimed to address how techniques and examples could be brought together (answered by the toolkit, in its evolving format) in a form which was of use for idea generation.
- Assessing how the toolkit was 'of use' was done directly, both quantitatively and qualitatively, by surveying early users of the toolkit, centred on simple questions of whether, and how, they had used the toolkit in their own work.
- This included a breakdown of feedback into a number of elements based on the Kirkpatrick model, a recognised model for evaluating training programmes, with reaction assessed using Reichheld's Net Promoter Score.
- It was also done qualitatively, through the workshops, focusing on the characteristics of participants' idea generation process using the toolkit.
- A purposive, naturalistic or stakeholder sampling approach was used. Multiple research methods helped bring a plurality of perspectives on the issues being researched, and enabled the triangulation of important issues and insights.

4 Toolkit development

> "The whole point of doing research is to extract reliable knowledge from either the natural or artificial world, and to make that knowledge available to others in re-usable form".
>
> Nigel Cross, 'Design Research: A Disciplined Conversation', *Design Issues* 15(2), 1999, p.9

Following the identification of the research questions in section 2.3, and consideration of appropriate research methodology in Chapter 3, this chapter describes how the design for behaviour change 'toolkit'—which became known as the *Design with Intent toolkit*—was developed. The plan in developing the toolkit was that it should allow designers to explore ideas around behaviour change, and relate them to problems at hand, triggering creative thinking, enabling different ways of looking at problems as well as solutions, and helping designers to generate ideas during a brainstorming-type process. The toolkit (and its contents) will provide a contribution to knowledge in design practice, while the process of toolkit development, and cycles of testing, will provide a contribution to knowledge in design research.

The later sections of Chapter 2 investigated design toolkits, idea generation methods and problem-solving in design, to uncover formats and elements which could be useful in structuring the toolkit, and elaborated a possible specification (section 2.4.4), focused on developing a 'library' of gambits, strategies and mechanisms for influencing behaviour through design, with examples for each. This chapter explores the realisation of this specification, via an action research methodology (section 3.4.4), comprising an iterative process of developing and evaluating the toolkit (Chapter 5) through a 'spiral' *plan–act–observe–reflect* approach (Robson, 1993). Figure 4.1 illustrates how these stages map onto this chapter and Chapter 5, and the development of the toolkit through versions 0.1–0.7 (considered together), 0.8, 0.9 and 1.0. Essentially, the *reflect* and *plan* stages of the spiral, for each version of the toolkit, are in this chapter, while the *act* and *observe* stages are in Chapter 5.

Initially this chapter covers issues such as levels of abstraction, target behaviours, and mapping particular behaviours to particular design techniques, incorporating these into a series of quick iterations leading to DwI v.0.7, which is the first version of the toolkit on which external feedback (from design practitioners) is sought. Drawing on that feedback (described in Chapter 5), the next version of the toolkit is developed, prior to subsequent further evaluation, and so on. This cycle iterates the toolkit a number of times, up to DwI v.1.0:

- DwI v.0.1–0.6: Initial attempts to find a satisfactory form and taxonomy for the toolkit, including much renaming, rephrasing and regrouping of both target behaviours and design techniques, and progressions in form towards a decision tree
- DwI v.0.7: A decision tree structure based on target behaviours, with 44 design techniques grouped into five 'lenses'
- DwI v.0.8: An 'idea space' format, again based on target behaviours, with 20 diagrams, five lenses and 44 techniques

- DwI v.0.9: Poster, card and online formats, with 'inspiration' and 'prescription'modes; six lenses and 47 design patterns
- DwI v.1.0: Card, worksheet and online formats, with eight lenses and 101 design patterns; multiple modes of use

The final section of this chapter reflects on lessons from the applied workshops, user survey and case studies with v.1.0 described at the end of Chapter 5, including implications for future development.

4.1 Initial considerations: from v.0.1 to 0.7

The review of approaches to behaviour (section 2.2) delivered a large set of implications for designers—techniques for influencing behaviour which were possibly applicable through design, while section 2.4 resulted in a range of possible characteristics and formats for the toolkit, summarised in the specification (section 2.4.4).

The process of developing the toolkit comprised progressively integrating some of the insights obtained—the initial aim was not simply to include all possible behaviour change techniques and all the possible formats examined, but rather about achieving something usable which could be refined through feedback and testing (Chapter 5). Thus, initial considerations for the toolkit centred on producing a 'proof of concept' on which external feedback could be sought.

4.1.1 Reflect

As mentioned in section 2.2, at this stage, the author had been writing the *Architectures of Control in Design* blog (soon to be renamed the *Design with Intent* blog) for two years (see Preface), and had built up a spreadsheet of examples of 'design influencing behaviour in the wild', drawn from a variety of sources, including blog readers' suggestions (Figure 4.2).[1]

These had not been classified initially, but in the light of the literature review in section 2.2, an attempt was made to match examples with some of the implications identified for designers, and, following the idea of the 'Prism of TRIZ' (section 2.4.1; Gadd, 2011), extract some 'abstract' principles or common features. One initial vision was to develop something at the more structured end of the possible specifications outlined at the end of Chapter 2: a tool along the lines of the TRIZ matrix (section 2.4.1) but for human behaviour, essentially a *BehaviourTRIZ*. As such, the early versions of the Design with Intent toolkit made use of the 'Prism of TRIZ', the arc leading from specific problem→abstract general problem→abstract general solution→specific solution (Figure 2.8 in Chapter 2).

Abstraction and target behaviours

For instance—drawing from both the 'Architecture and urbanism' and 'Digital architecture' literature (section 2.2.2)—the examples of:

- "paving an area with pebbles to make it uncomfortable for barefooted protesters to congregate", as used at the University of Texas, Austin, in 1973 (Macek, 1990; Schneier, 2006)

[1] Many of these were physical, often built environment examples, and many were explicitly focused on *restricting* users' behaviour, but there were also interface and product examples, and some representing a persuasive technology approach (section 2.2.3).

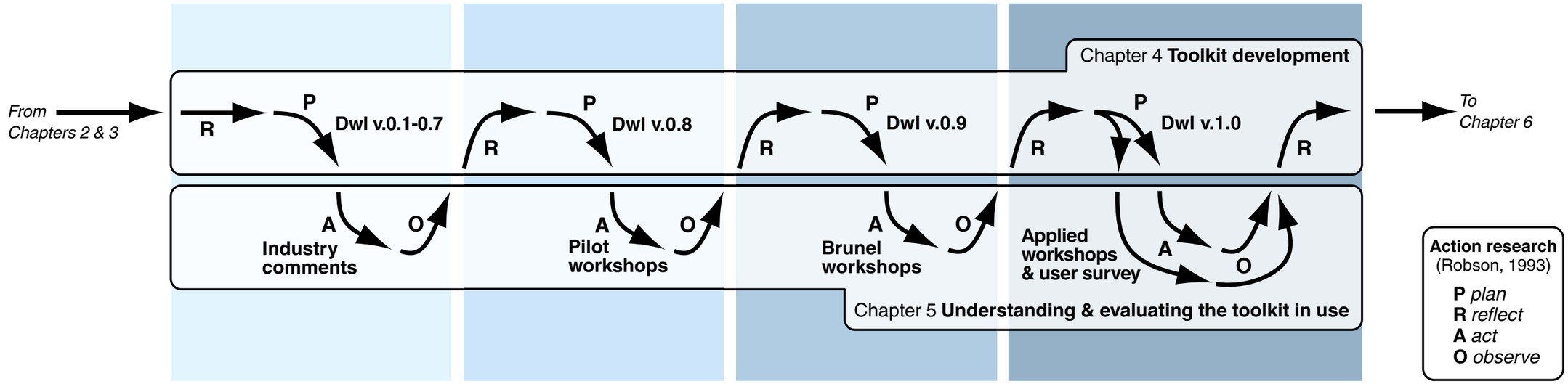

Figure 4.1: How the action research 'spiral' of *plan–act–observe–reflect* (section 3.4.4; Robson, 1993) maps onto Chapters 4 and 5, and the iterative development of the toolkit

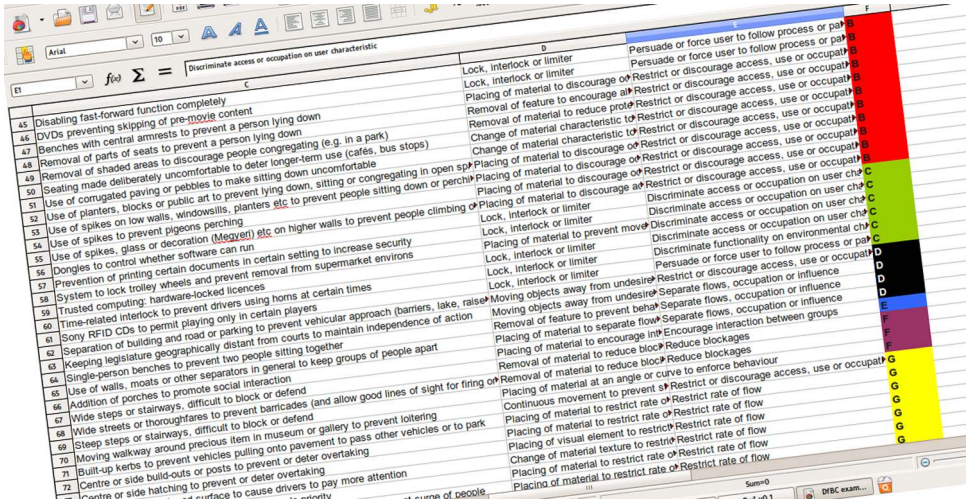

Figure 4.2: Screenshot of part of the spreadsheet of behaviour change examples compiled through the author's blog from 2005–7.

- "a hypothetical system which curtails a suspected criminal's mobility by remotely disabling a public transport pay-card" (Greenfield, 2006)

are very different specific strategies, but the abstract *intent* (the 'target behaviour') in both cases is to *restrict access* to an environment or a service, *based on some characteristic of the user*, whether that characteristic is bare feet or a data field in an ID system.

In one case the intended 'strength' of the method is fairly weak (it's more about discouragement); in the other the intended strength is high: this individual's freedom must be curtailed, and attempted circumvention must be detected. In the case of the pebbles, this solution could be described abstractly as MATERIAL PROPERTIES, which would also apply to, for example, rumble strips on a road; the technique of disabling the pay-card might be described as AUTHENTICATION-BASED ACCESS, which could also describe, say, a padlock, at least on the level of keyholder authentication rather than actual identity verification.[2]

The Prism of TRIZ—the process of abstracting from the specific example (with a specific strategy) to a general principle (both intention, and method)—can then be reversed, but with a different specific strategy in mind. As Barry et al (n.d.) note, the TRIZ matrix process can be simply described as:

> "Somebody someplace has already solved this problem (or one very similar to it.) Creativity is now finding that solution and adapting it to this particular problem. Much of the practice of TRIZ consists of learning these repeating patterns of problems-solutions, patterns of technical evolution and methods of using scientific effects, and then applying the general TRIZ patterns to the specific situation that confronts the developer."

Following the above examples, where else might a target behaviour of *restricting access based on some characteristic of the user* be useful? Other possible examples drawn from the literature and spreadsheet at this stage included, from the point of view of influencing more environmentally friendly behaviour:

[2]Note, though, that the rumble strip example does not match the access-restriction intent, instead being about making users aware of their speed; as with TRIZ, similar methods can be used to achieve different aims.

- an in-car monitoring system that adjusts the sensitivity (or the response curve) of the accelerator pedal so that a habitually heavy-footed driver's fuel use is reduced, whilst not affecting someone who usually drives economically anyway.

- a householder who throws away a lot of rubbish one week (recorded by the bin, somehow—perhaps as an extension of the unique identifier chip already introduced by some local authorities (Delgado and Cleaver, 2006)) is prevented from throwing away as much the next week—each taxpayer is given a certain allocation of rubbish per year, and this is enforced by the bin preventing itself being opened once the limit has been reached. (Increased fly-tipping would likely be a consequence!)

- less coercively—and extending the 'characteristic of the user' parameter to include characteristics of an object borne by the user (such as a key)—the circular slots and flaps on bottle banks (which make it more difficult to put other types of rubbish in—restricting access based on a characteristic of what the user's trying to put in it)

- narrower parking spaces or physical width restrictions to prevent (or discourage) wider vehicles (such as 4×4s) from being used in city centres.

All of these fit the same target behaviour of *restricting access based on some characteristic of the user*, but use different specific design techniques to do it.

As part of the process of reflecting on the literature and examples collected, this kind of rapid 'thought experiment', transposing ideas from one application to another, gave confidence that a more systematic approach along these lines—extracting abstract principles from examples and putting them in a form applicable to other problems—was worth developing further. The thinking was that while the specific strategy behind each example may be completely disparate, there were, on some levels, commonalities of *intent*—hence the name adopted for the project, *Design with Intent*.

The idea of 'target behaviours' is somewhat analogous to the 'ideal final result' concept in TRIZ (Domb, 1998).[3] The target behaviours were statements of the desired user behaviour as a result of the intervention: a specific target behaviour for a particular brief (e.g. "People comply with instructions for sorting their refuse for recycling") could be translated into a more abstract general target behaviour (e.g. "User follows process or path"). The aim was that for each general target behaviour, a range of possibly applicable techniques could be presented, all relatively abstract; the applicability of these to the specific brief could then be explored.

Mapping target behaviours and examples to design techniques: DwI v.0.1

A first step in turning the insights and examples into a 'toolkit' was to analyse examples in the context of the insights from section 2.2, mapping them both to possible abstracted target behaviours and to more abstract descriptions of the design techniques used. This then enabled 'similar'applications and contexts to be identified. Tables 4.1 and 4.2 show a small selection of this process; it was to some degree a creative process, recognising patterns in examples and principles and techniques across disciplines.

The next step was to link and cluster particular target behaviours and design techniques which were relevant to them. So, taking examples in Tables 4.1 and 4.2 for instance, Fogg's (2003) technique of TAILORING and Shingo's (1986) idea of CONDITIONAL WARNING poka-yokes are both relevant to the target behaviour *Users follow a path or process optimised for context or conditions*, as evinced by the personalised / tailored

[3] The term 'target behaviour' has existing currency in the field of applied behaviour analysis, and has also been used by Fogg (2003, 2009a), although with a different emphasis.

Table 4.1: Selection of 'behaviour change' examples with target behaviours abstracted, and analogous situations noted.

EXAMPLE	SPECIFIC TARGET BEHAVIOUR	ABSTRACT TARGET BEHAVIOUR	ANALOGOUS SITUATIONS
Staggered pedestrian crossings arranged so that pedestrians are turned to face oncoming traffic rather than having their back to traffic (Department of Transport, 1995)	Pedestrians turn at the right moment so they see traffic coming towards them	*Users follow a path or process, performing actions in a specified sequence*	e.g. pre-flight safety checks; using a ticket machine; using an ATM, buying something using a website.
Air conditioner with a light indicating if it's colder outside than inside (hence opening the window would be more efficient) (Becker & Seligman, 1978)	People switch off the air conditioner when it's not needed	*Users follow a path or process optimised for context or conditions*	e.g. car seatbelt warning lights; tailored exercise programmes; personalised home energy efficiency advice; software wizards.
Classroom seating arranged in groups of seats facing each other rather than in rows, making group work and discussions easier	Students work together, interact and talk to each other	*Users interact or cooperate with each other*	e.g. suggested follows on Twitter; Niedderer's 'Social Cups' (2007); Torres' 'Your turn' washing machine (Phillips, 2005); BitTorrent defaults to promote seeding

Table 4.2: Selection of 'behaviour change' examples with design techniques abstracted, and analogous examples noted.

EXAMPLE	DESIGN TECHNIQUE	ANALOGOUS EXAMPLES
Washing machines with a default temperature setting of 30° or less, to reduce energy use because many people will not change the setting	DEFAULTS (see section 2.2.3)	e.g. printer dialogue boxes where duplex printing is the default; software nag screens where receiving information on licensing is the default; countries where organ donation is the default
Automatic warning signs alerting drivers to upcoming dangers (or their own speed) at the right point for them to respond and slow down accordingly	KAIROS (information or feedback at 'just the right moment': Fogg (2003); see section 2.2.3)	e.g. cigarette packets designed so that smokers see images of disease at the point of use; a mobile app which uses GPS to suggests jogging just as you reach the park
Amazon's recommendations of other books or products buyers might be interested in, based on what's popular with people with similar browsing histories (and hence perhaps similar interests)	SOCIAL PROOF (see section 2.2.2)	e.g. OPOWER's energy bills showing neighbours' usage (Allcott, 2010); bestseller lists used as a marketing tool

programme examples and the warning light examples respectively—very different techniques, but both potentially useful in influencing users to follow a process optimised for the conditions. Thus, these are two design techniques relevant to this target behaviour. Of course, it is a many-to-many mapping: there are other design techniques relevant to this target behaviour, and other target behaviours relevant to these design techniques.

This process was followed for a subset of examples and design techniques, to produce a rough mapping (Figure 4.3), with a set of 10 abstract 'general' target behaviours mapped to design techniques tentatively grouped into categories. The process—labelled 'Design with Intent' (DwI) v.0.1 (Lockton, 2008a)—was:

1. Assuming you have a 'problem' involving the interaction between one of more users, and a product, system or environment (hereafter, the system), the first stage is to express what your intended target behaviour is. What do you actually want to achieve?

2. Attempt to describe your intended target behaviour in terms of one of the general target behaviours for the interaction, listed in the table. Your intended target behaviour may seem to map to more than one general target behaviour: this may mean that you actually have two 'problems' to solve.

3. You're presented with a set of techniques—loosely categorised as physical, psychological, economic, legal or structural—which, it's suggested, could be applied to achieve the general target behaviour, and thus your intended target behaviour. Some techniques have a narrow focus, dealing specifically with the interaction between the user and the system, and some are much wider in scope, looking outside the immediate interaction. Different techniques can be combined, of course: the idea here is to inspire 'solutions' to your 'problem' rather than actually specify them.

To check whether—and how—this sort of structure could work, it was applied to a 'problem' which had been a recurring topic on the blog, and for which a variety of known 'solutions' already existed: preventing people sleeping on park benches. Lockton (2008a) discusses the problem, and applies DwI v.0.1 to generate possible solutions—both aspects are controversial, but do represent an everyday example of design being used to influence behaviour for socially-related reasons. The choice of such a negative example for demonstrating this early version of the toolkit—where almost all the 'solutions' suggested are anti-user and generally unfriendly—reflects where the author's 'architectures of control' research came from in the first place.

As such, this was not intended to be a vision of how the project would progress, but rather a test of whether the toolkit being developed could be applied to a problem that had already been explored in previous research. From this perspective, it showed some promise, although the abstract descriptions of target behaviours were overly formal, perhaps self-consciously imitating TRIZ. Also, at this stage, the set of techniques (and the classification of them) did not by any means represent the full variety of strategies available to designers (section 2.2).

DwI v.0.2 – v.0.6

The subsequent stages of evolution of DwI, prior to v.0.7, were not developed into complete 'systems', but rather continued the attempts to find a satisfactory form and taxonomy for the toolkit, including much renaming, rephrasing and regrouping of both target behaviours and design techniques, and progressions in form towards a decision

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v 0.1: Jan 2008

Mechanism type	Narrow scope	Wider scope
Physical		
Psychological		
Economic		
Legal		
Structural		

Mechanism type	Narrow scope	Wider scope
Physical		
Psychological		
Economic		
Legal		
Structural		

Mechanism type	Narrow scope	Wider scope
Physical		
Psychological		
Economic		
Legal		
Structural		

Mechanism type	Narrow scope	Wider scope
Physical		
Psychological		
Economic		
Legal		
Structural		

General Target Behaviours
for user interaction with the system

A1: Access, use or occupation based on user characteristics

A2: Access, use or occupation based on user behaviour

B: No access, use or occupation, in a specific manner, by any user

C: User provided with functionality only when environmental criteria satisfied

D: Separate flows and occupation; users have no influence on each other

E: Interaction between users or groups of users

F: No user-created blockages or congestion caused by multiple users

G: Controlled rate of flow or passage of users

H: User follows process or path

I: User pays the maximum price which still results in a sale

•••
•••
•••

etc

etc

etc

B: No access, use or occupation, in a specific manner, by any user

Mechanism type	Narrow scope	Wider scope
Physical	Placing of material – to interrupt surface – to cause injury – to block entry/access Change of material characteristic – bulk mechanical properties (strength, stiffness, hardness, etc) – surface treatment or texture Movement or oscillation – powered or driven – introduction of extra degrees of freedom Spatial – moving objects apart or away – segmentation into multiple objects Orientation of material – introduce angled surfaces – introduce curvature Change of environmental characteristic – local temperature change – local illumination change – local audio change etc (more are possible - most obviously, digital / electronic analogues of some of the above, and other mechanisms, especially from the field of security)	Placing of material – to interrupt surfaces on approach to system – to cause injury on approach to system – to block entry/access on approach to system
Psychological	Reduction in subjective attractiveness of system – use of 'warning' aesthetics (colours, patterning, form/texture, sounds, smells, tastes) – use of form, labelling or signage to create unattractive perceived affordances (real or not) – using non-interaction by attractive other users to influence decision on interaction – using interaction by unattractive other users to influence decision on interaction Social proof applied to system – using deliberate non-interaction by other similar users to influence decision on interaction – using deliberate interaction by other dissimilar users to influence decision on interaction Authority applied to system – use of perceived authority to influence decision on interaction Surveillance (real or perceived) and use of pressure of social norms – surveillance by authority or enforcement figures – surveillance by members of the public – making interaction publicly visible through the use of alarms, visual indicators, displays, etc etc (many, many more are possible - generally, exploiting cognitive biases or heuristics to influence user behaviour - including many advertising techniques)	Increase in subjective attractiveness of alternative systems – use of 'liking' aesthetics (colours, patterning, form/texture, sounds, smells, tastes) – use of form, labelling or signage to create attractive perceived affordances (real or not) – using interaction by attractive other users to influence decision on interaction – using non-interaction by unattractive other users to influence decision on interaction Social proof applied to alternative systems – using deliberate interaction by other similar users to influence decision on interaction – using deliberate non-interaction by other dissimilar users to influence decision on interaction Authority applied to alternative system – use of perceived authority to influence decision on interaction Psychological assistance to remove need for user to perform interaction at all etc (many, many more are possible - generally, exploiting cognitive biases or heuristics to influence user behaviour - including many advertising techniques)
Economic	Financial incentives (rewards) for not performing interaction with system – monitored, i.e. requiring human or technological surveillance – not monitored Financial penalties (fines) for performing interactions with system – monitored, i.e. requiring human or technological surveillance – not monitored etc	Financial incentives (rewards) for performing interaction with alternative system – monitored, i.e. requiring human or technological surveillance – not monitored Financial penalties (fines) for not performing interactions with alternative system – monitored, i.e. requiring human or technological surveillance – not monitored Financial assistance to remove need for user to perform interaction at all etc
Legal	Threat of punishment Increasing perceived likelihood of punishment etc (I have not considered specific legal mechanisms at this stage)	Increasing enforcement in general Legal assistance to establish alternative systems Legal assistance to remove need for user to perform interaction at all etc
Structural	Removal of system entirely	Provision of alternative systems Removal of societal need for this kind of interaction with system altogether

Figure 4.3: The form of DwI v.0.1—a set of general target behaviours and sets of techniques (or 'mechanisms'), with mappings between them

tree (see section 4.12 below). Where features of these intermediate versions were retained in later versions (v.0.7, 0.8, 0.9 and 1.0), they are explained in detail later in this chapter, to avoid duplication.

4.1.2 Plan

The plan was to develop the DwI toolkit to a 'proof of principle' stage where it was ready to be presented externally—to a design consultancy with an interest in behaviour change—to get feedback on its form and content, and suggestions on how to develop it further. By v.0.7, enough elements were in place for DwI to be presented in this way.

Sections 5.1.1 and 5.1.2 (in Chapter 5) describe the 'act' and 'observe' phases of the action research process—introducing the toolkit to live|work, a service design consultancy, and their comments and suggestions. Section 4.1.2 here introduces the structure of DwI v.0.7.

An overview of DwI v.0.7

DwI v.0.7 was presented as a 'generative suggestion tool' in the form of a decision tree (Figure 4.4), following more closely some of the possible specification elements outlined at the end of Chapter 2. It was intended to be a structured 'suggestion engine', where a target behaviour is put in one end, and a range of applicable design techniques come out of the other.

Higher-level target behaviours, in the form "We want to..." were the starting point for using DwI—whatever the brief, as long as it could be expressed in terms of one of the four example higher-level target behaviours included at this stage, the process could be followed, specifying the target behaviour more fully using more specific lower-level target behaviours, for each of which a number of applicable techniques were suggested (grouped into different approaches, or *lenses*).

Introducing lenses

A metaphor was introduced to describe the five approaches: the *lens*, partially inspired by the concept (if not the details) of Brunswik's (1956) lens model for understanding perception. The idea here was that each lens represented a 'viewpoint' or 'worldview' of human behaviour and how to influence it—'looking' at a problem 'through' each lens in turn would suggest a different set of design techniques to apply to the problem, much as each of the disciplinary perspectives on behaviour outlined in section 2.2 had a different set of insights for designers. The idea has some parallels with de Bono's *Six Thinking Hats* as explained in section 2.4.1.[4]

Rather than just being a way of classifying the techniques, the lenses thus introduced a more active suggestion to "try looking at the problem like this", intended to spur designers to think outside the immediate frame of reference suggested by the brief (or the client). The five lenses—called *system element*, *poka-yoke*, *persuasive interface*, *cognitive*

[4] Although the author arrived at the idea independently, the lens metaphor has some precedent in a related context—game design—with Jesse Schell's *The Art of Game Design: A Book of Lenses* (2008) which was also accompanied by a pack of cards. Schell's 100 lenses for game design (examples: "Lens #18: The Lens of Flow"; "Lens #68: The Lens of the Hero's Journey") use the metaphor in the investigatory sense: "The lenses are small sets of questions you should ask yourself about your design. They are not blueprints or recipes, but tools for examining your design ... [E]ven though we can't have one complete picture, by taking all of these small imperfect lenses and using them to view your problem from many different perspectives, you will be able to use your discretion to figure out the best design" (Schell, 2008). Schell's lenses have since inspired 'Designing with Lenses' (Scott et al 2010), a website aiming to apply the same structure to concepts in user experience and interaction (primarily web) design.

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Generative suggestion tool

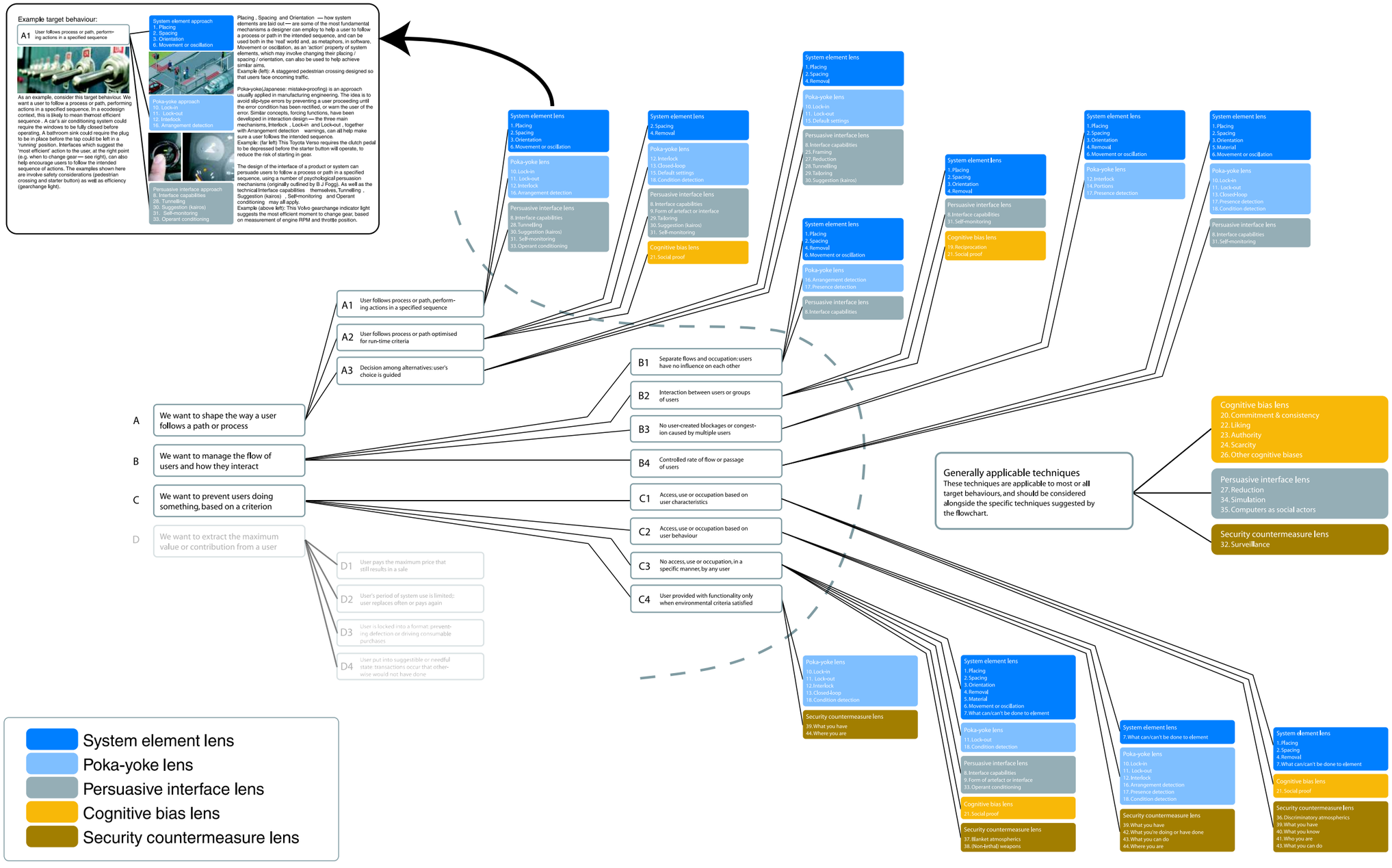


Figure 4.4: The overall structure of DwI v.0.7

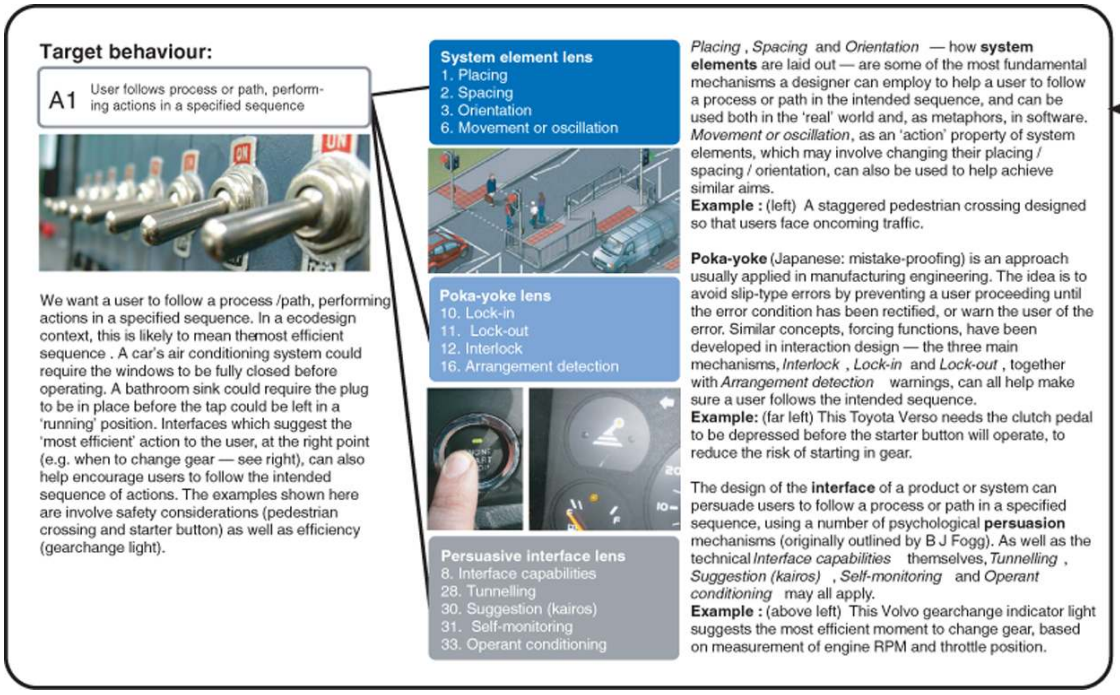


Figure 4.5: A close-up of the 'callout box' for the A1 target behaviour in DwI v.0.7.

bias and *security countermeasure*—contained between them 44 techniques, nine of which were suggested as being potentially applicable to all of the target behaviours.

The graphic presentation as a tree (Figure 4.4) was intended to be followed by a hyperlinked interactive version, where clicking on each technique or group of techniques would expand a 'callout box' with more detailed information and examples of how to apply the technique in the context of that target behaviour (Figure 4.5 shows an example of this for the lower-level target behaviour of "User follows process or path, performing actions in a specified sequence"—getting someone to do things in a particular order. In the event, this was prototyped with a paper version where the callout boxes were (literally) unfolded to reveal their content, and with a similar version where the extra information and illustrations were contained in transparent plastic folders, one for each lens.[5]

4.2 Design with Intent: from v.0.7 to v.0.8

Following the feedback from live|work, described in section 5.1.2, it was decided to reconfigure the 'decision tree' format of DwI v.0.7 into an 'idea space' diagram, presenting designers with a set of relevant possible techniques rather than implying definitive solutions to each problem, as well as addressing other points made by live|work. Once developed, the new version of the toolkit could be be trialled via pilot workshops, with participants given a 'sustainable' behaviour change brief, and asked to apply the techniques suggested by the diagrams.

The following sections reflect on applying some of the insights from the live|work

[5] A series of blog posts exploring applying v.0.7 to the target behaviour as mentioned above were published online in May 2008 (Lockton 2008b). This series was subsequently used as assigned reading material for a graduate class on 'Persuasive Technologies: Designing the Human' run by Kati London, as part of the Interactive Telecommunications Program (ITP) at New York University's Tisch School of Arts, with students producing short blog posts in response, fitting the ideas into a wider programme of debate around the possibilities and implications of persuasive technology.

feedback, and the plan of how they were incorporated into the next version of the toolkit, DwI v.0.8, prior to the pilot workshops (section 5.2).

4.2.1 Reflect

> "What a person *cannot* do he *will not* do, no matter how much he wants to do it."
>
> Herbert A. Simon, *The Sciences of the Artificial*, 1969 (p.36 of 1981 MIT press 2nd edition)

One element which arose during discussion with live|work was the (lack of) distinction in DwI v.0.7 between the relative 'force' of each technique: the 'persuasion–coercion' spectrum as described in section 2.1.3 of this thesis. While this was inherent to some extent in the distinction drawn between, for example, the *persuasive interface* and *security countermeasure* lenses, this was not necessarily as explicit as it could be. The author considered that a more nuanced treatment than a simple 'spectrum of control' was desirable (as covered in section 2.1.3) yet it needed to be presented simply as part of the toolkit.

In July 2008, the author was invited to present his research thus far at the New Sciences of Protection: Designing Safe Living conference at Lancaster University, an event concentrating on "[the concept of] 'protection' at the intersections of security, sciences, technologies, markets and design" and the sociotechnical and political implications of technology which aims to change or affect what people can do—primarily, government-led interventions for 'people's own good'. In preparation for presenting the Design with Intent project to a more theoretically focused audience, primarily from an science and technology studies (STS) background, it seemed appropriate to use a classification system which very clearly linked influencing user behaviour to the 'protection' concept, but also showed how design can be used to influence behaviour through encouraging and helping users.

Thinking along these lines, a simple but fundamental categorisation emerged (Figure 4.6): all approaches to influencing behaviour are either about trying to get people *to do something*, or trying to get people *not to do something*; and the ways to do that are either about changing how easy or difficult it is to do, or making it so people want to do (or not to do) it. This is primitive, and probably not complete, but as a very simple way of categorising the techniques, joining these (Figure 4.7; Table 4.3) to give *enabling*, *motivating* and *constraining* approaches creates a quick way to assess any brief and the relevant techniques.

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:

- making the target behaviour easier for a user to do
- making an undesired behaviour harder to do (which may be concomitant effects, but not necessarily)
- trying to get users to want to perform or not perform a particular behaviour

can be a useful first step. *Central route persuasion* (Petty & Cacioppo, 1981; see section 2.2.3) along with much work in Persuasive Technology is about *motivating* behaviour,

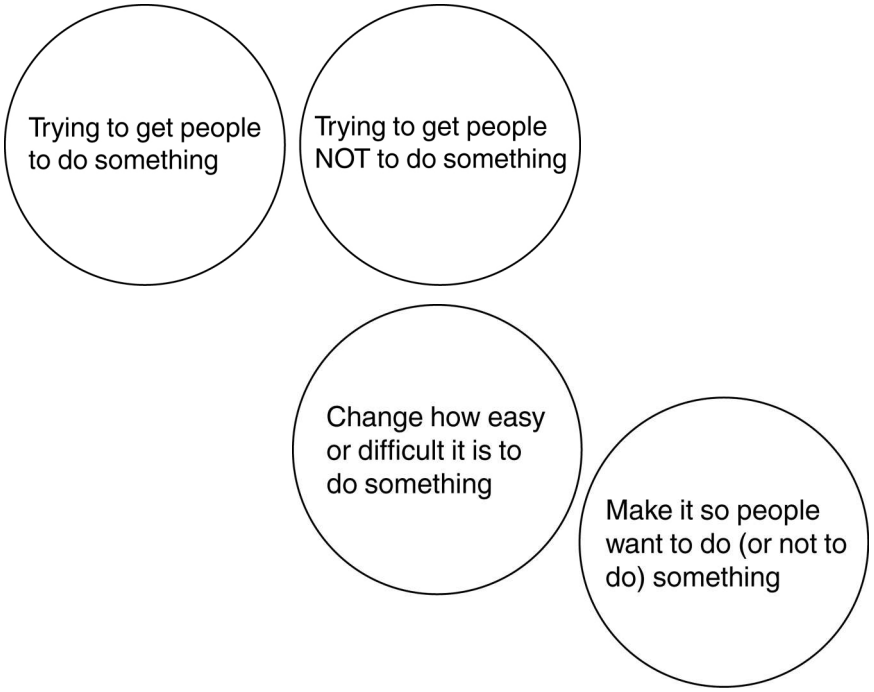


Figure 4.6: "All approaches to influencing behaviour are either about trying to get people to do something, or trying to get people not to do something; and the ways to do that are either about changing how easy or difficult it is to do, or making it so people want to do (or not to do) it."

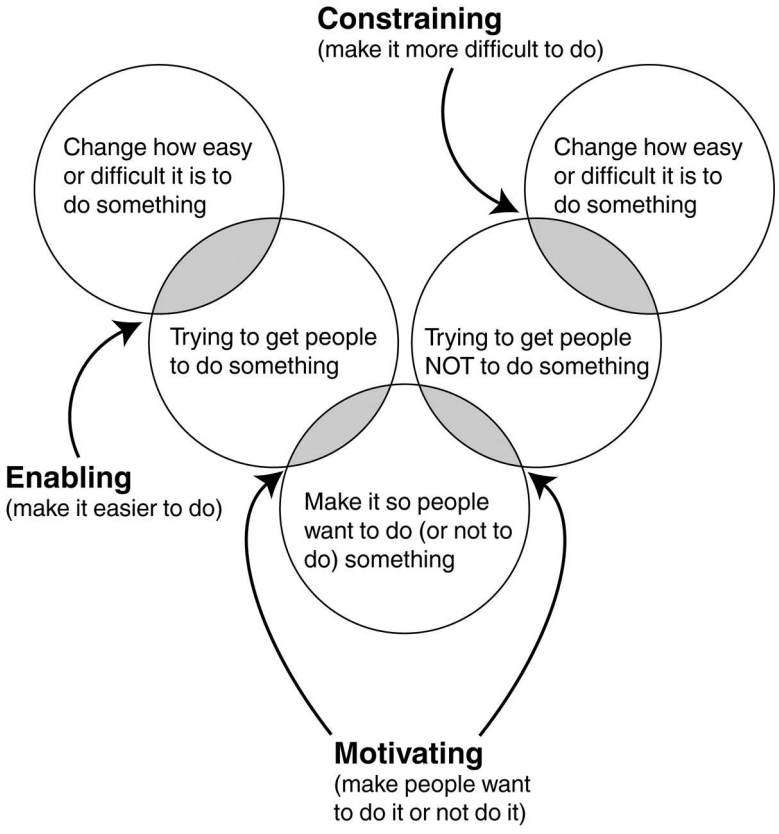
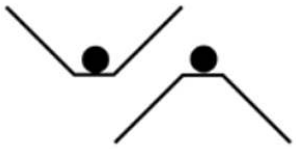
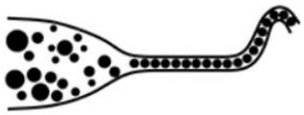


Figure 4.7: Joining the approaches from Figure 4.6, enabling, motivating and constraining emerge as a quick way to assess any brief and the relevant techniques.

Table 4.3: Three approaches to influencing behaviour by design, with simple icons

Enabling behaviour 	Enabling 'desirable' behaviour by making it easier for the user than the alternatives
Motivating behaviour 	Motivating users to change behaviour by educating, incentivising or changing attitudes
Constraining behaviour 	Constraining users to 'desirable' behaviour by making alternatives difficult or impossible

with attitude change either a precursor or a result, but Fogg's REDUCTION and TUNNELLING (Fogg 2003) are arguably also *enabling* particular behaviours by making them simpler (Maeda, 2006). Buckminster Fuller's 'trimtab' concept— "modify[ing] the environment in such a way as to get man moving in preferred directions" (Krause and Lichtenstein, 2001)—is also close to the enabling approach, and links to the wider field of design for social benefit. Strategies aimed at influencing health & safety behaviour often employ a constraining approach; Beatty's (2008) 'taxonomy for persuasive technologies in human factors engineering' includes this via incorporating Norman's (1988) *forcing functions*. (see section 2.2.2).

For any target behaviour, a designer could potentially consider tackling it 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 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, but the intention was also that a designer could bear the distinction between the approaches in mind in advance, while thinking about each relevant design technique, how it might be applied, and how users might react.

So a parallel aspect was considered for addition to DwI v.0.8, inviting designers to consider the enabling, motivating or constraining approach throughout the design process. In the next section, Figure 4.10 shows the complete process, including the other elements of DwI v.0.8.[6]

[6]It should be noted here for completeness that an 'enabling / motivating / constraining' classification has also been proposed (independently) by Kitching et al (2008) for analysing the ways in which government regulation affects small businesses: "Regulation enables agents to achieve their aims by

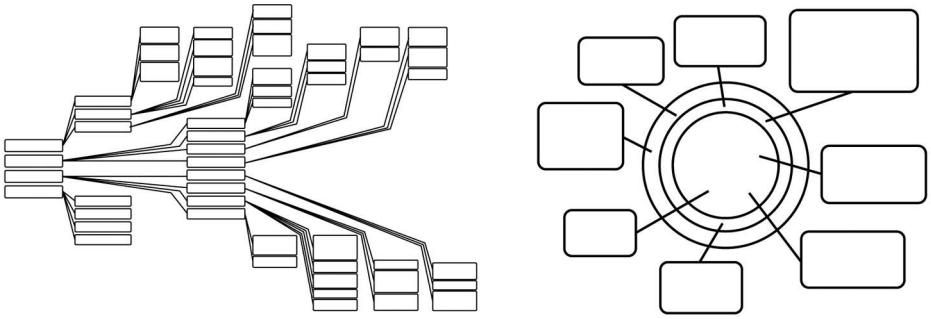


Figure 4.8: Decision tree structure compared with idea space diagram.

4.2.2 Plan

Planning how to apply the main recommendation from live|work (section 5.1.2), the concept of the 'idea space', the most obvious solution was a set of radial 'callout' boxes, each describing a design technique, mapping onto a central hub representing the 'problem space'—in this case, the target behaviours.

A simple way of doing this was to transpose the elements of the v.0.7 tree into a new diagram, as Figure 4.8 shows. The concentric circular configuration had a pleasing visual parallel with the 'lens' terminology (see section 4.1.2). This configuration also had the benefit of allowing the many techniques which were applicable to more than one target behaviour to be listed and described only once, mapped onto multiple target behaviours, rather than repeating the descriptions as in the tree structure.

However, given the 15 target behaviours identified at this point, mapping onto 44 techniques, a single diagram including illustrations and descriptive text for every technique would have been too large. So it was decided to produce a 'suggestion diagram' for each pairing of lens and higher-level target behaviour. This made 20 diagrams in total, but if working on only one target behaviour, a designer or design team would only need to look at the 5 diagrams corresponding to the behaviour of interest—one for each of the 5 lenses. At the same time, the system element and cognitive bias lenses were renamed *system architecture* and *heuristics & biases* respectively in an attempt to clarify their scope somewhat. Table 4.4 shows the short descriptions given for each lens.

To simplify the process of deciding which target behaviour applied, the descriptions were grouped, as shown in Table 4.5: *Paths*, *Flows*, and *Locks*. [7]

As with the decision tree in v.0.7, the suggestion diagrams were produced in a poster format, in this case A2 size to make it easy for a designer (or a team) to see all the ideas without turning or shuffling pages. Figure 4.9 reproduces one of them,' the Paths, System Architecture lens (in a slightly more space-efficient format than was actually used), with the P1 target behaviour highlighted to make it clearer how the diagrams are used.

In this case, all the System Architecture techniques—POSITIONING & PROMINENCE, SEGMENTATION & SPACING, ORIENTATION, REMOVAL and MOVEMENT & OSCILLATION—are relevant to P1, hence all the concentric rings are populated for the P1 sector

making certain actions possible; it motivates by incentivising agents to act in particular ways rather than others; and it constrains agents by limiting their scope for action." While these are very different contexts, the parallels are clear.

[7] At this stage, Fogg had not yet published his Behavior Grid (Fogg 2009a) which also uses the 'Paths' title for a different kind of target behaviour. Heath and Heath (2010) have also used 'Path' within a behaviour change context, although again with a different meaning.

Table 4.4: The five lenses of DwI v.0.8

LENS	SHORT DESCRIPTION OF VIEWPOINT EMBODIED
System architecture lens	Change a system's layout and structure to influence user behaviour—physical elements, or metaphors for them (e.g. in software or service contexts). Based on a range of *contextual* concepts, discussed throughout section 2.2.2.
Poka-yoke lens	'Error-proof' the system. As employed in manufacturing and medical device design, treat deviations from target behaviour as 'errors' which trigger warnings or are prevented by the system. Based particularly on concepts discussed in section 2.2.2.
Security countermeasure lens	Monitor and restrict users based on characteristics of their behaviour, or of the users themselves. Based particularly on concepts discussed in section 2.2.2.
Persuasive interface	Use a system's interface, and the information/ feedback provided through it, to persuade users to change their behaviour. Based particularly on concepts discussed in section 2.2.3.
Heuristics & biases	Recognise that users are influenced by cognitive biases and heuristics and make use of these to influence behaviour, or help counter them where they lead to 'undesirable' behaviour. Based particularly on concepts discussed in section 2.2.3.

Table 4.5: Target behaviour groups for DwI v.0.8, with examples

PATHS GROUP: Shape the way that a user follows a path or process		
P1	User follows process or path, performing actions in a specified sequence	Example: customer places order via website without missing out any steps
P2	User follows process or path optimised for run-time criteria	Example: User fills/boils kettle with right amount of water
P3	Decision among alternatives: user's choice is guided	Example: Diners choose healthier meal in office canteen
FLOWS GROUP: Manage the flow of users and how they interact		
F1	Separate flows and occupation: users have no influence on each other	Example: Traffic follows one-way system into/out of car park
F2	Interaction occurs between users or groups of users	Example: Staff from different departments mix socially in atrium
F3	No user-created blockages or congestion caused by multiple users	Example: Wide pedestrian concourses prevent groups blocking passage for others
F4	Controlled rate of flow or passage of users	Example: Visitors to popular museum exhibit routed past it slowly on moving walkway
LOCKS GROUP: Prevent users doing something, on some criteria		
L1	Access, use or occupation based on user characteristics	Example: Only users who know PIN can access bank account via ATM
L2	Access, use or occupation based on user behaviour	Example: If driver speeding, next traffic lights turn red, else green
L3	No access, use or occupation, in a specific manner, by any user	Example: Park bench fitted with central armrest to prevent anyone lying down
L4	User provided with functionality only when environmental criteria satisfied	Example: Office lighting cannot be switched on if ambient daylight adequate

Positioning & prominence

This is the most fundamental of all the design techniques: simply, the way that things are physically positioned affects how people behave when using them.

Positioning/prominence may be implemented as simply as arranging elements (functions, buttons, shops, products on shelves — effectively, anything) in a particular arrangement or sequence, so that a user interacts (sees / notices / experiences / uses) them in the 'right' order, or at the 'right' time. This might involve actually hiding one element behind another so that the first 'must' be dealt with before progressing to the next (or only displaying the second element once the first has been dealt with), but often this is not necessary: users will tend to interact with elements in a predictable sequence, at least where it is clear which direction the sequence is meant to progress (compare reading directions in different alphabets, for example, and the effect this has on the layout of interfaces).

Positioning can also involve arranging elements to 'channel' users, enforce priority, or block certain types of users (or vehicles for example) — walls, turnstiles and guard rails are obvious architectural examples, but there are more subtle ones too, such as the layout of some casinos, in which winners are 'funnelled' past many lures on their way to a single cashier.

Orientation

Orientation is necessarily related to positioning/prominence and segmentation/spacing — the relative angle or attitude of system elements can influence the way users interact with them.

A trivial example is the use of angled walls to 'funnel' pedestrians along a particular path into an area. Staggered pedestrian crossings can ensure users turn to face the direction of oncoming traffic, using the changing orientation of the walkway to change users' orientation. Angled surfaces, litter bins and benches make it more difficult to place objects on them, or to lie down.

Removal

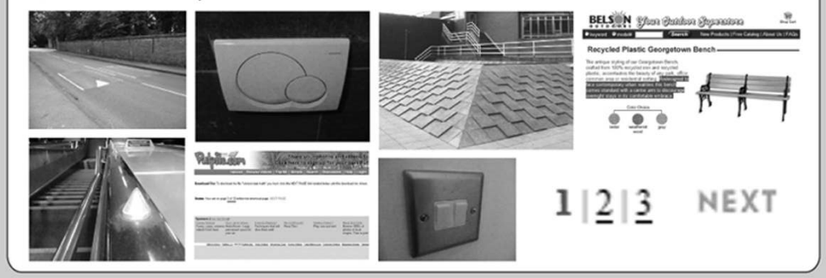
One of the simplest techniques for influencing user interaction with a system is to remove or disable elements which would otherwise lead to particular behaviour. If they're not present, people can't choose/use/interact with them.

Removal of elements can also be used to increase the transparency of a system, by making it easier for users (or other people) to see the consequences of their actions (and thus change their behaviour in response), or to slow users down — increasing the amount of decisions they need to make — by removing cues on which they previously relied. See also **Reduction** and **Tunnelling**.

Segmentation & spacing

Segmentation — dividing an object into multiple elements, and spacing — deliberate separation of elements in space, can be used strategically to influence users' behaviour interacting with a system.

Sometimes segmentation/spacing can be used to increase the number of ways of interacting, or to allow users to interact with each element individually, but it can also prevent certain interactions by breaking up an object so it can't all be used at once, or can't be used by certain classes of users, or in a particular manner, or so interactions have to occur in a certain order, or to prevent users interacting with each other. The same effect can be used in reverse: removing spacing, or integrating segmented elements, can also be used intentionally.



Movement & oscillation

Movement or oscillation may involve changing the positioning/spacing/orientation of system elements, and can be applied in a physical or metaphorical sense to influence user behaviour.

A moving indicator which guides the user through a process or sequence, or indeed, brings system elements which require interaction to the user (or routes them past), encourages (or forces) following procedures in the 'right' order, for example; an escalator prevents people loitering or sitting on it as well as giving pedestrians a rest. Movement can also draw users' attention to particular elements of a system.

Consider this technique as a dynamic implementation of positioning/spacing/orientation: it has the potential to shape even more fully the way in which users are exposed to objects or functions, or what affordances are available to them. The most obvious examples are conveyors on production lines, bringing components or products to stationary workers in the right sequence, and thus removing the need for the worker to remember the sequence, but even museum exhibits such as the Crown Jewels may be displayed in a rotating or constantly moving case, which reduces the possibility of undesired interactions.

Paths

System architecture

Paths, System Architecture lens

Target behaviour highlighted: P1 User follows process or path, performing actions in a specified sequence

Figure 4.9: DwI v.0.8—System architecture lens suggestion diagram for Paths, with P1 sector highlighted.

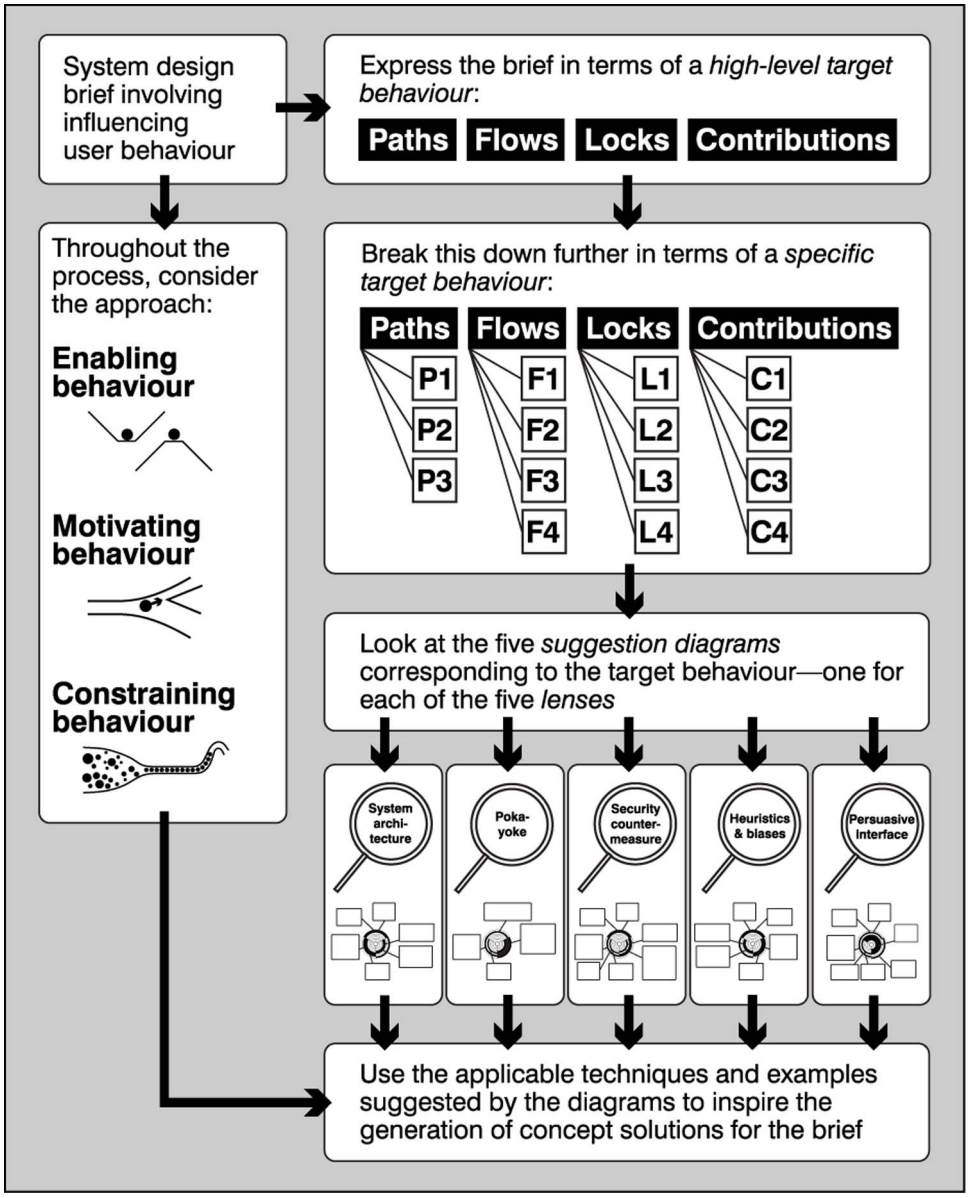


Figure 4.10: The intended process for using DwI v.0.8, with two parallel routes

of the diagram, but for P3 (for example), only SEGMENTATION & SPACING and REMOVAL are applicable, hence only those two rings are shown.

Figure 4.10 outlines the overall procedure for using the diagrams, including the parallel element of considering enabling, motivating or constraining behaviour (see section 4.2.1).[8]

The plan was to trial this version of the toolkit through a limited number of 'pilot' workshop sessions, primarily to test its usability. The method is described in section 3.5.1, while the details of the sessions themselves, and the results, are covered in sections 5.2.1 and 5.2.2, and **[C2]**.

[8] *Contributions* was an extra group of target behaviours, not developed further at this point.

4.3 Design with Intent: from v.0.8 to v.0.9

Section 5.2 describes the pilot study workshop sessions run with DwI v.0.8, which aimed primarily to help assess the usability of the toolkit structure, enabling the design to be developed further prior to subsequent application in larger workshops and subsequent public release. In this section, insights from section 5.2 are reflected upon, and revisions to the toolkit, to produce DwI v.0.9, planned.

4.3.1 Reflect

The initial pilot study sessions described in section 5.2 were very limited tests of the toolkit. The sessions did suggest that the DwI toolkit allows a designer to generate concepts in response to briefs about environmentally relevant behaviour, but the sample size was very small. The extent to which participants were initially guided by the categories and classifications, but felt free to merge or ignore them, is indicative of how the DwI toolkit or similar methods might be used by designers in practice: it ideally needs to be usable for both *inspiration* and *prescription* (Table 5.2 in Chapter 5).

Recommendations for improving the DwI toolkit included:

- Reduction in overall complexity of the toolkit so it is quicker to understand and apply
- Simplification of categories: the lenses seem to be easier to understand than the enabling / motivating / constraining approach distinctions
- More succinct (e.g. bulletted) descriptions of techniques, maybe with more familiar 'everyday' names or examples alongside specialised terminology
- Suggestion diagrams or similar should highlight applicable techniques more clearly
- Rethink of the target behaviour groups and the mapping of target behaviours to applicable techniques
- Provision for the method to be used more easily in either prescription or inspiration 'modes', with or without using target behaviours

In the next iteration of the toolkit, v.0.9, described in section 4.3.2, these points were addressed, along with other improvements.

During the development of v.0.9, the author was invited by the Royal Society for the encouragement of Arts, Manufactures and Commerce (RSA) to produce a simple reference on design techniques for behaviour change, which could be used as background material by students entering the 2009-10 RSA Design Directions competition (in which a number of the briefs related to influencing behaviour for social benefit).

It was decided that the most accessible form for this would be an online version of the toolkit as a series of WordPress blog posts and a downloadable poster. Producing a full online version of DwI, to accompany the blog, had always been part of the development plan, but the RSA's request brought this aspect forward, and made this use-case an additional criterion for the planning of v.0.9.[9]

[9] As a result of putting the material online, and significant interest from a number of designers and design and user experience-related blogs, the toolkit poster (hosted by Brunel's archive site, BURA, after the first few weeks), received around 30,000 downloads from May-December 2009. Anecdotally, the poster has been displayed in design studios at a number of companies, including Engine, Onzo and Nokia. Collaboration with the RSA continued, and subsequent workshop sessions using DwI are covered in Chapter 5.

4.3.2 Plan

In planning revisions to the toolkit, the recommendations listed in section 4.3.1 were taken as a specification. The overall goal was reduction in complexity, while still preserving the ability to use the toolkit in both *prescription* and *inspiration* 'modes' (section 5.2.2), and improving the coverage of the behaviour change methods included. The following sections outline the changes and the reasoning behind each of them.

One additional change, not arising from the pilot study sessions, but from further consideration of the literature discussed in section 2.4.2, was the introduction of the term *pattern* to describe the design techniques making up the toolkit, since it was felt that the structure of DwI was moving more closely towards the 'design pattern' approach exemplified by Tidwell (2005), Crumlish & Malone (2009) and others, where 'archetypal' examples of particular techniques act as both a description of the technique and a demonstration of its real-world application.

Inspiration and prescription modes

The toolkit was redesigned to make it explicit that it can be used in either inspiration or prescription modes. The inspiration mode was intended to be a simpler way of navigating the techniques—now renamed patterns—by presenting designers with a set of 12 'headline' patterns applicable to a wide range of target behaviours, grouped into six lenses. Reducing the patterns immediately visible to just 12 was intended to make them quicker to understand and apply—giving designers a rapidly applicable 'flavour' of each lens which could be investigated in more depth if desired.

Drawing on the approach used by Tidwell (2005) and Crumlish & Malone (2009) in particular (see section 2.4.2), the patterns were summarised with a title, a one-sentence 'tagline', two short bullet-pointed paragraphs, and one, two or three photographs or screenshots to illustrate examples of the pattern (Figure 4.12). As Fincher (2009) describes it, including DwI v.0.9 in her 'HCI Pattern-Form Gallery' (see section 2.4.2):

> "Each 'pattern' has a name, followed by a quote—or speech snippet—apparently to explain, or illustrate the name (so INTERLOCK is followed by 'that doesn't work unless you do this first'). Then there are two paragraphs which describe the intent. These are followed by examples, which are always formed of a photograph and a textual description of what the photograph shows."

The use of relatively simple illustrated examples was intended to allow designers to understand and recognize the patterns quickly—and relate them to the problem at hand, even where the terminology is unfamiliar. This kind of pattern recognition can be an important component of decision-making for experienced designers; as Cross (2004) puts it, specifically in this context, "a key competency of an expert is the ability mentally to stand back from the specifics of the accumulated examples, and form more abstract conceptualisations pertinent to their domain of expertise."

Figure 4.13 shows the 'idea space' poster **[A1]** produced for use in trials with designers, together with a detailed view of one of the headline patterns from the Cognitive lens, SOCIAL PROOF. The remaining 35 patterns not included on the poster were presented on separate sheets for each lens, and also online.

In prescription mode, the plan was for designers to be able to formulate the brief in terms of one or more of the target behaviours, from a list of 11 provided (Table 4.6). The Paths, Flows and Locks labels for the target behaviours were abandoned in favour of a simple division into *user-system* and *user-user* behaviours.

For each target behaviour, a subset of most applicable design patterns from each lens is presented, illustrated with examples, typically 15–25 applicable patterns. Still serving

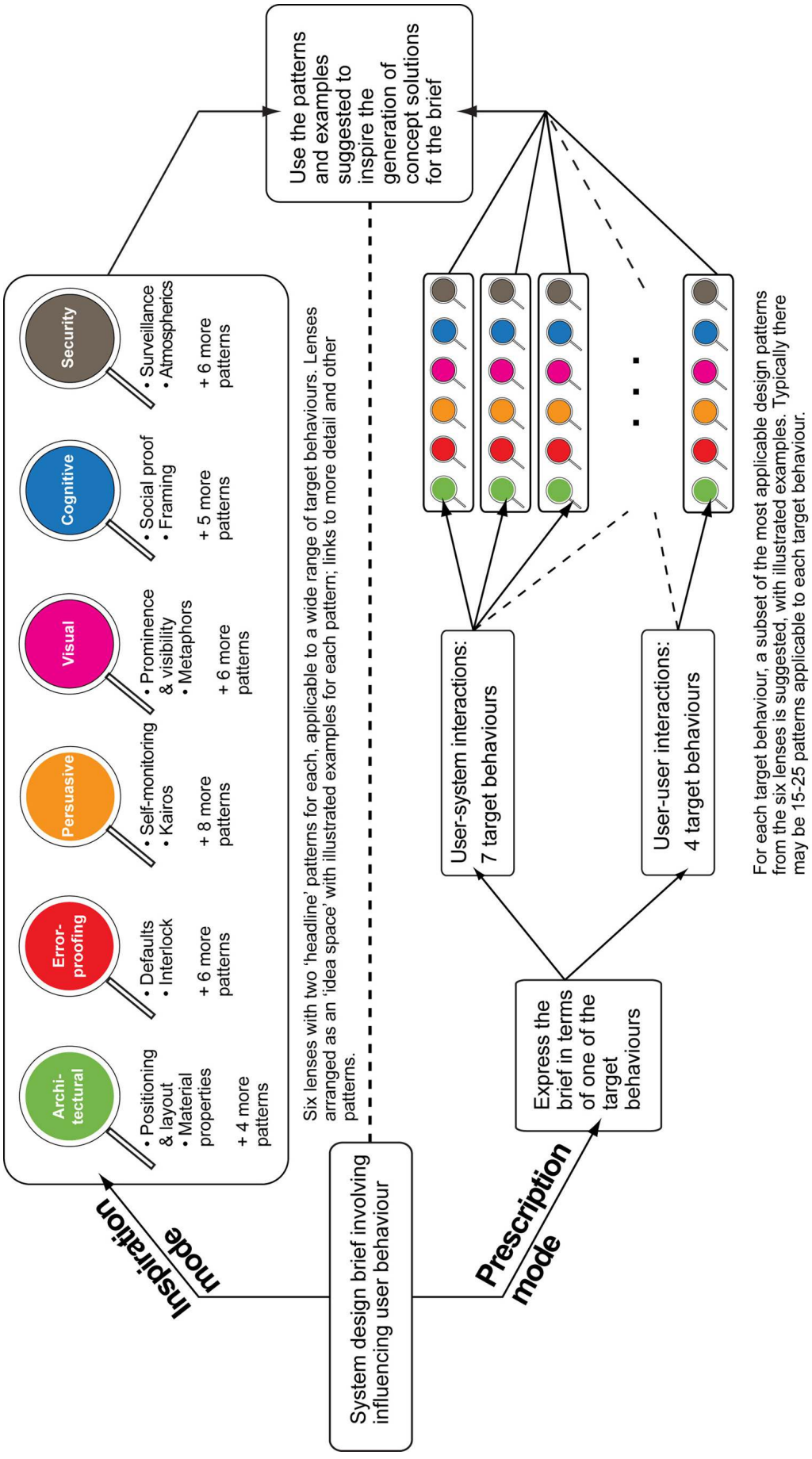


Figure 4.11: Comparison of the inspiration and prescription modes of the DwI toolkit v.0.9.

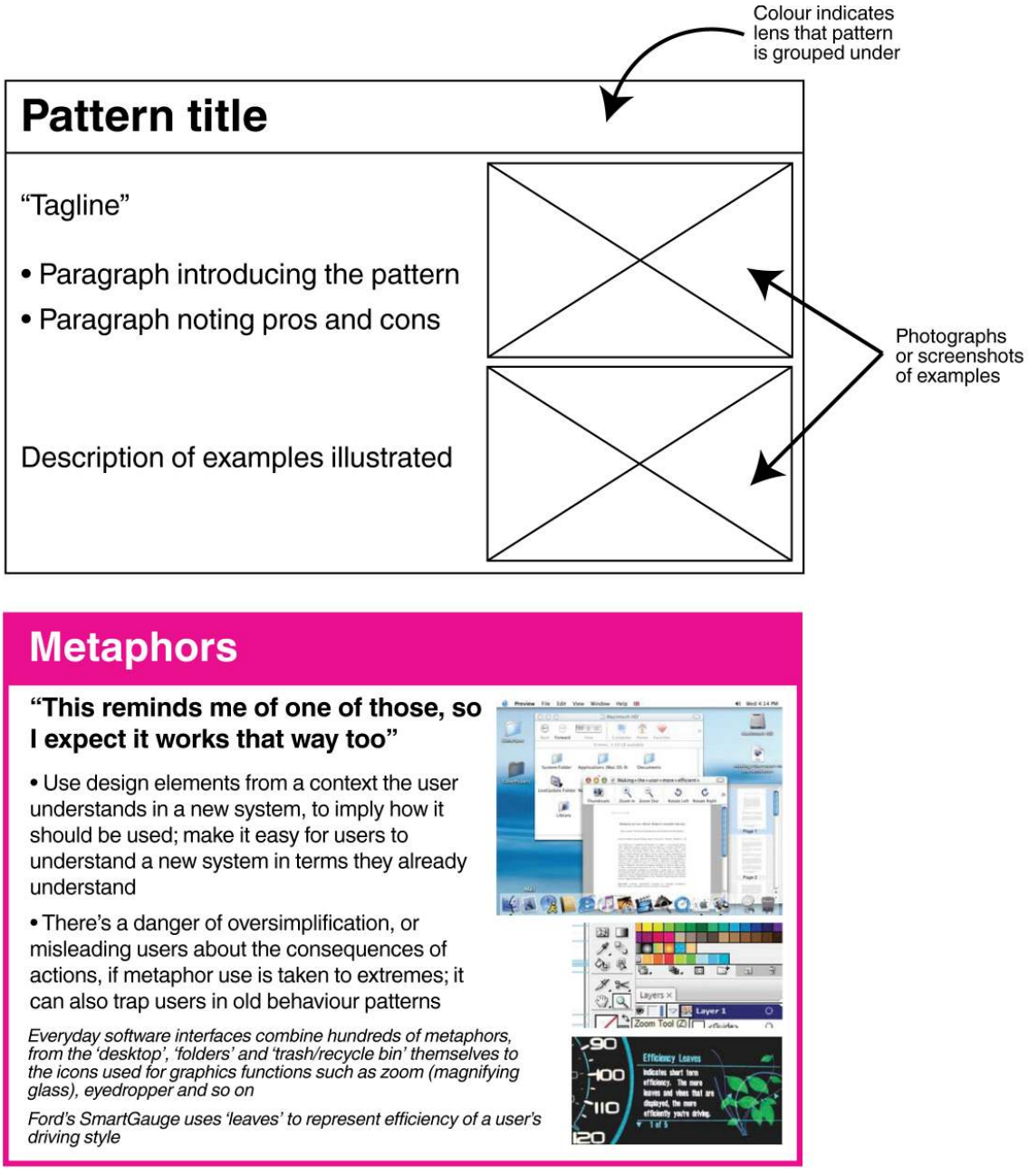


Figure 4.12: Form of the pattern descriptions as used in both Inspiration and Prescription modes, with the METAPHORS pattern as an example

Figure 4.13: The 'idea space' poster showing the 12 headline patterns, with a close-up of the SOCIAL PROOF pattern from the Cognitive lens as an example. The full poster is included in the appendix as **[A1]**.

Table 4.6: The eleven target behaviours provided for v.0.9, with examples.

	USER-SYSTEM INTERACTION: *influencing interactions between a user and a system*	
S1	The user follows a process or path, doing things in a sequence chosen by the designer	Example: customer places order via website without missing out any steps
S2	The user follows a process or path that's optimised for those particular circumstances	Example: user only spends as much time as really needed in the shower
S3	Decision among alternatives: a user's choice is guided	Example: diners choose healthier meal in office canteen
S4	Only certain users / groups of users can use something	Example: only users who know PIN can access bank account via ATM
S5	Only users already behaving in a certain way get to use something	Example: if a driver's travelling below the speed limit, the next set of traffic lights turn green, otherwise they stay red
S6	No users can use something in a particular way, regardless of who they are or what they've done before	Example: park bench fitted with central armrest to prevent anyone lying down
S7	Users only get functionality when environmental criteria are satisfied	Example: office lighting cannot be switched on if ambient daylight adequate
	USER-USER INTERACTION: *Influencing interactions between a user and other users, mediated by system*	
U1	Multiple users are kept separate so they don't affect each other while using a system	Example: traffic follows one-way system into/out of car park
U2	Users (and groups of users) do interact with, and affect each other while using a system	Example: staff from different departments mix socially in a building's atrium
U3	Users can't block or dominate a system to the exclusion of others	Example: wide pedestrian concourses prevent groups blocking passage for others
U4	Controlled rate of flow or passage of users	Example: visitors to popular museum exhibit routed past it slowly on moving walkway

as a creative inspiration, this mode effectively 'prescribes' a set of patterns which have been applied to analogous problems, each discussed with notes on implementation, user reactions and effectiveness; a range of design concepts can thus be generated, all of which have at least some precedent in terms of application in behaviour change contexts.

The mapping of behaviours to design patterns (at this stage) remained still primarily an attempt at a draft of this particular form of method, to allow investigation of whether it was of use to—and usable by—designers. Figure 4.14 shows some of the design patterns prescribed for a particular target behaviour.

Six lenses on influencing behaviour

> "Classification wants to be used... [taxonomies] need to address day-to-day cataloguing issues and empirical information management practicalities"
>
> Resmini and Rosati (2011, p.91)

The five lenses in v.0.8 (section 4.2.2) were expanded and regrouped to incorporate some additional techniques. Two lenses were renamed: *poka-yoke* became *errorproofing* and *heuristics & biases* became *cognitive*—in both cases to lower a barrier to rapid comprehension—while the *visual* lens was introduced to capture some of the product semantics, Gestalt and perceptual techniques relevant to influencing behaviour, discussed in section 2.2.2. Table 4.7 summarises the six lenses and lists the patterns (47 in total).

As before, the point of the lenses was to group the design patterns in a way intended to capture different disciplinary worldviews on behaviour change, with the aim of challenging designers to think outside the immediate frame of reference suggested by the brief (or the client). In this sense, the lenses can act as a way of triggering disruptive ideas within a brainstorming session, somewhat analogous to Eno and Schmidt's *Oblique Strategies* (1975) or the 'Six Thinking Hats' (de Bono, 1990; Hewitt-Gleeson 2008) method as discussed in section 2.4.1, though very different in structure to either. The lenses are not formal ontologies for classifying the patterns—indeed they overlap to some extent, with certain patterns arguably fitting into more than one lens—but are intended primarily to aid the idea generation process in a practical context.

Prior to running workshops using DwI v.0.9, a detailed worked example was carried out, applying the toolkit to an interaction behaviour problem with 'known solutions'. This, together with the workshops, is described in section 5.3.

Cards as an additional format

In addition to the 'idea space' poster, website and printed sheets, a card format version of DwI v.0.9 was produced to explore the affordances this offered, both in workshops and potential use as a reference, drawing on some of the advantages noted in section 2.4.3. The way the patterns were presented, both the 12 'headline' patterns on the DwI v.0.9 poster and the remaining 35 on separate sheets (and the online versions of each) was essentially quite similar to a card format anyway, but the amount of text was more than was considered desirable. So to produce individual cards, the text was reduced further for each pattern, with each card retaining a single example as illustration. At this stage, the text was not yet rephrased as questions (section 4.4.2).

Two sizes of printed cards were produced, to a standard business card-size $3\frac{1}{4}$"$\times 2\frac{3}{16}$" and larger $5\frac{1}{2}$"$\times 3\frac{1}{2}$", similar in size to the IDEO Method Cards. Two packs of the smaller cards were printed by Moo, a business card-printing company, while multiple packs of larger cards (Figure 4.16) were colour laser-printed onto paper and spray-mounted to card backing. It was intended that the smaller cards would be useful for exercises with

Figure 4.14: An example of the prescription mode of the DwI toolkit: the 22 design patterns suggested as applicable to target behaviour S1. In this illustration, the patterns are shown as cards (see below); in the workshop studies described in Chapter 5, the pattern names were simply listed so participants could then look at the printed sheets about each pattern.

Table 4.7: The DwI v.0.9 lenses with brief descriptions and the patterns contained within each. The first two in each lens are the 'headline' patterns used on the poster.

LENS & PATTERNS	DESCRIPTION
Architectural 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 (see section 2.2.2). While the techniques have been developed in the built environment, many of the 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 DEFAULTS; INTERLOCK; LOCK-IN & LOCK-OUT; EXTRA STEP; PORTIONS; CONDITIONAL WARNINGS; PARTIAL SELF-CORRECTION; SPECIALISED AFFORDANCES	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 (see section 2.2.2). This view on influencing behaviour is often found in health & safety-related design, medical device design and manufacturing engineering.
Persuasive SELF-MONITORING; KAIROS; SIMULATION & FEEDFORWARD; REDUCTION; TUNNELLING; TAILORING; COMPUTERS AS SOCIAL ACTORS; FEEDBACK THROUGH FORM; OPERANT CONDITIONING; RESPONDENT CONDITIONING	The Persuasive Lens represents the emerging field of persuasive technology, 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 (see section 2.2.3). The patterns here are based mainly on ideas from BJ Fogg's work.
Visual PROMINENCE & VISIBILITY; METAPHORS; IMPLIED SEQUENCES; PROXIMITY & SIMILARITY; PERCEIVED AFFORDANCES; COLOUR & CONTRAST; WATERMARKING; POSSIBILITY TREES	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 (see section 2.2.2). These techniques are often applied by interaction designers without necessarily considering how they can influence user behaviour.
Cognitive SOCIAL PROOF; FRAMING; AFFECTIVE ENGAGEMENT; SCARCITY; COMMITMENT & CONSISTENCY; RECIPROCATION; AUTHORITY	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' (see section 2.2.3). 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.
Security SURVEILLANCE; ATMOSPHERICS; THREAT OF DAMAGE; WHERE YOU ARE; WHO YOU ARE; WHAT YOU HAVE; WHAT YOU'VE DONE; WHAT YOU KNOW OR CAN DO	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 (see section 2.2.2). 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'.

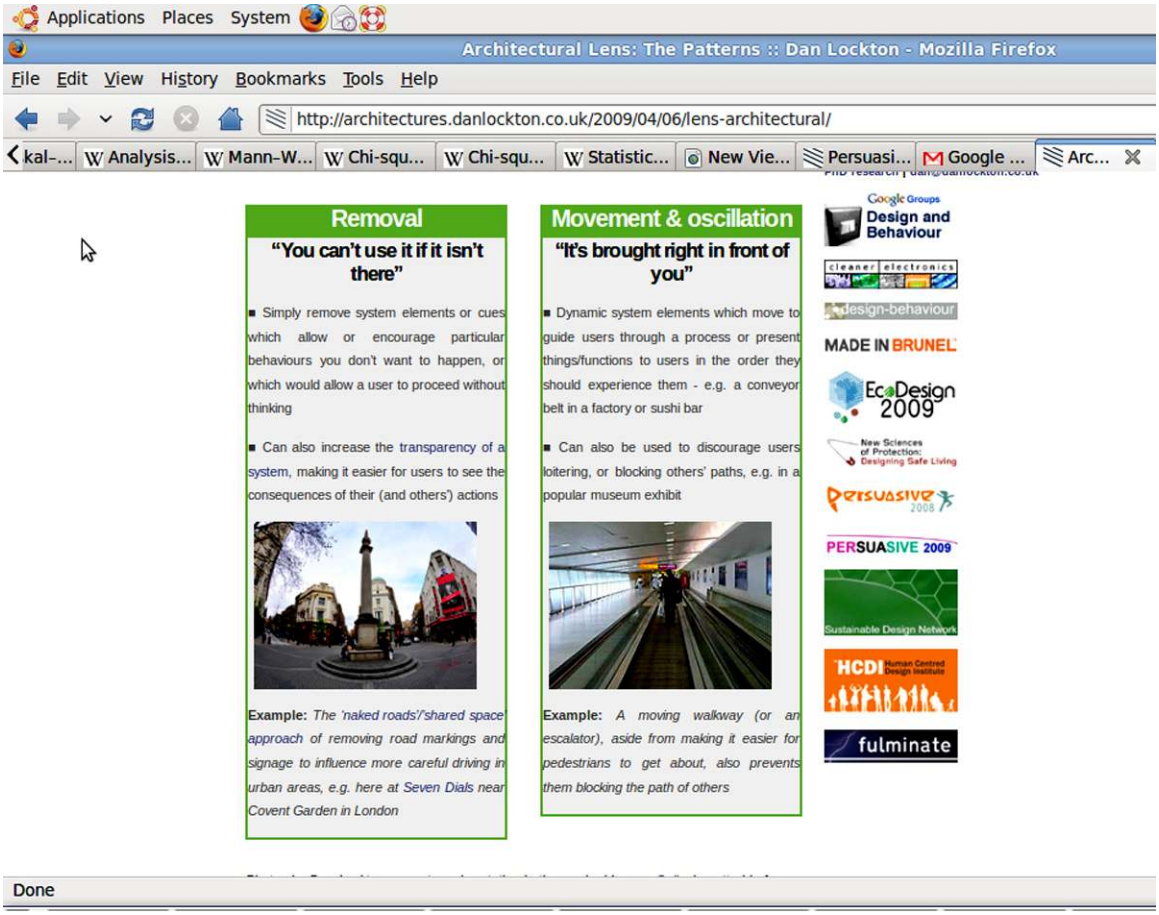


Figure 4.15: Screenshot of online version of v.0.9.

Figure 4.16: DwI v.0.9 cards (large size)

individuals, whereas larger cards would permit pairs or groups to use the cards together more easily. Worksheets were also produced—A3 colour sheets, one for each lens (Figure 4.17), with the cards as images on each sheet. These could be cut up to make cards, or used as they were. By collecting together the patterns for each lens, the worksheets made it easy to see at a glance the diversity of ideas contained in the lenses, and how they compared.

The cards and worksheets were used in a number of the exploratory applied workshops described in section 5.3.3.

4.4 Design with Intent: from v.0.9 to v.1.0

The Brunel workshops and exploratory applied trials with DwI v.0.9 covered in section 5.3 led to a number of insights about how participants made use of the toolkit, and how to improve it. The following sections describe the process of reflecting upon and implementing these insights to develop the toolkit from v.0.9 to v.1.0.

4.4.1 Reflect

The Brunel workshops described in section 5.3.2 showed that for many participants, using the toolkit in a free-form inspiration mode, following conventional brainstorming, helped them generate more concepts for addressing the briefs than conventional brainstorming alone.

However, using the toolkit in prescription mode was not particularly effective overall—although for some, the idea of focusing on a target behaviour provided a useful starting point for thinking about the problem further. This suggested that future versions of the toolkit need to be usable in a variety of different ways by designers and other stakeholders, to suit what they need in different contexts. This is the approach taken

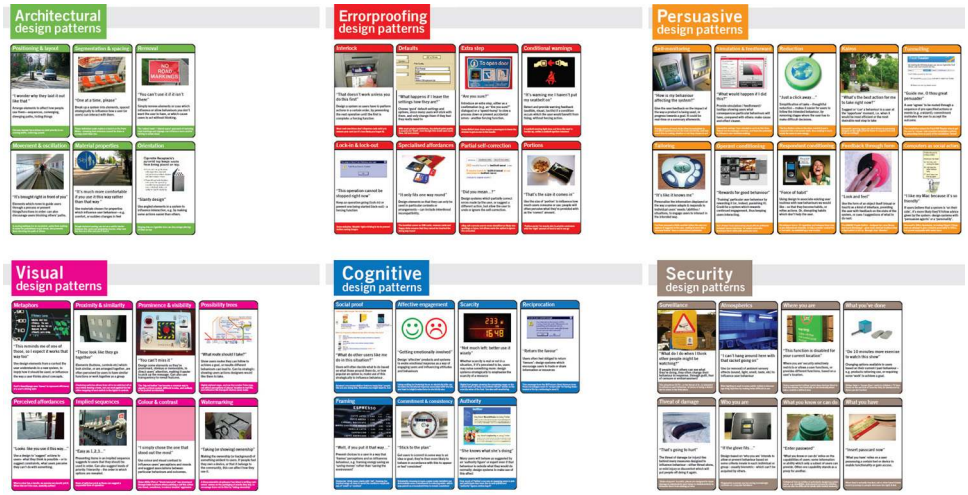


Figure 4.17: DwI v.0.9 worksheets

in developing the toolkit from v.0.9 to v.1.0: aiming to create something which affords use both as an inspiration 'idea space' and as a more structured reference guide, without requiring complicated rules or procedures for use.

One of the aspects of the toolkit which seems to have been most effective is the 'pattern' form, with an emphasis on example implementations of principles—'previous instances of design elements in a variety of different situations' (Eckert & Stacey, 2000: p.527)—rather than simply descriptions of the principles themselves. Many of the concepts in Tables 5.6–5.9 (Chapter 5) arguably involve 'idea creation by analogical transfer' (Stacey et al 2009: p.362; Tseng et al 2008), or metaphors (Casakin, 2006), from 'time to destination' displays on kettles to curtains styled to look like a woollen jumper; drawing analogies 'can bring forth valuable knowledge from a known situation... to the ill-defined design situation at hand' (Leclercq & Heylighen, 2002: p.287). This is a strength of the toolkit and should be retained in future versions.

Reactions to DwI v.0.9

As noted in section 5.3.3, "the most important test of an idea generation tool is probably whether it is found of use by its users". If people choose to employ a method or toolkit, and continue to use it, perhaps even embedding it into their business or organisational decision-making processes, then this suggests that it meets some of the needs of practitioners in the sector concerned. The decision was made earlier during the development of DwI that it should be made available to potential users in industry and the public sector as early as possible, and iteratively developed in response to their feedback. It was hoped that using a Creative Commons licence, permitting non-commercial use and modification (with attribution) would encourage the adoption and adaptation of the toolkit and incorporation of the ideas into other forms which might be more of use or applicable in particular applications.

Section 4.3.2 described the reasoning and strategy behind creating online versions of the DwI v.0.9 poster and accompanying illustrated reference, partly in response to a request from the RSA to make reference material on design for behaviour change available for its Design Directions student competition. The first applied trial of v.0.9 also came from the RSA (see section 5.3.3).

Survey: Influencing User Behaviour

As part of the process of extracting insights from the use of v.0.9, and reflecting on them to inform development of the next version of the toolkit, a small online survey was put together in July 2009, running until the end of the year. The intention was for this to help the author understand better the possible audience for future versions of the DwI toolkit, and provide a stream of potentially applicable suggestions for improvement.

The survey was announced via the blog in order to target an audience more likely to be already familiar with the idea of influencing behaviour through design. The patterns were presented in card form (see section 4.3.2), with participants asked whether they were familiar with any of them from use in their own projects, and if so, in what sort of behaviour change applications; also, whether they had any suggestions for patterns to add, or patterns which they had identified or used themselves. They were also asked whether they had any existing methods or guides relevant to this field, whether they would find a new guide of use, and whether they were familiar with the DwI toolkit in its current form (the online variant of v.0.9).

Thirty-three responses were received, of which 22 were 'full' responses, answering all the sections, from a range of practitioners and students. For the purposes of discussion here, the 11 participants who only filled in the yes/no questions have been ignored. One of the opening questions, 'Where do you work?' was poorly worded, leading to answers both about companies / domains as expected, but also countries and towns. So it is possible to say that the domains in which participants worked included architecture, electrical consumer product design, interaction design, hospitals, television companies and universities, and the locations included the UK, the US, the Czech Republic, Indonesia, New Zealand and Australia.

Table 4.8 summarises the responses regarding familiarity with the different patterns and suggested additions. While this was only a small sample, certain patterns emerged as more familiar than others: POSITIONING & LAYOUT, PROMINENCE & VISIBILITY and COLOUR & CONTRAST were familiar to over 60% of participants, with 17 patterns familiar to around half (40-59%). This suggests that there is, perhaps, a 'core' of patterns for influencing behaviour which designers draw on, even if it has not previously been formalised in a single collection. The patterns with the least familiarity (19% and below) include some with relatively inaccessible terminology, such as OPERANT and RESPONDENT CONDITIONING. The principles themselves may have been familiar, but the way the patterns were explained were not. On this basis, it makes sense for future iterations of the toolkit to attempt to provide more familiar names for the patterns where they exist.

Participants suggested some extra patterns for certain lenses, some explained in more detail than others, and some very specific.[10]

Other useful insights from the survey included details of projects in which respondents who had used the toolkit online discussed how they had applied some of the patterns with the intention of influencing user behaviour. Some of the more interesting examples included:

- ORIENTATION was used by one participant, an architect, in an adult mental health unit where "all projecting or protruding objects are require to be ligature proof

[10] One elaborated further was the MYSTERY & THE JOURNEY OF DISCOVERY pattern, which the participant described as "intentionally obscuring a view so that visitors cannot see the space or feature without 'exploring' or moving around the environment to get a better look", noting its possible relation to Alexander et al's (1977) pattern 134, ZEN VIEW. This is quite an intricate pattern—more so than many of the relatively simple ideas included in the toolkit at this stage—but is still understandable when described in context, via an actual use-case. This suggested that more involved patterns, requiring the designer to think through the sequence of how users might experience the patterns in use, could be appropriate in a development of the toolkit, so long as they were explained clearly enough.

Table 4.8: Familiarity with DwI v.0.9 patterns, from the survey 'Influencing user behaviour'.

LENS	PATTERNS	FAMILIARITY (n=22)
Architectural	POSITIONING & LAYOUT	16 (73%)
	MATERIAL PROPERTIES	12 (55%)
	SEGMENTATION & SPACING	9 (41%)
	ORIENTATION	10 (45%)
	REMOVAL	10 (45%)
	MOVEMENT & OSCILLATION	6 (27%)
Errorproofing	DEFAULTS	11 (50%)
	INTERLOCK	9 (41%)
	LOCK-IN & LOCK-OUT	8 (36%)
	EXTRA STEP	9 (41%)
	SPECIALISED AFFORDANCES	6 (27%)
	PARTIAL SELF-CORRECTION	8 (36%)
	PORTIONS	6 (27%)
	CONDITIONAL WARNING	7 (32%)
Persuasive	SELF-MONITORING	11 (50%)
	KAIROS	10 (45%)
	REDUCTION	12 (55%)
	TAILORING	9 (41%)
	TUNNELLING	4 (18%)
	FEEDBACK THROUGH FORM	5 (23%)
	SIMULATION & FEEDFORWARD	6 (27%)
	OPERANT CONDITIONING	3 (14%)
	RESPONDENT CONDITIONING	3 (14%)
	COMPUTERS AS SOCIAL ACTORS	7 (32%)

LENS	PATTERNS	FAMILIARITY (n=22)
Visual	PROMINENCE & VISIBILITY	16 (73%)
	METAPHORS	8 (36%)
	PERCEIVED AFFORDANCES	9 (41%)
	IMPLIED SEQUENCES	12 (12%)
	POSSIBILITY TREES	5 (23%)
	WATERMARKING	5 (23%)
	PROXIMITY & SIMILARITY	10 (45%)
	COLOUR & CONTRAST	14 (64%)
Cognitive	SOCIAL PROOF	7 (32%)
	FRAMING	13 (59%)
	RECIPROCATION	5 (23%)
	COMMITMENT & CONSISTENCY	6 (27%)
	AFFECTIVE ENGAGEMENT	8 (36%)
	AUTHORITY	9 (41%)
	SCARCITY	4 (18%)
Security	SURVEILLANCE	8 (36%)
	ATMOSPHERICS	8 (36%)
	THREAT OF DAMAGE	4 (18%)
	WHAT YOU HAVE	6 (27%)
	WHAT YOU KNOW OR CAN DO	4 (18%)
	WHO YOU ARE	4 (18%)
	WHAT YOU'VE DONE	2 (9%)
	WHERE YOU ARE	9 (41%)

(i.e. anti-hanging) – slanty design is often the eventual solution to this, sometimes in combination with rubbery / bendy design."

- REMOVAL of some rubbish bins in an office "means the remaining ones are emptied more often."
- A number of Architectural, Errorproofing and Persuasive patterns consciously applied in the design of an online customer relationship management (CRM) system, including "arranging elements in a sequence to encourage users to fill in the most important information first."
- Use of TAILORING, SELF-MONITORING, KAIROS, OPERANT CONDITIONING and COMPUTERS AS SOCIAL ACTORS in an immersive learning environment (using video goggles and mobile phones) for new skiers, to help reduce injury rates.
- A project aiming to "create a link between a reflective and a reactive state of mind" in purchasing situations where someone is liable to make purchase decisions later regretted. "The object is a model of measured data (skin conductance, heart rate and breathing rate) from an earlier buying situation, and aims to remind the carrier of the bodily states that influence purchase decisions."
- Use of Architectural and Errorproofing patterns in the design of ovens and washing machine interfaces, to "make it easier and more enjoyable to use the common functions and a little more difficult or least instinctive to use the less commonly used functions which have some risks attached if not used properly."
- The use of patterns from all of the lenses in the design of 'shopping cart' software for artists, craftspeople and musicians to use on their own websites.
- Removal of options on a website to prevent "overwhelming the user with a new tool: hiding them "until the user clicks on the tab to expand and show more actions."
- Concerning AFFECTIVE ENGAGEMENT, the idea that "copy is also [an] interface. A good copy can give users the right amount of emotion needed when interacting on complex interfaces."

The most salient point here is the diversity of types of situations in which designers are intending to influence user behaviour – from web design to building design to more experimental kinds of physical interface. Some patterns are used in digital contexts as metaphors for physical concepts. None of this was surprising, but it did emphasise that the potential user base for the DwI toolkit would span a number of different disciplines and industry sectors, and so it would need to be presented and publicised through different channels to reach more of its potential audience.

Pinballs, shortcuts and thoughtfulness: 'what users are like'

> "User-friendliness helps naturalize electronic objects and the values they embody. For example, while electronic objects are being used, their use is constrained by the simple generalized model of a user these objects are designed around: the more time we spend using them, the more time we spend as a caricature. We unwittingly adopt roles created by the human factors specialists of large corporations".
>
> Anthony Dunne, Hertzian Tales, MIT Press, 2005, p.21-22

In section 4.2.1, *enabling*, *motivating* and *constraining* were introduced to represent different approaches designers can take when considering behaviour change. While these only found limited application in the subsequent pilot study (section 5.2.2), one idea which emerged from running workshops with DwI v.0.9—and discussions during and after the sessions—was that for each brief, the concepts generated by different participants seem to embody different *models* of 'what users are like'. Each behavioural intervention concept can be seen as a simple statement, something like "people will do *that* if our design does *this*..."

In some group sessions, discussions (if not quite arguments) ensued on what could be assumed about human nature when designing with the intention to influence behaviour, the debate centring on how much people can be expected to think before behaving in a particular way, in a sustainability context but also with respect to other kinds of behaviour change. A recurring point of debate was whether it was 'worth' trying to explain things to people, or whether it would be better just to change their behaviour 'silently', whether or not they understand.[11]

It was decided to investigate the field of 'models of the user', to understand how these models relate to design for behaviour change, and to the kinds of design patterns applied by designers. From the perspective of developing the toolkit further—to improve future versions—the purpose of the investigation was to characterise these models so that if possible, links could be drawn between the models and patterns which were especially relevant, to help designers explore the possibilities available.

This study—which took place at an industry conference—is described in **[B3]**. Participants, mainly user experience and interaction designers from industry, were asked to write down statements about 'what users are like', based on their own experience and models of users they had encountered from clients and colleagues. These were then clustered using an open card sort method into affinity diagrams, ultimately revealing three main categories, which were matched with particular examples of design for behaviour change and relevant design patterns, and also aligned with a formal systems analysis approach for human-computer interaction developed by Dubberly et al (2009).

Insights from the study pertinent to the development of the toolkit can be summarised here:

- Three main models emerged: the 'pinball', 'shortcut' and 'thoughtful' models of how users behave, and thus how their behaviour can be influenced through design (Table 4.9)
- The recommendation is that designers probably should assume variability across the range of the prospective users of a product or service, but that certain design patterns and strategies are better suited to each of the three models from the perspective of influencing behaviour (Table 4.9)
- The models are not a permanent way of segmenting the population, but representative of assumptions about behaviour at a particular time or in a particular interaction or decision-making situation.

[11] 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)—or other issues—and that individual people might be 'persuasion profiled' (Kaptein & Eckles, 2010) it is inevitably 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"; Jelsma (2006) uses the term "fictive user".

Table 4.9: Brief descriptions of the pinball, shortcut and thoughtful models as used in introductory material to DwI v.1.0.

The 'pinball' user Some 'pinball' patterns: *Architectural* CONVERGING & DIVERGING, CONVEYOR BELTS, FEATURE DELETION, HIDING THINGS, POSITIONING, ROADBLOCK, SEGMENTATION & SPACING *Errorproofing* CHOICE EDITING, INTERLOCK, MATCHED AFFORDANCES, TASK LOCK-IN/OUT *Machiavellian* BUNDLING, DEGRADING PERFORMANCE, FORCED DICHOTOMY *Security* COERCIVE ATMOSPHERICS, 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	In this case, you think of users as, pretty much, very simple components of your system, to be shunted and pushed and pulled around by what you design, whether it's physical or digital architecture. This view basically doesn't assume that the user thinks at all, beyond basic reflex responses: the user's a pinball (maybe a slightly spongey one) pushed and pulled this way and that, but with no requirement for understanding coming from within. While things like deliberately uncomfortable benches or the Mosquito 'sound weapon' (e.g. Akiyama, 2010) act against the Pinball User—effectively treating users like animals—this view need not always take such a negative approach. Lots of safety systems, even down to making sure different shape connectors are used on medical equipment to prevent mistaken connections, don't mind whether the user understands what's going on or not: it's in everyone's interests to influence behaviour on the most basic level possible, without requiring thought.
The 'shortcut' user Some 'shortcut' patterns: *Architectural* MAZES, SIMPLICITY *Errorproofing* DEFAULTS, OPT-OUTS, PORTIONS *Interaction* PARTIAL COMPLETION, TUNNELLING & WIZARDS *Ludic* MAKE IT A MEME, REWARDS, UNPREDICTABLE REINFORCEMENT *Perceptual* COLOUR ASSOCIATIONS, CONTRAST, IMPLIED SEQUENCES, MOOD, PERCEIVED AFFORDANCES, PROMINENCE, PROXIMITY & GROUPING, SIMILARITY *Cognitive* DECOYS, DO AS YOU'RE TOLD, EXPERT CHOICE, FRAMING, SCARCITY, SOCIAL PROOF *Machiavellian* ANCHORING, SERVING SUGGESTION, STYLE OBSOLESCENCE, WORRY RESOLUTION	Here, you think of users as being primarily interested in getting things done in the easiest way possible, with the least effort. So you assume that they'll take shortcuts, or make decisions based on intuitive judgments (Is this like something I've used before? How does everyone else use this? I expect this does what it looks like it does), habits, and recognising simple patterns that influence how they behave. The Shortcut User is assumed not to want to think too much about what's going on behind the scenes, beyond getting things done. He or she's not always thinking about the best way of doing things, but a way that seems to work. If systems are designed well to accommodate this, they can feel very easy to use, intuitively usable, and influence user behaviour through these kinds of shortcut mechanisms rather than anything deeper. But there's clearly potential for manipulation, or leading users into behaviour they wouldn't choose for themselves if they weren't taking the shortcuts.
The 'thoughtful' user Some 'thoughtful' patterns: *Errorproofing* CONDITIONAL WARNINGS, DID YOU MEAN?, ARE YOU SURE? *Interaction* FEEDBACK THROUGH FORM, KAIROS, PEER FEEDBACK, REAL-TIME FEEDBACK, SIMULATION & FEEDFORWARD, SUMMARY FEEDBACK *Ludic* LEAVE GAPS TO FILL, ROLE-PLAYING, STORYTELLING *Perceptual* NAKEDNESS, WATERMARKING *Cognitive* EMOTIONAL ENGAGEMENT, PROVOKE EMPATHY *Machiavellian* I CUT, YOU CHOOSE *Security* SURVEILLANCE, PEERVEILLANCE, SOUSVEILLANCE	Thoughtful Users are assumed to think about what they are doing, and why, analytically: open to being persuaded 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. If you think of your users as being Thoughtful, you will probably be presenting them with information and feedback which allows them to explore the implications of what they're doing, and understand the world around them better. Most of us like to model ourselves as Thoughtful Users, even though we know we don't always fit the model. It's probably the same with most people: so knowing when it's appropriate to assume that users are being mindful of their behaviour, and when they're not, will be important for the 'success' of a design.

The models are most appropriately considered at the early stages of the design process, in parallel with concept generation, and so the process of reflecting on (and perhaps challenging) the assumptions being made about user behaviour could be seen as an additional element of the toolkit. For example, if most of the ideas being generated during a session are representative of a particular model of behaviour—say, assuming a pinball-like model of the user—introducing the provocation of considering a different way of thinking about people (say, the thoughtful model) could spur the creation of another field of possible ideas for influencing behaviour. 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 final part of section 4.4.2 below covers how the pinball, shortcut and thoughtful models were incorporated into DwI v.1.0.

Using questions

An interesting development at this stage—with implications for developing the next version of the toolkit—was an adoption of the DwI approach in the social marketing field, an area addressing many of the same issues as design for behaviour change and persuasive technology, but primarily from a communications and information angle rather than via design[12]. Nedra Kline Weinreich, author of the textbook *Hands-On Social Marketing* (Weinreich, 1999), created a worksheet for use by social marketers, 'Applying the Design Approach for Behaviour Change' (Weinreich, 2009), based on the six lenses from DwI v.0.9. Presented entirely in text form, the worksheet rephrased the 12 headline patterns from the DwI v.0.9 poster as questions for the social marketing practitioner when developing a campaign (Table 4.10), along the lines of some of the provocation techniques discussed in Chapter 4 of this thesis.

Weinreich's second edition of *Hands-On Social Marketing* (Weinreich, 2010) includes a whole chapter on 'Influencing behaviour by design', in which the DwI toolkit and the patterns are cited, and the six lenses of DwI v.0.9 used to structure a discussion of examples from both design and social marketing contexts, notably around promoting healthier behaviour.

Phrasing each pattern as a question seemed to offer three advantages over the existing format used in DwI v.0.9:

- It turned the patterns into provocations, explicitly asking the designer to think about how the pattern might be applied, where previously this had only been implicit
- It reduced the amount of reading required, thus making the patterns faster to use
- It also allowed for quicker elimination of patterns which were deemed to be irrelevant, simply by answering the question negatively. As the toolkit expanded, ways of filtering out less applicable patterns would be desirable.

A 'question' format was thus considered worth incorporating into the next version of the toolkit (see section 4.4.2).

Weinreich's use of 'How can you...?' to start each question displays a confidence that there will definitely be a way in which each pattern can be applied to any behaviour change situation. This may well be the case, and could certainly be followed through in a 'forced creativity' fashion, but it was felt that when considering a greater number of patterns, an initial 'Can you...?' or 'Could your design...?' provocation might be

[12] McKenzie-Mohr and Smith (1999) have developed a range of approaches for influencing more sustainable behaviour through community-based social marketing.

Table 4.10: The questions asked in Weinreich's (2009) 'Applying the Design Approach for Behaviour Change' worksheet, derived from DwI v.0.9.

CATEGORY (LENS)	QUESTION	DWI V.0.9 PATTERN
Architectural Design	How can you use positioning or layout elements to either encourage or constrain the behaviour?	POSITIONING & LAYOUT
	How can you make it more comfortable for people to do the behaviour?	MATERIAL PROPERTIES
Errorproofing Design	How can you make the desired behaviour be the default?	DEFAULTS
	How can you force the behaviour as a necessary step in another desirable process?	INTERLOCK
Persuasive Design	How can you show the actual effect of the behaviour on the overall system for self-monitoring?	SELF-MONITORING
	How can you provide a cue to action at the appropriate time?	KAIROS
Visual Design	How can you make the 'right choice' or the cue to action more visible?	PROMINENCE & VISIBILITY
	How can you use a metaphor of something your users are already familiar with to help them understand how or when to perform the desired behaviour?	METAPHORS
Cognitive Design	How can you demonstrate social proof that others are successfully engaging in the behaviour?	SOCIAL PROOF
	How can you frame the behaviour or the benefits of the behaviour in a way that helps people see it in a more positive light?	FRAMING
Security Design	How can you encourage people to do the desired behaviour if they think people are watching?	SURVEILLANCE
	How can you use sensory effects (e.g., sound, smell, light, taste) to encourage the desired behaviour?	ATMOSPHERICS

Figure 4.18: Modified selection of DwI v.0.9 patterns presented in card form at Design for Persuasion conference, Brussels, 2009

more appropriate, to allow the faster filtering as mentioned above. This construction also follows more closely Polya's (1945) approach in *How to Solve It* (see section 2.4.1) where heuristic questions such as 'Can you derive the result differently?', 'Could you restate the problem?' and 'Do you know a related problem?' help the reader explore problems through asking questions about them.

The 'question' approach was tentatively explored in a handout the author produced for the inaugural Design for Persuasion industry conference held in Brussels in October 2009. To introduce the DwI idea, the handout featured 'Six questions to ask yourself if you're designing to influence users' behaviour'—one selected pattern from each of the lenses, phrased as a 'Can you...?' question (extract in Figure 4.18). The patterns were presented here in card form (see section 4.3.2). Although the conference involved a presentation rather than a workshop, the question format of the selected patterns allowed rhetorical question-and-answer examples to be used as part of the presentation. The example brief used derived from the brief given by Learndirect (see section 5.3.3 below) relating to encouraging users of an online learning environment to stay engaged with the course, and allowed questions such as 'Can you use a metaphor of something that users understand to influence how they use your system?' to be answered directly with 'Yes—we could do X, or Y, or perhaps Z', showing illustrations representing possible solutions using the 'Metaphors' pattern.

4.4.2 Plan

While trials with the DwI v.0.9 cards and worksheets were continuing, consideration turned to planning how to improve the toolkit for the next version, based on insights and

feedback from early users, the survey, and the workshops. Features and improvements considered could be divided into those which were immediately feasible, and those which would require significantly more work but which would still be desirable in the longer term. The latter are included in the discussion in section 4.5.1, but the immediately feasible improvements were as follows:

- Expanding the toolkit with a greater variety of patterns and examples
- Splitting existing patterns into more specific variants
- Introducing new patterns of which the author has become aware, or that workshop participants, survey participants or other correspondents have noted and suggested
- Use of open 'Can you...?' and 'What would happen if...?'-type questions to introduce each pattern
- Inclusion of 'suggested activities'—ways the toolkit can be used, in workshops or otherwise
- Revised lens structure, both to accommodate new patterns and to clarify and make the existing lenses better-defined
- Less text on the cards / worksheets, and simple names wherever possible
- Landscape format, larger cards to allow two people to hold a card together without their fingers obscuring the text (noticed as an issue with portrait format v.0.9 cards)
- Use wherever possible of images for which the copyright is owned by the author
- An accompanying online page for each pattern (and for each lens) to allow extra information, references, background details and examples to be added (perhaps by readers, in a wiki format)
- Introduction to the pinball / shortcut / thoughtful 'models of the user' (see section 4.4.1) as a way of navigating the patterns

It was decided to attempt to implement all of the immediately feasible improvements in a revised version of the toolkit, now primarily in card form (physical and digital) but with worksheet and online wiki companion versions. To signify that this was the first version to be 'fully' publicly released as a 'product' in itself, this would be Design with Intent v.1.0 **[A2]**.

New patterns and revised lens structure

The 47 patterns in DwI v.0.9 were expanded in a number of stages, both splitting existing patterns and adding new ones. For example, in the Architectural lens, the pattern POSITIONING & LAYOUT, which covered a number of cases of physically placing objects or structuring space, was split into the more specific POSITIONING, CONVERGING & DIVERGING, MAZES and ROADBLOCK, each of which covers a particular configuration or aspect of structure. Figure 4.19 compares the patterns, using the text and images from the online versions of each.

New patterns were also added which were not previously present in any form—mainly based on ideas spurred by ongoing literature research, suggestions arising during workshops and comments by readers of the blog. In particular, a set of patterns drawing on game mechanics, play, storytelling and techniques which have since come loosely under

Positioning & layout

"I wonder why they laid it out like that"

■ Arrange elements to affect how people use them—it can involve simply positioning elements (functions, buttons, etc) in sequence, hiding elements so they are only available for interaction in that sequence, or designing paths to converge or diverge intentionally

■ The layouts of supermarkets, shopping malls and offices can influence the paths taken by users, exposing them to the shelves, shops and colleagues in a strategic order or hierarchy

Examples: *In this service station bathroom (above), the mirrors have been moved from behind the sinks to an intentionally awkward position near the door, so users don't spend too long in front of them. See this discussion by Meagan Call.*

Chicane layouts (below) force drivers to yield priority to oncoming traffic, reducing speeds.

page | discussion | view source | history

Positioning

A **Architectural Lens**

Can you rearrange things so people interact with them in the locations you want them to?

Example: Positioning pedestrian crossing push-button units on the right-hand side (UK) makes it more likely that users turn to notice oncoming traffic

Photo by Dan Lockton (Brighton, Sussex, UK)

page | discussion | view source | history

Mazes

A **Architectural Lens**

Can get people to follow the path *you* want them to, on the way to reaching something *they* want?

Example: Some store layouts route or channel shoppers past 'impulse purchase' items — often snacks — on their way to the checkouts

Photo by Dan Lockton (Windsor, Berkshire, UK)

page | discussion | view source | history

Converging & diverging

A **Architectural Lens**

Can you channel people so they come together (or split up)?

Example: Gates (and gatehouses) channel visitors through a narrow opening, allowing a toll to be levied, or to help control potential threats

Photo by Dan Lockton (Windsor, Berkshire, UK)

page | discussion | view source | history

Roadblock

A **Architectural Lens**

Can you put things in users'way, so they take an alternative route, or adjust their speed?

Example: 'Chicanes' can slow down drivers, pedestrians and cyclists; the crossing chicane prevents running or cycling straight across the road

Photos by Dan Lockton (Richings Park, Bucks & Uxbridge, Middlesex, UK)

Figure 4.19: On the left, the POSITIONING & LAYOUT pattern from DwI v.0.9; on the right, the more specific POSITIONING, CONVERGING & DIVERGING, MAZES and ROADBLOCK patterns from DwI v.1.0. These are screenshots from the online versions of the toolkit.

the heading of 'gamification' in the field of digital media (section 2.2.3; see, e.g. Deterding et al, 2011), were added as the Ludic Lens; some more explicitly manipulative patterns (of the kind which Brignull (2010) has recently called 'dark patterns'), were added as the Machiavellian Lens, and a number of patterns relating to influencing perception were added to the Visual Lens, which was renamed the Perceptual Lens to take account of olefactory and auditory techniques such as SEDUCTIVE ATMOSPHERICS.

The Persuasive Lens was renamed the Interaction Lens, to clarify a query arising from participants during some workshops with v.0.9: that the patterns, many of them drawn from Fogg's *Persuasive Technology* (2003), were not necessarily about 'persuasion' in terms of argumented attitude change, but about influencing behaviour through how a system responds to users' interactions with it. As suggested by the survey reported in section 4.4.1, SELF-MONITORING was split into more nuanced feedback patterns: PEER FEEDBACK, REAL-TIME FEEDBACK and SUMMARY FEEDBACK, while FEEDBACK THROUGH FORM and SIMULATION & FEEDFORWARD were kept as separate patterns. The COMPUTERS AS SOCIAL ACTORS pattern, while the term has academic currency based on the work of Reeves and Nass (1996) and more recently Nass and Yen (2010), was renamed to the simpler-to-understand (if much less precise) PERSONALITY and moved to the Cognitive Lens.

This last point illustrates one of the tensions involved in defining a pattern, which must have affected Alexander et al, Tidwell, Crumlish and Malone, and others involved in this sort of effort: is it better to name and draw the boundaries of patterns narrowly, and precisely, or to make them wider and fuzzier? In the idea-generation context in which DwI was mostly intended to be used, simple names such as PERSONALITY might allow faster engagement with the idea, even if some precision is lost. However, using the patterns as a taxonomic system, perhaps classifying design examples, a more specific breakdown might be more appropriate. Inevitably, overall, the set of patterns contains some which are much 'higher-level' or more abstract than others, but this could also make it easier to appreciate the ways in which concepts can be transposed between disciplines.

In total, the revised DwI v.1.0 set of patterns comprised 101 patterns grouped into eight lenses, summarized in Tables 4.11 and 4.12. The '101' figure was somewhat arbitrary—there remains a list of 'marginal' patterns which have not been included—but was intended to follow the naming convention of books and guides such as Frederick's (2007) *101 Things I Learned in Architecture School* as well as echoing the US convention of 'Subject name 101' as the name of an introductory class for a subject at college or university (Engber, 2006). To some extent, the choice over which patterns to include or exclude at this stage was determined by whether suitable examples (with representative images) were available, since the image plays such a major role in the format of the cards. Figures 4.21 and 4.22 show the cards comprising two of the lenses (the full set is included in **[A2]**).

New card format

The new card format was to be landscape orientation, scaled and cropped to fit a standard 6" × 4" photograph format, with much less text overall and use of 'Can you...?' and 'What would happen if...?'-type questions to introduce each pattern. The new size meant that the 'cards' could be printed at a lower cost as required, using standard photo printing services (including self-service machines and online services).

Figure 4.20 shows the format, with CHALLENGES & TARGETS, from the new Ludic lens, as an example, while Figures 4.21 and 4.22 show the cards comprising two of the lenses (the full set is included in **[A2]**).

Worksheets were also produced (Figure 4.23; **[A2]**), following closely the format used for the v.0.9 worksheets. The online version was constructed using MediaWiki software,

Tables 4.11 and 4.12: The eight lenses of DwI v.1.0, with the description used on the 'introduction card' for each

LENS & PATTERNS	DESCRIPTION	LENS & PATTERNS	DESCRIPTION
Architectural: 12 patterns ANGLES, CONVERGING & DIVERGING, CONVEYOR BELTS, FEATURE DELETION, HIDING THINGS, MATERIAL PROPERTIES, MAZES, PAVE THE COWPATHS, POSITIONING, ROADBLOCK, SEGMENTATION & SPACING, SIMPLICITY	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 (see also the Security Lens). While most of the techniques have been developed in the built environment, many of the 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. Some of the patterns, such as SIMPLICITY, FEATURE DELETION and HIDING THINGS are really fundamental to all kinds of design.	Perceptual: 17 patterns (A)SYMMETRY, COLOUR ASSOCIATIONS, CONTRAST, FAKE AFFORDANCES, IMPLIED SEQUENCES, METAPHORS, MIMICRY & MIRRORING, MOOD, NAKEDNESS, PERCEIVED AFFORDANCES, POSSIBILITY TREES, PROMINENCE, PROXIMITY & GROUPING, SEDUCTIVE ATMOSPHERICS, SIMILARITY, TRANSPARENCY, WATERMARKING	The Perceptual 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 puts them into forms which invite the designer to think about how they might influence people's behaviour. Most are predominantly visual, but they need not be: sounds, smells, textures and so on can all be used, individually or in combination. These techniques are often applied by interaction designers in the course of doing a job without necessarily considering how they can influence user behaviour.
Errorproofing: 10 patterns ARE YOU SURE?, CHOICE EDITING, CONDITIONAL WARNINGS, DEFAULTS, DID YOU MEAN?, INTERLOCK, MATCHED AFFORDANCES, OPT-OUTS, PORTIONS, TASK LOCK-IN/OUT	The Errorproofing Lens treats 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. It's a view often found in ergonomics, health & safety-related design, medical device design and manufacturing engineering (as *poka-yoke*). Much of this builds on Don Norman's classic concept of forcing functions. A key difference between an errorproofing approach and some other views of influencing user behaviour is that errorproofing doesn't care whether or not the user's attitude changes, as long as the target behaviour is met.	Cognitive: 15 patterns ASSUAGING GUILT, COMMITMENT & CONSISTENCY, DECOYS, DESIRE FOR ORDER, DO AS YOU'RE TOLD, EMOTIONAL ENGAGEMENT, EXPERT CHOICE, FRAMING, HABITS, PERSONALITY, PROVOKE EMPATHY, RECIPROCATION, REPHRASING & RENAMING, SCARCITY, SOCIAL PROOF	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, although this risks the accusation of design becoming a tool of the 'nanny state' which 'knows what's best'. The patterns detailed here draw heavily on the work of Robert Cialdini, Richard Thaler and Cass Sunstein among others.
Interaction: 10 patterns FEEDBACK THROUGH FORM, KAIROS, PARTIAL COMPLETION, PEER FEEDBACK, PROGRESS BAR, REAL-TIME FEEDBACK, SIMULATION & FEEDFORWARD, SUMMARY FEEDBACK, TAILORING, TUNNELLING & WIZARDS	All the patterns are really about interaction design in one form or another, but the Interaction Lens brings together some of the most common design elements where users' interactions with the system affect how behaviour is influenced. So there are core HCI patterns here, such as kinds of feedback, PROGRESS BARS, and previews, and some less-used such as feedforward. This lens also includes patterns from the growing field of Persuasive Technology, where computers and phones are used to persuade users: changing behaviour through contextual information, advice and guidance. Among these are KAIROS, TAILORING and TUNNELLING, identified in BJ Fogg's seminal book *Persuasive Technology*.	Machiavellian: 14 patterns ANCHORING, ANTIFEATURES & 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	The Machiavellian Lens comprises design patterns which, while diverse, all embody an 'end justifies the means' approach of the kind associated with Niccolò Machiavelli. These will often be considered unethical, but nevertheless are commonly used to control and influence consumers through advertising, pricing structures, planned obsolescence, lock-ins and so on, and central to much work by authors such as Vance Packard and Douglas Rushkoff revealing the 'hidden' structures which shape our everyday behaviour. In technology contexts, Benjamin Mako Hill and Chris Nodder have both done great work exploring this area. An element of Game Theory is present in some of the patterns, and this is an area worthy of further investigation.
Ludic: 11 patterns CHALLENGES & TARGETS, COLLECTIONS, LEAVE GAPS TO FILL, LEVELS, MAKE IT A MEME, PLAYFULNESS, REWARDS, ROLE-PLAYING, SCORES, STORYTELLING, UNPREDICTABLE REINFORCEMENT	Games are great at engaging people for long periods of time, getting them involved, and, if we put it bluntly, influencing people's behaviour through their very design. Yet this potential has (so far) been underexplored in application to other kinds of situations outside 'recreation'. The Ludic Lens includes a number of 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 operant conditioning, to common game elements such as SCORES, LEVELS and COLLECTIONS.	Security: 12 patterns 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	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. From a designer's point of view, this can often be an 'unfriendly'—and in some circumstances unethical—view to take, effectively treating users as 'guilty until proven innocent'. However, it's possible to think of ways that the patterns could be applied to help users control their own habits or behaviour for their own benefit—encouraging exercise, reducing energy use, and so on.

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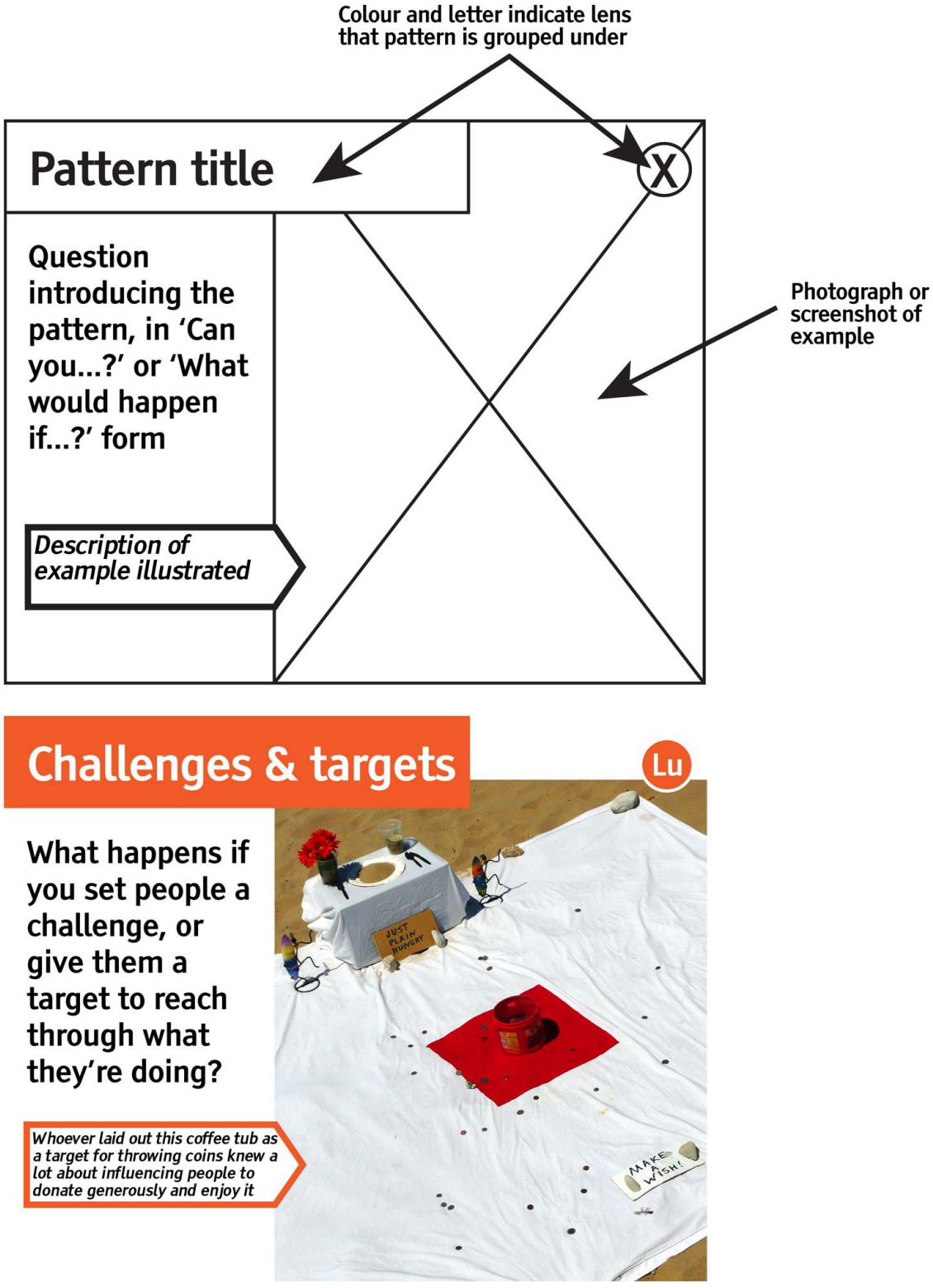


Figure 4.20: The DwI v.1.0 card format, with CHALLENGES & TARGETS, from the new Ludic lens, as an example.

Figure 4.21: The cards of the Interaction lens of DwI v.1.0. The full pack is included in **[A2]**.

Figure 4.22: The cards of the Errorproofing lens of DwI v.1.0. The full pack is included in **[A2]**.

Figure 4.23: DwI v.1.0 worksheets in use at a workshop at Philips Research, Eindhoven (see section 5.4.3)

allowing a Wikipedia-like interface with the ability to update, edit and add pages easily, and, in time, the facility to open up editing to registered users so they could add their own examples and comments. The initial 'Design with Intent toolkit wiki' was put online in April 2010 along with releasing a free PDF version of the cards (and worksheets) for download. Printed versions were put on sale in May 2010, initially at the UX London industry conference, and then online, priced at a level to cover the costs of production and postage, including a small surplus to fund giving away packs of cards to certain people and organisations whose feedback was considered desirable. Feedback from early users of the toolkit will be discussed in section 5.4.4.

Incorporating models of the user, and suggested activities

The pinball, shortcut and throughtful models were introduced in section 4.4.1, drawing on **[B3]**. To incorporate these into the toolkit, extra cards and a wiki page giving a brief summary of each model were included as part of the introductory material (Table 4.9) in DwI v.1.0, with a suggestion of some of the DwI patterns from the different lenses which might embody each model. Matching (some of) the patterns to the models was possible, but by no means definitive. The introductory text was as follows:

> The different approaches to influencing people's behaviour outlined in the Design with Intent toolkit are pretty diverse. Working out how to apply them to your design problem, and when they might be useful, probably requires you, as a designer, to think of "the user" or "users" in a number of different ways in relation to the behaviour you're trying to influence. I've done some research on this with designers, and reckon there are maybe three main ways of thinking about users—models, if you like—that are relevant here.

A suggestion was made in the 'How to use the cards' introductory text for an exercise using the models:

> MODELS OF THE USER
>
> Works best with three or more people. Using the 'Pinball', 'Shortcut' and 'Thoughtful' cards, each person should try to generate ideas sticking to one of the models, then explain (and defend) them to the rest of the group.

The 'How to use the cards' introductory text included a range of suggested activities (Figure 4.24) based on the author's experience running workshops at this stage, and a question was included in the user survey (section 5.4.4) addressing this issue, so that future versions could be augmented with examples of the kinds of ways that users had made use of the toolkit.

Once the new version of the toolkit was ready, it was time to act, and observe, through a series of applied workshops and a user survey—described in section 5.4.

4.5 Design with Intent: from v.1.0 onwards

In section 5.4, DwI v.1.0 was evaluated through its application to a range of behaviour change problems, via workshops, examples and case studies, and a survey of 100 early users of the toolkit was detailed and analysed. This section reflects on insights from this evaluation, and their implications for future development of the toolkit after the conclusion of this PhD.

4.5.1 Reflect

The applied workshops and worked example described in sections 5.4.1–5.4.3 represent a maturation of the toolkit to a form suitable for wider application. Building on the DwI v.0.9 Brunel and applied workshops examined in section 5.3, the v.1.0 workshops demonstrated that the toolkit could be successfully applied to 'real' problems, and briefs set externally, by participants from industry (e.g. Philips, UX London), the public sector (e.g. West Sussex County Council) and academia (e.g. NTNU, Brunel), generating diverse sets of concepts (e.g. as demonstrated by the Twente workshop) for influencing user behaviour through design, and facilitating discussion of behavioural issues (e.g. as intended in the MBE KTN exercise).

The survey (section 5.4.4) and feedback from the case studies (section 5.4.5) suggest that the toolkit is found of use by those who responded, at least; the majority of survey respondents said that they were likely to recommend the toolkit to colleagues, and most respondents also said that their *knowledge* had increased as a result of using the toolkit, with more than half stating that their *attitudes or perspectives* had changed, and some also having improved their *skills* (all aspects of the Kirkpatrick (1998) Model for evaluating training programmes). Nevertheless, a number of suggestions were made for improvements, and these are detailed below.

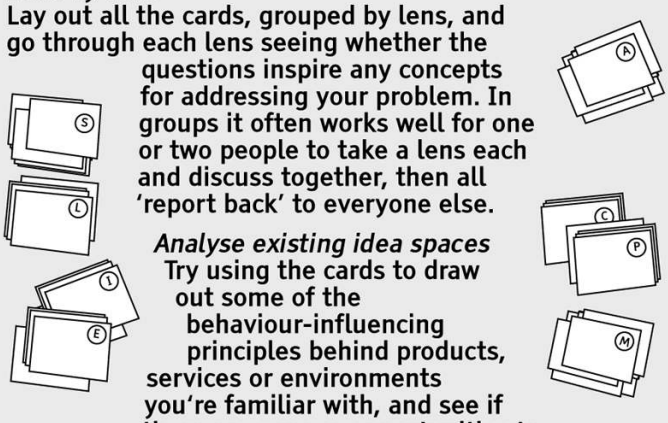
Evolution of the workshop format

The evolution of the workshop format was also addressed, particularly via the comments in the tables in section 5.4.3: a possible 'specification' for effectively using the toolkit cards or worksheets in workshops gradually emerged, including points such as:

How to use the cards

Each pattern / gambit is phrased as a question — a provocation to invite discussion about the behaviour change question or brief you're considering*. The landscape format means it is easier for two people to look at a card together.

Lens-by-lens
Lay out all the cards, grouped by lens, and go through each lens seeing whether the questions inspire any concepts for addressing your problem. In groups it often works well for one or two people to take a lens each and discuss together, then all 'report back' to everyone else.



Analyse existing idea spaces
Try using the cards to draw out some of the behaviour-influencing principles behind products, services or environments you're familiar with, and see if there are gaps or opportunities to explore further. Printing the cards onto sticker paper can be useful here for 'annotating' real items.

Models of the user
Works best with three or more people. Using the 'Pinball', 'Shortcut' and 'Thoughtful' cards, each person should try to generate ideas sticking to one of the models, then explain (and defend) them to the rest of the group.

Target behaviours
Using the 'Target behaviours' card as a starting point, try to frame your problem in terms of a target behaviour, and keeping this is mind, look at the cards suggested as most applicable.

Random pairings
Pick two cards at random, perhaps from different lenses, and think about the possibilities of applying the ideas to your problem, both individually and together.

Weekly idea
101 cards means that every week for two years you could have a new card 'on show' as a talking point in the office to inspire creative thinking**.

Your own way
If you've found your own way to make use of the cards, let everyone know! Write about it, or email me: dan@danlockton.co.uk

**I'm grateful to Nedra Weinreich for suggesting the 'question' approach. **Hat tip to Zoe Stanton of Uscreates for this idea.*

Figure 4.24: The 'How to use the cards' panel added to v.1.0 of the toolkit, with suggested exercises.

- A group size which works well is 4 or 8, so that each participant can become a 'mini-expert' in one or two lenses, and consider individually how they apply to the brief, before 'reporting back' to the group. A group discussion can then proceed to "amalgamate and refine the ideas" (as recommended by Rossiter and Lilien, 1994).
- For one facilitator, 40 participants divided into five groups is probably the largest size where it is possible for every group to receive sufficient attention.
- Enabling each participant to become a mini-expert in some way can help where groups contain some participants who might otherwise feel their voice is not being listened to (e.g. where there are particularly dominant group members).
- If time and numbers allow (e.g. where there is only a small number of participants), each person's reporting back can be done to the whole room, thus again helping participants feel they are being listened to.
- Cards or worksheets both work; worksheets are possibly more applicable where participants are less confident about their 'design' expertise, since they present a more clearly 'finite' set of patterns.
- Again in cases where participants are less confident about their 'design' expertise, or have not considered behaviour change previously, allocating just one (different) lens per group, with all groups addressing the same brief, can reduce the feeling of being overwhelmed, and allow each group to come up with substantially different perspectives on the problem.
- For small or quick workshops, limit the number of briefs to enable groups to explore them within the time available.
- For very small or quick workshops, where participants will not be able to consider more than one or two patterns from each lens, cards are better than worksheets since a selection of cards (rather than the full 101) can be used.
- Cards overall appear to be more 'fun' for participants to use, particularly where the workshop is being seen as something different to everyday work. Cards also provide affordances such as being able to pick (or combine) patterns at random more easily—again, enabling a more fun slant.
- If using worksheets, make it clear that participants can annotate them, e.g. using Post-It notes.
- Ideally, one person from each group should be confident at sketching or at least recording the group's ideas.
- It is possible to use a matrix or otherwise exhaustively to try applying *every* pattern (or a pre-chosen subset of them) to the brief, and this may work where participants want to generate as many concepts as possible (even if unrealistic), to show that a wide range of perspectives have been taken, or where participants are especially confident about their creativity.
- At the end of the workshop, every group should present its (self-chosen) 'best' concept(s) to the whole room, if necessary explaining the brief first. This can be done purely verbally, via sketches, or even through the group members 'acting out' their concept, perhaps using simple props, and with some group members acting as part of the system. This last method can work well where the concepts are services, or include products which are already present in the room.

- 'Typical' workshop timings have converged on:
  - a 20 minute introduction to design for behaviour change and the toolkit
  - 45 minutes in groups generating concepts
  - optionally, 15 minutes to put together scenes for acting out the concept(s) if this format is used
  - 10 to 20 minutes for groups to explain or act out their concepts to the whole room
  - 10 minutes for whole room discussion and reflection

Insights from the survey and case studies

The survey (section 5.4.4) and case studies (section 5.4.5) revealed insights directly from people who had chosen to use the toolkit in their work (or for their own interest), and these thus represent a very important set of considerations to reflect upon. Synthesising suggestions, criticisms and possible longer-term improvements identified earlier, points for consideration in future revisions to the toolkit (after this PhD is completed) include:

- **A toolkit structured to enable multiple ways of using it**
  - Survey responses showed that early users made use of the toolkit in a variety of ways; while individual and group brainstorming were the predominant use-cases, others included informal inspiration, browsing/reading through the cards like a book, use as a reference, use to analyse or classify existing ideas, and use as teaching material. Most respondents mentioned more than one way they had used the toolkit.
  - As such, the toolkit needs to make it easy to use it in multiple ways, for example by:
    * Improving and augmenting the 'How to use the cards' coverage, with case studies of how others have used them, more suggested exercises, and perhaps a flow-chart for how to use the cards.
    * Making sure that the text and images are available in formats which can be copied and embedded easily for new uses.
    * Offering forms other than cards and worksheets—perhaps a game, random draw method or other kind of structured system.
    * Software applications (e.g. for iPad) based on the DwI cards, but making use of online capabilities to allow sharing of examples, discussion, annotation and deeper background material.
    * A poster, ring binder or book version to allow multiple patterns to be scanned more easily at once
    * Videos, animations and interactivity ("find out more" links) on the online version
  - The implications of some otherwise contradictory suggestions from respondents hint at the need for multiple formats—smaller cards for individual use, larger cards or posters for group use, detailed background information for users who want it, with simpler summaries for those who do not.

- **A toolkit which explicitly recommends particular patterns based on characteristics of the behaviour change situation**
  - A number of respondents, and workshop participants wanted clear recommendations about when to use particular patterns—essentially, a better version of the 'prescription mode' (see section 4.3.2), perhaps in the form of "these types of behavioural challenges are often best approached through these levers" as suggested by IDEO's Lydia Howland; perhaps, ultimately, the *BehaviourTRIZ* as suggested in section 2.4.1.
  - This would require much more evidence about the effectiveness in practice of different behaviour change techniques, in different circumstances—a huge project, but not impossible in the longer term. One respondent went so far as to suggest "an algorithm for when to use which patterns", which would would potentially be even more deterministic (see section 6.4) than a *BehaviourTRIZ*.
  - This could make use of the pinball / shortcut / thoughtful models more clearly, by using these to connect contextual research about users' motivations and levels of understanding to particular design patterns, but this will require research on the part of designers beforehand.
  - It could also include, at the very least, caveats about when particular patterns are more likely to be unsuitable, or clear 'pros' and 'cons' for each, which were included in earlier versions of the toolkit but removed to make the descriptions shorter in v.1.0
- **Variants of the toolkit focused on particular fields or disciplines**
  - Some respondents found it difficult to transpose certain patterns into the context on which they were working—for example, as noted in some of the workshops, there were not many metaphorical transpositions of concepts from the Architectural lens such as ROADBLOCK or SEGMENTATION & SPACING into interface design.
  - This could suggest ensuring that each pattern has examples from multiple contexts—product design, built environment, service design and/or interface design.
  - Alternatively, and as requested by some respondents, there could be multiple variants of the toolkit with examples drawn only from particular kinds of products, services and environments—e.g. a 'built environment' DwI toolkit, a 'software and website' DwI toolkit and a 'product design' DwI toolkit
  - Or, variants could focus on particular kinds of behaviour change—e.g. home energy use behaviours, social engagement or community group development. This has been achieved to some extent by users making their own subsets of cards which they feel are most relevant to their field, but could be done 'officially' as part of the toolkit itself.[13]
- **Aesthetic and usability improvements**
  - Aesthetic criticism of the cards centred on the visual design and the quality of the printing. Fitting the varying length question text onto the cards for all

[13] e.g. Autodesk's sustainability team have created a 'Sustainable Design with Intent' pack, which comprises 52 cards chosen from the 101, for use in workshops on behaviour change (Danby and Menter, 2012).

101 patterns led to some having more cramped text than others, something which should be solved for a future version.

- A cheap, on-demand (photo-printing) method was used for the physical cards in DwI v.1.0, but with some investment up-front, larger print runs on higher quality card stock, perhaps with rounded 'playing card' corners, would be feasible.
- From a usability perspective, suggested improvements include:
  * Numbering of the cards
  * Tabs on the introductory 'index card' for each lens
  * Links to related or similar patterns on the online version
  * Making it easier to scroll through the patterns online
  * Using both sides of cards—with more details on the back

- **Structural and content changes**
  - One recurring suggestion was the use of multiple examples for each pattern rather than just one, potentially making cross-disciplinary transposition easier. Allowing readers of the wiki to add their own examples (and potentially their own patterns too) could be a way to support this, and could also address the concern that the examples are currently too UK-centric.
  - Regular review of the examples to keep them current was suggested; this is more likely to be a problem with examples which are frequently updated websites or software.
  - Some respondents would prefer formal, mutually exclusive disciplinary categories for the patterns, rather than the relative informality of the lenses. This may be possible, but would not necessarily support cross-disciplinary transposition.
  - As the field of design for behaviour change develops, more detailed case studies can be included, from both academia and industry/public sector, which explain the design process as well as the resulting product. Whether these would be included as cards, or as part of an accompanying book (more likely), case studies of this kind, ideally with background context information on the behaviour concerned, and data on the effectiveness of the intervention, would significantly enhance the credibility of the toolkit, and directly provide designers with deeper examples of 'how to do it' (and perhaps how not to).
  - Presenting a design for behaviour change 'process' as part of the toolkit could encourage research with users and a more reflective approach to the idea generation process, including aspects such as suggestions for how to test and measure behaviour change, ethical considerations and questioning assumptions held about the users.

While not all of the suggestions and points for consideration can necessarily be implemented, the process of feedback from early users, together with direct insights from running the workshops, has enabled reflection on the value of the toolkit in its intended use context. Chapter 6 continues this reflection, broadening the discussion to the PhD as a whole.

4.6 Conclusions of toolkit development chapter

Following the identification of the research questions in Chapter 2, and consideration of appropriate research methodology in Chapter 3, this chapter described how the design for behaviour change 'toolkit'—which became known as the *Design with Intent toolkit*—was developed, essentially comprising the *reflect* and *plan* stages of the action research spiral, for each version of the toolkit from v.0.1 to v.1.0. This chapter is intended to be read in conjunction with Chapter 5, which covered the *act* and *observe* stages.

4.6.1 Which parts of the research questions were addressed?

In section 2.3.2, a gap in the literature was identified as the first research question of this thesis:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

The form in which the ideas were brought together—the toolkit, as described here in Chapter 4—would answer parts of this 'How?' question, while the *act* and *observe* stages described in Chapter 5 would also address a second research question:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

Which parts of the first question can the *reflect* and *plan* stages here in Chapter 4 answer? Primarily it is the sub-questions of:

- How can behaviour change techniques and examples from a range of disciplines...
- ...be brought together in a form... for idea generation...
- ...for designers working to influence more environmentally and socially beneficial behaviour?

Note that the 'of use' criterion, along with the second research question, are largely addressed in Chapter 5.

4.6.2 How Chapter 4 addressed parts of the research questions

The overarching narrative of this chapter has been around addressing the "...be brought together in a form... for idea generation" sub-question.

While the chapter initially reflected on considerations for developing the toolkit which would allow designers to explore ideas around behaviour change, and relate them to problems at hand (the "How can behaviour change techniques from a range of disciplines..." and "...for designers working to influence more environmentally and socially beneficial behaviour"sub-questions), the majority of the chapter has covered the *form* of the toolkit as it was developed, covering issues such as levels of abstraction, target behaviours, and mapping particular behaviours to particular design techniques.

These considerations were incorporated these into a series of quick iterations leading to DwI v.0.7, which was the first version of the toolkit on which external feedback (from design practitioners) was sought. Drawing on that feedback (described in Chapter 5), the next version of the toolkit was developed, prior to subsequent further evaluation, and so on. This cycle iterated the toolkit a number of times, up to DwI v.1.0.

The versions described were:

- DwI v.0.1–0.6: Initial attempts to find a satisfactory form and taxonomy for the toolkit, including much renaming, rephrasing and regrouping of both target behaviours and design techniques, and progressions in form towards a decision tree
- DwI v.0.7: A decision tree structure based on target behaviours, with 44 design techniques grouped into five 'lenses'
- DwI v.0.8: An 'idea space' format, again based on target behaviours, with 20 diagrams, five lenses and 44 techniques
- DwI v.0.9: Poster, card and online formats, with 'inspiration' and 'prescription'modes; six lenses and 47 design patterns
- DwI v.1.0: Card, worksheet and online formats, with eight lenses and 101 design patterns; multiple modes of use

Each of these represents an evolution of the form, with evaluation of each from v.0.7 to v.1.0 described in Chapter 5. Each is an answer to the "...be brought together in a form... for idea generation" sub-question.

The final section of this chapter returned to the wider "...for designers working to influence more environmentally and socially beneficial behaviour"sub-question, reflecting on lessons from the applied workshops, user survey and case studies with v.1.0 described at the end of Chapter 5, including implications for future development and the evolution of the workshop format in the context of designers working on behaviour change.

4.6.3 Summary of chapter's outcomes

In summary, Chapter 4 answered:

- How can behaviour change techniques and examples from a range of disciplines...
- ...be brought together in a form... for idea generation...
- ...for designers working to influence more environmentally and socially beneficial behaviour?

through the iterative development of a toolkit which in its final form, brings together behaviour change techniques and examples from a range of disciplines into 101 'design patterns', grouped into eight lenses, in card, worksheet and online formats.

5 Understanding and evaluating the toolkit in use

This chapter is paired with Chapter 4 as part of the 'spiral' *plan–act–observe–reflect* approach (Robson, 1993) to action research methodology (section 3.4.4). Chapter 4 covered the *reflect* and *plan* stages of the spiral, for each version of the toolkit, while this chapter concentrates on the *act* and *observe* stages, exploring the iterative evaluation of the toolkit in use, through workshops, worked examples, a survey of early users and case studies. Figure 4.1 in Chapter 4 provides a visual representation of the research stages through the development of the toolkit.

5.1 Evaluating Design with Intent v.0.7

> "It may be better to think of your initial version not as a product, but as a trick for getting users to start talking to you."
>
> Paul Graham, 'What Startups are Really Like', 2009

The plan as outlined in section 4.1.2 was to develop the DwI toolkit to a 'proof of principle' stage where it was ready to be presented externally—to a design consultancy with an interest in behaviour change—to get feedback on its form and content, and suggestions on how to develop it further (the 'act' and 'observe' stages of the action research process). By v.0.7, enough elements were in place for DwI to be presented in this way. Section 4.1.2 in Chapter 4 introduce the structure of DwI v.0.7.

5.1.1 Act

The research questions (section 2.3.2) being answered through the development of the toolkit focus on being of use to "designers working to influence more environmentally and socially beneficial behaviour" in practice. Design industry feedback was thus an important component in the research process, and at this early stage, it was decided to seek feedback on the toolkit's form and content, and potential suggestions on how to develop it further, to test whether the toolkit was 'on the right track', and if not, how to improve it prior to running workshops.

Designers, particularly those working on behaviour change, were the target users. In selecting a consultancy to present to, the author looked for organisations which had some experience in this area, and were likely to be engaged in similar projects in the future. One company which fitted the criteria was live|work, one of the pioneering British service design consultancies, and one which was used to engaging with academic research on design methods in practice (e.g. Han, 2010a).

Live|work had been responsible for *Low Carb Lane* (Tan, 2008), a project run as part of the Design Council 'Designs of the time' (Dott 07) initiative in north-east England, in which a street in East Ashington, Northumberland provided an ethnographic research base for insights into reducing domestic energy use, particularly in lower-income households which could, proportionally, benefit more from reduced utility bills: "What began

as designing ways to reduce the carbon footprint of a home, ended up being a financial service for tenants... The designers developed a service that linked energy use to finance by providing a Saverbox financial package for tenants. Tenants would also be able to monitor energy use and financial information on an energy 'dashboard' through their TV" (Tan, 2008).

Service design was considered a relevant industry sector from which to seek initial feedback, primarily because of its explicit focus on people[1], and their interaction and experience with 'touchpoints' (products, services, and product-service systems; e.g. Kimbell, 2009), but also because workshops, idea generation sessions, inspiration cards and similar tools (Tassi, 2008) appear to play a significant part in the everyday practice of the discipline (e.g. Stickdorn and Schneider, 2010). For many service design consultancies, particularly those working with the public sector, 'socially beneficial' design forms a large proportion of their work, and much of this involves attempts to influence behaviour in one form or another. Han (2010a) describes live|work's "belief that service is about people, networks and sustainability in economic, social and ecological environments."[2]

A meeting was arranged with live|work's Ben Reason, Rory Hamilton and Harriet Creed, and the discussion covered a number of design approaches to behaviour change, and details of the Low Carb Lane project as well as other energy and environment-related projects with which live|work were involved. The author explained the thinking behind the DwI toolkit and how it could be applied to a problem, using an A1-sized print of the tree diagram in Figure 4.4 (Chapter 4), and a set of five transparent folders to represent the five lenses, each containing the callout boxes as printed sheets, with extra illustrations of examples.

5.1.2 Observe

The comments from the live|work team were effectively that:

- The idea of a resource to help designers working on behaviour change problems was of use and had value
- The 'toolkit' approach made sense and could potentially be a useful way of exploring ideas and principles applicable to behaviour-related design problems...
- ...however, the 'if...then' tree structure was too limiting and too definitive for a tool in this field, where the appropriateness or effectiveness of different techniques was likely to be very context-dependent, and something which live|work would aim to to discover and evolve through prototyping services with users, rather than through making rigid decisions at an early stage
- The aim should be to open up the idea space by showing lots of possibilities, usefully categorised, rather than narrowing it down with prescribed solutions too early on
- There should be some element relating to the 'strength' of the different techniques, since they seem to be a mixture of coercive and persuasive approaches

[1] Indeed, Penin and Tonkinwise (2009) argue that "[w]hat differentiates service design from all other forms of design is that is primarily the design *of* people, rather than the design of things, environments or communications *for* people."

[2] It is outwith the scope of this thesis to investigate in detail the full potential for behaviour change work in service design, although two articles were subsequently co-authored, with practising service designers, for *Touchpoint*, the 'industry journal' of the Service Design Network, looking at how aspects of DwI might be used in this context (**[D2]** and **[D3]**). The applied case studies of DwI v.0.9 and v.1.0 described later in this chapter include a number of service design applications.

- The large 'poster' format combined with separate, more detailed sheets for the different lenses was a good idea for group brainstorming and planning work
- The structure of the decision tree was too complex for quick use by designers looking for inspiration or relevant examples
- The concept of the lenses was a useful structure, allowing different ways of approaching a problem to be appreciated, and could perhaps be adjusted to match different *stakeholders'* views of the problem
- The duplication of technique names in the tree, where the same technique was applicable to multiple lower-level target behaviours, appeared confusing and increased the amount of text that needed to be read
- Overall, therefore, a preferable structure for the toolkit would be something like "a circular space of options" illustrating example applications of different design techniques relevant to behaviour change, centred on different lenses.

It was clear from live|work's comments that the toolkit needed significantly more work before it would be of use in an industry context, or indeed worth testing in workshop sessions. Redesigning the toolkit around the circular 'idea space' concept seemed to be a direct way forwards.

Section 4.2 in Chapter 4 covers the 'reflect' and 'plan' stages of the action research process, leading from v.0.7 to v.0.8 of the toolkit, taking into account live|work's comments and recommendations.

5.2 Evaluating Design with Intent v.0.8

Following the feedback from live|work, described in section 5.1.2, the toolkit was reconfigured into a set of 'idea space' diagrams, along with incorporating other new elements. The process of reflection and planning which led to DwI v.0.8, as well as its form, are described in sections 4.2.1 and 4.2.2.

In the following two sections, the first 'pilot study' workshop sessions using the toolkit are covered briefly—a full description has been published as **[C2]**.

5.2.1 Act

Four participants (two recent design graduates and two product design students with industrial experience and an interest in design for social benefit) were chosen to take part in the initial pilot study workshop sessions (Figure 5.1 shows one of the sessions).These sessions were primarily intended to investigate the *usability* of the DwI toolkit in its then-current form (v.0.8), addressing the following questions (Table 5.1):

The procedure is described in detail in **[C2]**; to summarise, participants A, B and C received an instruction booklet leading them through the toolkit, together with large (A2) versions of all the suggestion diagrams. The rationale and structure of the toolkit were explained with reference to a non-environmental user behaviour design problem—preventing a customer leaving his or her card in an ATM (see **[B2]**)—and the types of solutions suggested were discussed, along with the usability and feasibility of each. Participant D, as a control, received neither the toolkit nor any instructional material, but was set the same briefs.

All participants were then given 40 minutes, individually, to use the instruction booklet and diagrams however they wished to generate conceptual solutions to one of two briefs—

Table 5.1: Questions addressed by the v.0.8 pilot study

QUESTIONS	HOW ADDRESSED
Is it possible for a designer to understand how to use the DwI toolkit, quickly?	Time; questions from participants
How does the designer use the categories / structure? Which elements cause confusion?	Observation; participants' think-aloud narratives and questions; evidence of misunderstanding
Does the designer generate concepts using the toolkit?	Output from sessions

Figure 5.1: A pilot study session in progress: a participant uses the suggestion diagrams to generate concept solutions.

on influencing domestic lighting use behaviour, and on influencing printing behaviour[3]. Full details are included in **[C2]**.

A *think-aloud protocol* was used (Ericsson and Simon, 1984), where, as far as possible, each participant explained his or her thought processes as each part of the task was undertaken. After the sessions, the participants were asked to run through the ideas generated and explain the thinking behind them where this had not already been mentioned; the discussion continued with debriefing interviews in which the usability of the toolkit was addressed and the questions around how it was used were explored further.

5.2.2 Observe

The questions addressed by the study are listed below. A full analysis of the observations and findings is contained in **[C2]**, but a summary will be given here.

Is it possible for a designer to understand how to use the toolkit, quickly?

Introducing and explaining the toolkit took about 20 minutes for participants A, B and C, including answering questions about aspects of its use, prior to the 40 minute session. Participant B referred to the instruction booklet in the early part of the session to compare the target behaviour descriptions, and thereafter used the suggestion diagrams to support the concept generation, whereas A and C asked questions throughout the session to clarify aspects of how the toolkit should be used. All three generated a range of design concepts addressing the brief chosen in the 40 minute session—so within an hour's total time, it was possible to understand the toolkit to some extent, and apply it—but the degree of clarification needed suggests that either more time is needed, or the toolkit needs to be simpler and more rapidly comprehended. A lot of time was taken reading the technique descriptions: more succinct (e.g. bulletted) text here would help, especially with unfamiliar terminology, e.g. KAIROS and SOCIAL PROOF.

How does the designer use the categories / structure?

Two overall usage patterns were apparent from the participants' sessions. B followed the flow chart (Figure 4.10 in Chapter 4) to a large extent, considering which target behaviours were most applicable to the brief (lighting), and using the suggestion diagrams to narrow down the set of applicable techniques before using these for inspiration. A and C, while aware of the target behaviours, made little use of them, instead using the techniques and examples on the suggestion diagrams directly as inspiration for generating concepts (for the printing brief). The two usage patterns are summarized in Table 5.2.

Considering other aspects of how the toolkit was used:

- The lenses were used by all participants as part of their concept generation process, working through the lenses' suggestion diagrams in turn, seeing what concepts were suggested by the techniques and examples before moving on to another.
- Not all lenses proved of equal use, based on participants' comments. For example, A commented that only the *persuasive interface* and *poka-yoke* lenses seemed relevant to the printing brief, and accordingly only used techniques from those two lenses.

[3] From the author's assessment, both of these briefs fitted a P2 target behaviour (Table 4.1 in Chapter 4) most closely, 'User follows process or path optimised for run-time criteria', but this was not mentioned to participants.

Table 5.2: Two usage patterns apparent from the sessions

Prescription + inspiration	B	Deciding on target behaviours, and using the mappings between target behaviours and applicable design techniques to support the generation of concepts, working through each lens's suggestion diagram
Inspiration only	A & C	Using the suggestion diagrams as a starting point, generating concepts directly inspired by the techniques and examples, making little use of the target behaviours and mappings

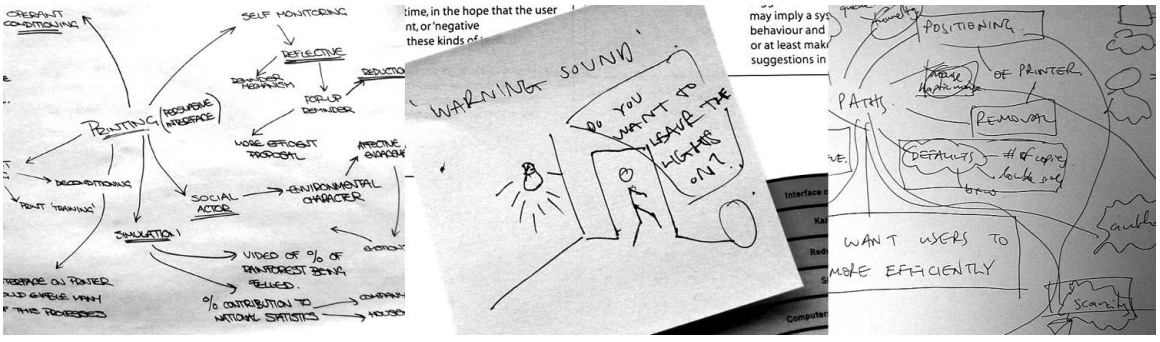


Figure 5.2: A selection of participants' sketches and notes from the pilot study sessions.

- B was the only participant to make full use of the target behaviour classification, settling on the P2 and P3 specific target behaviours: *User follows process or path optimized for run-time criteria* (i.e. the user would switch lights on/off according to the environment at that moment) and *Decision among alternatives: user's choice is guided* (i.e. the user would be somehow guided as to when lights should be on/off).

- The suggestion diagrams' use of colour or its absence to indicate which techniques and examples are especially relevant to each target behaviour was potentially visually confusing and while explained in the instruction booklet, no participant made full use of this distinction. It was clear that this aspect of the toolkit would, therefore benefit from clarification or a redesign of the diagrams.

- None of the participants explicitly made use of the enabling / motivating / constraining approach distinction, which suggests that it was poorly explained or simply not considered immediately useful.

- Participants chose to use either large sheets of paper or Post-It notes to describe and sketch concepts, either annotating the suggestion diagrams in place, adjacent to the techniques which inspired them, or creating 'mind-map' style networks of ideas and sketches (Figures 5.2 and 5.3).

Do participants generate concepts using the toolkit?

From the point of view of developing new design solutions, these are the most interesting results, and while the aim of the pilot study was primarily to improve the usability of the method, the nature of the concepts generated is also valuable to examine. **[C2]** includes a selection of the concepts generated by the participants. They vary in the detail of resolution expressed, as would be expected given the time pressure of the session, but all are technologically feasible.

How many concepts did participants generate?

A generated 12, B generated 18, C generated 9 and D, the control, generated just 5. With such a small sample size, it is not possible to say whether the relatively more prolific performance of B, with a *prescription* + *inspiration* usage pattern (Table 5.2), versus the *inspiration* only pattern of A and C, is significant, or whether it is due to the different briefs addressed, or the individual design ability of the participants.

Nevertheless, A, B and C all generated more concepts than D who had no stimulus material, which suggests that having something to focus one's thinking may be useful for concept generation. The concepts D suggested, as control, working on the printing brief, paralleled some of the same ideas A and C generated, but did not venture outside the feedback / self-monitoring area.

Section 4.3 reflects on the insights from the pilot study sessions in considering the next stage of development of the toolkit, v.0.9.

5.3 Evaluating Design with Intent v.0.9

Following the pilot study sessions with DwI v.0.8 described above, a process of reflection and planning (see sections 4.3.1 and 4.3.2) led to the development of DwI v.0.9, with a number of revisions, including the introduction of 'inspiration' and 'prescription' modes of using the toolkit.

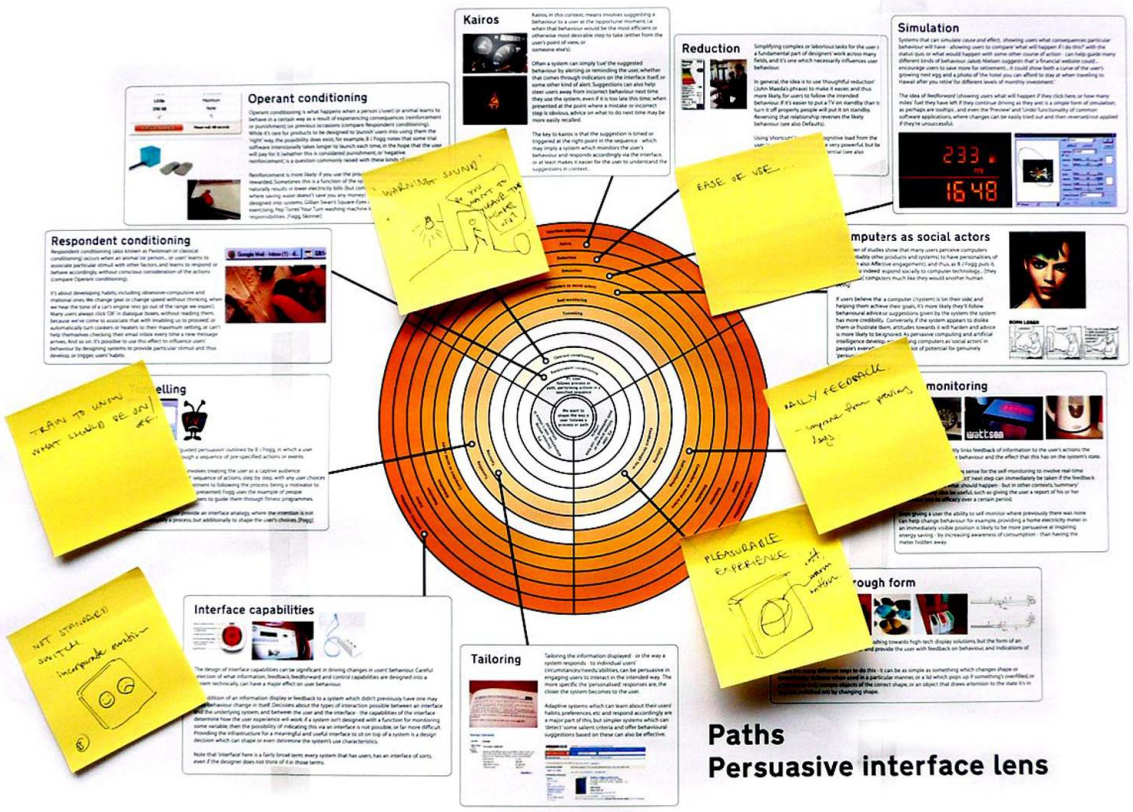


Figure 5.3: A participant's use of Post-It notes to annotate one of the suggestion diagrams.

The aim was to test this via a series of workshops, in both academic and applied settings (see section 3.5.1 for the background to workshops as a research method), and these are described in sections 5.3.2 and 5.3.3 below. Prior to the workshops—the 'act' and 'observe' phases of the action research procedure at this stage of the toolkit's development—a worked example was created, applying the toolkit to an interaction behaviour problem with 'known solutions'.

5.3.1 Worked example: reducing ATM card error

Before running the workshop studies, an example application of DwI v.0.9 (in prescription mode—section 4.3.2) was carried out. This has been published in **[B2]**, so will be recounted here in abridged form. As explained in section 3.5.2, worked examples can allow a new process to be 'run through' to check for problems, enabling a degree of validation of the toolkit against existing solutions, as well as potentially acting as a useful demonstration for users of the toolkit.

The worked example concerned the interaction behaviour problem of users leaving their bank cards in ATMs (cash machines) after use. While not a 'sustainable behaviour' problem, ATMs are also particularly suitable for analysis using ergonomics methods and concepts, and a number of improved interface designs have been tested by human factors researchers (e.g. Chan et al. 2009; Zimmerman & Bridger 2000). The behaviour-influencing features of real ATMs, developed in response to user errors over the years, are also easy to compare with the possible techniques suggested by applying the toolkit.

Background to the problem

Automatic teller machines are the face of a product-service system in which user behaviour must be limited to a defined set of permissible interactions, and errors must be designed out. A hierarchical task analysis (HTA; Stanton, 2006) was carried out of the most common interaction goal, 'Get cash from ATM', for a typical modern ATM, and this is included in **[B2]** together with a discussion of its implications. Essentially, ATMs are intended to replace a human teller, so the limited interactions afforded by the machine—the 'critical interaction path'—replicate a subset of what is possible in human-to-human interaction, but without the opportunity for intelligent contextual correction of errors.

A major opportunity for error with historic ATMs came from a user leaving his or her ATM card in the machine's slot after the procedure of dispensing cash or other account activity was complete (Rogers et al. 1996; Rogers & Fisk 1997). This was primarily because the cash was dispensed before the card was returned, leading to a postcompletion error—"errors such as leaving the original document behind in a photocopier... [or] forgetting to replace the gas cap after filling the tank" (Byrne & Bovair 1997). The obvious design solution was an interlock forcing function (see section 2.2.2; Norman 1988) or control poka-yoke (Shingo 1986), requiring the user to remove the card before the cash is dispensed (Zimmerman and Bridger, 2000). When both cash-then-card and card-then-cash ATM designs were in common use concurrently, there was disagreement among banks as to which design was better for customers (New York Times 1990), since the interlock forcing the user to remove his or her card before receiving cash meant that any desired subsequent transaction would require inserting the card and going through the identification process again—potentially inconvenient.

Would DwI v.0.9 in prescription mode have suggested the interlock idea? What alternative design techniques might also be applicable? With the brief "We don't want users to leave their cards in ATMs after use", what concepts does DwI suggest?

Deciding on a target behaviour

Applying the toolkit in prescription mode, the brief "We don't want users to leave their cards in ATMs after use" is first expressed as a target behaviour (Table 4.1). The idea of the critical interaction path suggests that target behaviour S1 is a fit for the brief as an overall strategy—"The user follows a process or path, doing things in a sequence chosen by the designer." Elements of the ATM and its environment in practice may satisfy different individual target behaviours, but here the brief relates only to users leaving their cards in the slot—a small part of the overall system, but representative of the problem scope designers may be asked to address. The design patterns suggested for S1 are now consulted (see Figure 4.14 in Chapter 4), including some from each of the six lenses. In total, 22 applicable patterns are suggested as being relevant.

Design concepts inspired by the patterns

A table of concepts from the author's own application of the process—with each of the DwI patterns which suggested it—is included in **[B2]**. Not every pattern suggested inspired suitable concepts; some inspired very similar concepts; many concepts could work together. Among the concepts suggested, the now-ubiquitous INTERLOCK card-then-cash forcing function is included—'Don't dispense the cash until the card has been removed', as are cues such as on-screen displays or lights adjacent to the card slot imploring card removal. These too are present on many current ATMs (Chung & Byrne 2008). In some territories, a 'swipe the card rather than leaving it inserted' design is found. Some advanced features have been trialled by individual banks: for example, the Swedish bank SEB has installed talking ATMs which guide users through the transaction process (Betts 2007), similarly to the concept suggested by the COMPUTERS AS SOCIAL ACTORS pattern.

Each concept suggested has strengths and weaknesses, including the impact it could have on other elements of the system and users' interactions. A system emphasising the return of the ATM card could lead to users forgetting to retrieve their cash, or draw unwanted attention from passers-by. This is the sort of issue where specialist domain knowledge of user behaviour would be valuable, together with user trials of the concepts.

Discussion of example application

This subsection has described applying the toolkit to a 'user behaviour' problem to illustrate its use. The worked example is simplistic and the full range of real-world constraints has not been applied, but a set of pertinent design concepts was generated, enabling easy explanation of the toolkit to potential users. It is arguable that most of the concepts suggested would be obvious to experienced designers and human factors professionals, particularly those with interface design expertise, but as Stanton and Young (2003) note, design decisions about aspects of systems affecting human performance are often made "by people with no specialist training in ergonomics."

A limitation of the application of DwI in the example is that it was carried out by the author, rather than independent designers, and the brief related to a problem which is already 'solved' to a large extent. In this sense, there is a risk of the concepts produced being 'engineered' to fit ideas which are already well-known with ATMs. Equally, the understanding of how to apply the design patterns suggested would differ for people untrained in the ideas behind them and unfamiliar with their development. The ATM example should thus be viewed as simply a demonstration of how DwI can be applied, as a precursor to workshops, rather than a test of its efficacy.

5.3.2 Brunel workshops[4]

The toolkit was now at a stage where it was considered appropriate to run a series of workshops, in greater depth and with a larger number of participants than the pilot study sessions described in section 5.2. As explained in section 3.5.1, these took the form of brainstorming / idea-generation / ideation sessions where participants were asked to generate concepts, individually or together, in response to a design problem or brief concerning influencing user behaviour—*redesigning everyday products to help users use them more efficiently.* The workshops were run at Brunel University and are referred to here as the 'Brunel workshops' although a number of participants were from other organisations (see discussion of 'Participants' below).

Act

Section 3.5.1 explains the background to the workshops, including the research questions. Summarising, the aim was to observe how participants made use of the toolkit, empirically, to uncover insights which would be of use for improving it, addressing issues such as how participants applied patterns to the briefs, how well different aspects were understood, and how the inspiration and prescription modes were used. Participants were asked to generate as many concepts as possible in response to each brief (Osborn, 1953; Nemeth et al, 2004). As well as the quantity of concepts generated, the nature and possibilities of the concepts were examined and discussed.

The briefs

The briefs were based on redesigning aspects of everyday products with which users interact, where user decisions (or lack of decisions) are responsible for a significant proportion of the products' environmental impact—using electric kettles efficiently, closing curtains at night to conserve heat[5], helping users print documents more efficiently, and influencing people to turn off the tap while brushing their teeth[6]. The focus on mundane interactions with familiar products meant that participants would be (it was hoped) able to relate to them as *users* as well as designers, and no specialist knowledge would be required. The text of the briefs and the images used to introduce them, are presented in Table 5.3; note that a very similar brief to B3 was also used in earlier pilot studies with DwI v.0.8, reported in section 5.2.

The workshop situation was artificial, and time-constrained, and did not give the participants the chance to research or understand the real situations and contexts in which the products are used, beyond their own experience. Thus, while the process focused very much on user behaviour, it was abstracted from the 'deep understanding of the target users' (Dong & Vanns, 2009: p.95) which is central to user-centred design.

Participants

Sixteen participants (10 male, 6 female) were involved in the workshops. A *naturalistic enquiry* (Lincoln and Guba, 1985; see section 3.6), *purposive sampling* approach was

[4] A paper based partly on this section will appear as Lockton et al (2014), Exploring design patterns for sustainable behaviour, *The Design Journal 17*(1) **[B4]**.

[5] While the other briefs (B1, B3 and B4) cover relatively familiar areas for design for sustainable behaviour, the curtain problem, B2, is worth examining in more detail, as an example of part of a problem which is frequently addressed in sustainable design via *infrastructure* changes (better insulation) rather than necessarily considering influencing behaviour via design. This analysis is included in the Appendix.

[6] According to Michl (2002), most commercial design is really *redesign* of one form or another; this is the approach taken in the selection of these briefs.

Table 5.3: The four 'design for sustainable behaviour' briefs given to participants.

NAME	TEXT OF BRIEF	MAXIMUM IMPACT (EST.)
B1: Using the kettle more efficiently 	Many people boil more water than they need when using an electric kettle. There's a tendency to fill it up with much more water than is necessary for a mug or cup of coffee / tea / etc. Sometimes it's because it's easier to re-boil it all each time than going to fill the kettle up from the tap, but other times it's because it's too difficult to judge how much water's actually needed. And the more water, the longer it takes to boil, too (wasting our time as well as money). DEFRA estimates that the amount of electricity wasted every year by overfilling kettles in the UK is enough to power all our street lighting (Product Creation, n.d.). So it's a big problem, even though kettles themselves are quite efficient at boiling water. *How could you, as a designer, improve the design of electric kettles to influence—or help—users fill or boil them more efficiently?*	1.27 TWh per year reduction in UK electricity demand
B2: Closing curtains at night 	Lots of energy is wasted when people forget or can't be bothered to close curtains at night. The Energy Saving Trust (2003) estimates that 20% of all household heat in the UK is lost through windows – making sure the curtains / blinds / shutters are closed at night can be a big help here. It can save householders money and doesn't (necessarily) require special extra equipment. For some people, such as the elderly or disabled, closing the curtains may currently be difficult (e.g. if furniture is in the way, or they are too awkward to reach). *How could you, as a designer, improve the design of curtains, or windows / frames / etc, to remind—or help—users to close them when it gets dark, or at some point in the evening?*	Up to 20% reduction in UK household heating energy demand
B3: Printing more efficiently 	Many people waste paper, ink / toner, energy and time printing unwanted or unnecessary pages. A Lexmark report found that US government employees each waste on average 2,520 printed pages per year—around 35% of what they print (Lexmark, 2009). Sometimes prints don't come out how we expect; other times we accidentally print multiple copies instead of one, and so on. This is to a large extent a design problem—users don't think about the options presented by print dialogue boxes, print previews, etc, because of the way the options are presented. *How could you, as a designer, improve the design of printers or printer software to influence or help users print more efficiently (and effectively)?*	2,500 pages per person per year reduction in printing waste
B4: Turning off the tap 	A lot of people leave the tap running while brushing their teeth. It might not seem like a major problem, but as water becomes scarcer and the costs of treating it get higher, this sort of mindless waste will become more obvious. Rough calculations suggest that 2 gallons (9 litres) per person per day would be saved by only running the tap briefly to wet and rinse the brush at the start and end of the process. While the wasted water could be recycled as part of a 'grey water' system, it would seem better to try to influence people not to waste the water in the first place. *How could you, as a designer, improve the design of taps / sinks / bathrooms / toothbrushes (etc) to influence users to turn off the tap while they're brushing their teeth?*	3,200 litres per person per year reduction in water usage

taken to participant selection—the use of design students is common in academic design research (e.g. Lilley, 2007; Tang, 2010), and in the case of the toolkit, such participants were appropriate since they were a subset of its potential users, either in their own projects, or (as designers in training) in later projects once working in industry. Students from Brunel University, the University of Brighton and San Francisco State University participated, from both under- and postgraduate design courses.

Practising designers from industry were also recruited to take part alongside students, to broaden the scope of expertise present. This recruitment relied upon blog readers responding to invitations, so the sample was largely self-selecting: these were people interested in being involved in a workshop, learning from and contributing to the development of the toolkit. All were early-career practising designers and creative technologists with a variety of product and interaction design, engineering, built environment, information architecture, computer science and human factors specialisms.

Participants' level of experience was not formally assessed, although in retrospect this would have provided some useful additional insights. All were likely already to have an interest in socially beneficial design, given their desire to participate in the study voluntarily, and all had a degree of technological expertise which, it was felt, would make it more likely that they would generate technically feasible concepts. While English was not the first language of all participants, all were at least reasonably fluent and offered clarification of language if requested.

Eight of the 16 participants were divided into four pairs (A & B, C & D, E & F and G & H) and the remaining eight participated individually (I, J, K, L, M, N, O, P). Pairs were chosen rather than larger groups to attempt to avoid the phenomena of *production blocking* (the more participants, the less chance each person has to contribute), *social loafing* (the more participants, the less accountability each person may feel) and *evaluation apprehension* (the more participants, the greater the worry that ideas will be poorly received, hence they are suppressed), which have been identified in group brainstorming research (e.g. Diehl & Stroebe, 1987). Figure 5.4 shows some scenes from the workshops.

The exercises

There were four exercises (Table 5.4) which each pair and individual tried out, always in the same order but applied to a different brief each time, which provided some variety and ensured that concepts generated in one exercise were not simply repeated.

The exercises were presented in an order simulating how the toolkit might be used in the real world as a designer becomes more familiar with it—conventional brainstorming (existing idea generation practice), followed by a free-form exploration of the toolkit patterns (the inspiration mode), then a guided introduction to the more focused prescription mode, and finally a self-guided use of the prescription mode. Depending on the amount of reading required, the exercises had slightly different overall time allowances: 15 minutes was always given for the actual idea generation period.

The conventional brainstorming exercise, represented by CB in the tables here, was always first since it was most likely to be affected by carryover effects (learning or practice effects; Blandford et al, 2008) if carried out after the participants had already used the toolkit in any variant.

The inspiration mode exercise, IM, followed CB. Then, as an additional element, there were two further exercises using the prescription mode: PM1 and PM2. These were ordered after IM because of the extra complexity involved in thinking about target behaviours and the abstractions involved; as mentioned, it was expected that any real-world use of the prescription mode would follow an 'inspiration mode' introduction to the toolkit patterns. In PM1, the brief was explicitly matched to a target behaviour

Figure 5.4: A selection of images from the workshops. One pair (bottom right) made use of coffee cups and water bottles as 'readymades' to explore the kettle brief.

Table 5.4: How the workshop exercises were run, with the times given. In this and subsequent tables, red text represents the conventional brainstorming exercise CB.

	CB: CONVENTIONAL BRAINSTORMING	IM: TOOLKIT, INSPIRATION MODE	PM1: TOOLKIT, PRESCRIPTION MODE, GUIDED	PM2: TOOLKIT, PRESCRIPTION MODE, SELF-GUIDED
TIME /MIN*	15	15 + 3 for reading	15 + 3 for reading	15 + 8 for reading
A & B	B1: Kettle→	B2: Curtains→	B3: Printing→	B4: Tap
C & D	B2: Curtains→	B3: Printing→	B4: Tap→	B1: Kettle
E & F	B3: Printing→	B4: Tap→	B1: Kettle→	B2: Curtains
G & H	B4: Tap→	B1: Kettle→	B2: Curtains→	B3: Printing
I	B1: Kettle→	B2: Curtains→	B3: Printing→	B4: Tap
J	B1: Kettle→	B2: Curtains→	B3: Printing→	B4: Tap
K	B2: Curtains→	B3: Printing→	B4: Tap→	B1: Kettle
L	B2: Curtains→	B3: Printing→	B4: Tap→	B1: Kettle
M*	B3: Printing→	B4: Tap→	B1: Kettle→	B2: Curtains
N	B3: Printing→	B4: Tap→	B1: Kettle→	B2: Curtains
O	B4: Tap→	B1: Kettle→	B2: Curtains→	B3: Printing
P	B4: Tap→	B1: Kettle→	B2: Curtains→	B3: Printing

**Participant M is dyslexic and asked for 25% extra time to be given, in line with common practice in the UK.*

and so to a subset of relevant patterns, and participants were asked to bear this target behaviour in mind while thinking of ideas.

So, for brief B2 (Curtains), the target behaviour S1 ('The user follows a process or path, doing things in a sequence chosen by the designer'; see section 4.1.1 for target behaviour definitions) was given, providing a prescribed starting point for the patterns to look at, and a focus (getting people to close the curtains as part of a sequence or routine every evening). In PM2, participants were given the full list of target behaviours and asked to decide for themselves on the target behaviour(s) most relevant to the brief given, and so self-prescribe the patterns to look at further. With a larger pool of participants to lessen the effects of individual variability in creativity, it would have been feasible to give different participants different exercises—even to the extent of running a randomised controlled trial—but these workshops were mainly about exploring how participants made use of the toolkit in practice, to help improve and refine it, rather than a formal investigation.

The briefs, B1, B2, B3 and B4, were given in a different order to participants so that all (pairs and individuals) tried out all four briefs and each brief was tried by a pair and two individual participants in all four exercises. The participants were not aware of the briefs beforehand, and they were revealed in sequence as part of a workbook, so there was no opportunity to read ahead or to see what others had done. This also had the advantage, as Jones (2003) notes, of preventing overload from too many instructions at the beginning of the session.

For each brief, participants were asked to note and sketch as many concepts as possible (following Nemeth et al, 2004) in whichever way they preferred (A3 paper, Post-It notes and a variety of pens were provided); it was emphasized that it was the toolkit being investigated rather than the participants' ability, and it was exhorted that every idea should be recorded, even if not favourable. It was suggested to pairs that they use something close to a think-aloud discussion method (Lewis & Rieman, 1994) with each other (rather than with the experimenter), explaining their thoughts together as they proceeded. Audio recordings and notes by the facilitator served to catch any concepts which were expressed (e.g. in discussion within pairs) but not recorded on paper.

The toolkit was presented via the A2 poster (Figure 4.13 in Chapter 4) showing the 12 headline patterns, plus further sheets for the remaining 35 patterns. The poster and sheets were not visible to the participants until the start of the second brief, (exercise IM), after the first brief (under conventional brainstorming exercise CB) was finished. For the subsequent exercises PM1 and PM2, a diagram mapping target behaviours to relevant patterns was revealed.

After each exercise, the concepts were discussed between the facilitator and participants—this was considered most valuable where there were two individual participants present, who had worked on the same briefs, but had not been able to talk to each other during the session. Encouraging a discussion between the periods of working in silence helped remove any 'exam' atmosphere which might otherwise have arisen, and observations by (and of) participants during and after the sessions also provided feedback on usability aspects of the toolkit.

Filtering the concepts

After the sessions, the concepts generated by participants for each trial, recorded in the form of notes and sketches (and, in the case of pairs, a transcript of the conversations between participants) were reviewed and categorised using a variant of Elias et al's (2007) 2×2 matrix, described in section 2.1.2.

The aim was to filter out, and set aside, concepts which were not specifically about influencing user behaviour via product redesign (e.g. just improving the efficiency of

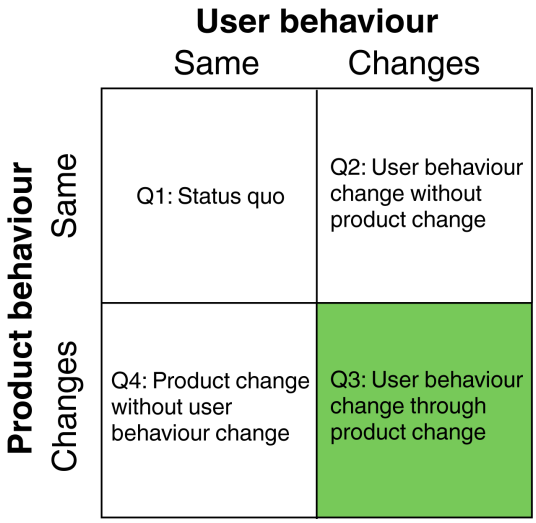


Figure 5.5: A modified version of Elias et al's (2007) matrix, used to filter the concepts generated by participants.

a product, or advertising campaigns telling people to save energy). These are valuable contributions to design for sustainability, and it was expected that some would arise as a 'freewheeling' corollary of idea generation, but they fall outside the intended scope of the toolkit. Any duplicate concepts from the same participant were also set aside, but where more than one participant came up with the same idea, these were counted as separate concepts, since they were generated independently.

This modified version of Elias et al's (2007) matrix (Figure 5.5) retains the four quadrants but slightly changes the terminology: it effectively classifies overall system behaviour change as being a result of user behaviour change alone (Q2), product behaviour change alone (Q4), or a combination of the two (changes in product behaviour leading to changes in user behaviour: Q3).[7]

The distinction here is that, for example, an educational social marketing campaign to encourage householders to close curtains at night would fall into Q2; curtains that closed themselves automatically with no need for the user to think would fall into Q4; but curtains that in some way prompted the user to close them, or made it easier or desirable to close them, would fall into Q3, along with probably the majority of work in design for behaviour change. Q4 is essentially about making the product more efficient so the user doesn't have to think—this does not meet the definition of design for behaviour change explored in this thesis (although it does certainly reflect much valuable work in reducing the environmental impacts of product use).

From the point of view of DwI, it is Q3 concepts which are of most interest, so any concepts generated by participants which could be categorised as Q2 or Q4 were discarded at this point, and the remaining concepts were counted and compared across the exercises. It was made clear to participants in the introductory material that the aim was to generate ideas for influencing user behaviour through the design of the product or system (i.e. Q3), so while some Q2 or Q4 ideas would inevitably be generated even simply as a corollary of thinking about the briefs, they should concentrate on thinking about behaviour.

[7] An attempt was made to sub-divide the matrix further, creating a 'behaviour change barometer' diagram (inspired by the prominence of the word CHANGE) but the diagram proved too complex to be immediately useful. A description is included in **[E2]**.

Figure 5.6: A selection of participants' sketches for B4 (the tap brief).

Observe

Observing the results of an intervention (in this case the toolkit) is one of the four phases of the action research procedure (see section 3.4.4). In the case of the workshops, the observation covered a range of insights around how the toolkit was used (including the use of specific elements such as the target behaviours) and the quantities and details of concepts generated by participants using the toolkit, compared to those generated prior to using it.

How was the toolkit used?

Most individual participants did not have time to consider all the relevant patterns for each brief. Some started with one lens and worked through all the patterns before moving onto the next, while others primarily picked patterns which stood out to them—perhaps due to a visually interesting image. In almost all cases, the participants were still working when the end of the session was reached.

However, pairs generally approached the patterns, at least in the IM exercise, with each person taking three of the six lenses, thinking and noting down some ideas, then explaining the lens and the patterns to his or her partner, and talking together for the rest of the session, reviewing and building on the initial ideas, mutating them into further concepts.[8]

There was no explicit evidence that participants did not understand the lenses, or the idea of transposing design patterns from one discipline to another. However, only a few participants transposed concepts from the Architectural lens to non-physical, system architecture or information architecture situations (e.g., for brief B3, SEGMENTATION & SPACING might have suggested breaking up a document into elements which could be chosen separately to print, with different settings). This suggests that different phrasing for the Architectural lens, or the use of more non-physical examples, might be appropriate for a future iteration of the toolkit.

[8] This accords with a method suggested by Rossiter and Lilien (1994), and can be seen as a combination of the first stage of the *nominal group technique* (Delbecq & van de Ven, 1971) with conventional face-to-face brainstorming.

Use of target behaviours

In the prescription mode exercises (PM1 and PM2), while some participants stuck closely to the target behaviours, most only used these as a starting point. Particularly with pairs, as discussion between the participants threw up new concepts, the target behaviour often seemed to be forgotten. When asked to choose target behaviours themselves (PM2), a variety of choices were made, with some participants running through a number of target behaviours and 'testing' how well each seemed to apply to the brief, without actually committing to any—indicating an interest in understanding the problem, but not necessarily conducive to generating as many concepts as possible. There was no consensus apparent, although for B1, B3 and B4 at least some participants did choose the target behaviour that was expected.

It is clear that the target behaviours in the current form are not well-understood, and (based on the quantity of concepts generated) do not appear to be especially useful at the idea generation stage of the design process.

But why is this? The target behaviours introduce a *constraint*, which it is often suggested (e.g. Johnson-Laird, 1988) can act as a spur to innovation and creativity rather than a hindrance, by giving participants something around which to build their ideas. In this case, though, it may be that the combination of the briefs themselves, the requirement to generate concepts specifically about influencing behaviour, the lenses and the patterns together comprised a sufficiently constrained atmosphere for concept generation, and having to think about the target behaviours in addition was simply a constraint too far.

There is also perhaps the issue suggested by live|work (section 5.1.1) that designers—who are used to being 'creative' on demand—simply do not need or appreciate a very highly structured idea generation method. This might be different for brainstorming in other domains or with participants for whom it is a much less common activity. Particularly at the idea generation stage of a project, when the point is to come up with a large quantity of concepts which can be explored and pruned later, an additional constraint such as the target behaviour is, perhaps, unnecessary.

However, the *reflective* process that thinking about and discussing the target behaviours encouraged was nevertheless potentially valuable. It was apparent that some participants had different approaches to considering users, 'what they are like', and how to influence their behaviour, ranging from expressed opinions that many users were 'unpersuadable' (and so products would need to force them to behave in certain ways, or 'correct' their behaviour) to emphasis on educating people through the design of interfaces (especially) so that they would decide to change their own behaviour. Where a pair of participants had different views, this led to some engaging discussion, often mirroring debates that have occurred on a much larger scale in public discourse on libertarian paternalism, environmental policy and in interaction design, HCI and user experience over the concept of 'the user' itself.

This avenue—examining designers' models of users with respect to influencing behaviour—seemed worth exploring further, and has been developed in a separate study, **[B3]**.

Other insights

One participant commented, directly after reading about the FRAMING pattern (but applying more generally to the whole DwI toolkit), that "the photos and text massively affect how people think about and frame the problem: the old 'if all you've got is a hammer, everything looks like a nail' scenario." This is a valid point, although the lenses are an intentional attempt to mitigate this somewhat.

A related participant comment was that "having all the patterns arranged like this almost invites you to fit your existing ideas into the patterns you're provided with", suggesting that ideas that would have arisen without the stimulus material (as in the control condition) are subconsciously 're-labelled' by participants to fit with the DwI patterns. On the other hand, another participant commented that a framework such as DwI, with specific names and examples for the different patterns, "makes it easier to defend your ideas [to colleagues or management]" because you can easily point to work that others have done using the same approach. This echoes comments by staff at Engine Service Design when the author was invited to give a presentation about the toolkit, that some of the value of DwI as a structured collection of techniques and examples may be in using it as a reference to explain and justify design decisions to clients, both during the design process and afterwards, as an addition (or even an alternative) to using it during the idea generation process. The development of the Design with Intent cards and wiki (section 4.4) is an attempt to make this use of the DwI patterns as a reference easier.

How many concepts were generated?

The first task in assessing the results was to categorise the concepts generated by participants using the 'filtering' method described in the previous section. The vast majority of concepts participants came up with—373—fitted into the Q3 category, but the few Q2 concepts included ideas such as "Celebrities or iconic figures should be shown turning off the tap while brushing their teeth"; there were also some Q4 concepts such as "Boiler under kitchen counter rather than having a separate kettle". Only Q3 concepts have been included in the following tables. The Q4 and Q2 concepts were, in many cases, innovative in themselves as possible ways of reducing the environmental impact of products, but were outside the scope of the study.

Table 5.5 shows the number of concepts that participants generated, by brief and by exercise. B3, the brief on printing, resulted in the most concepts—this might suggest that this is a problem which personally frustrates some of the participants in their everyday jobs and studies in a way which, say, heat loss via uncurtained windows does not.

Different participants came up with very different amounts of concepts. One pair, A&B, was particularly prolific, producing nearly three times the number of concepts of pair G&H; the mean number of concepts generated by pairs (48.5) was slightly more than double the mean number generated by individual participants (22.4), although some individuals were actually more productive than some pairs. Exercise IM (the inspiration mode) resulted in more concepts overall (112) than either conventional brainstorming (CB: 84) or the prescription modes (PM1: 88; PM2: 89), but it was not uniformly better for all participants individually. So a one-size-fits-all approach may not be ideal: it seems worthwhile to provide different ways of using the toolkit.

Figure 5.7 is a box plot of the quantity of concepts generated per participant in the four exercises. Exercise IM has the highest value for median and upper and lower quartiles, but also has a very wide range from sample minimum (1) to maximum (14—an outlier). This again suggests that different participants found different ways of using the toolkit most of use, and that future iterations must be usable in a range of ways to accommodate this. The sample size is really too small for statistical analysis to be considered valid, although tentative Wilcoxon signed-ranks tests (a non-parametric test since the quantities of concepts generated per participant for each exercise were not obviously normally distributed) showed a significant difference between CB and IM ($Z = -2.141$, $p < 0.05$)—but no significant differences between CB and either of the prescription mode exercises.

Recommendations for successful brainstorming (e.g. Wilson, 2006) often include the idea of a 'warm-up exercise' using a problem not directly related to the one intended for

Table 5.5: Number of concepts generated by participants in each exercise, arranged by brief (upper half) and by exercise (lower half).

	A&B	C&D	E&F	G&H	I	J	K	L	M	N	O	P	TOTAL
B1	15	19	6	5	2	3	7	4	4	3	9	6	83
B2	28	9	7	2	1	8	3	7	8	4	8	6	91
B3	26	14	12	11	2	5	8	10	8	3	5	9	113
B4	7	13	12	8	4	4	5	8	7	4	10	4	86
CB	15	9	12	8	2	3	3	7	8	3	10	4	84
IM	28	14	12	5	1	8	8	10	7	4	9	6	112
PM1	26	13	6	2	2	5	5	8	4	3	8	6	88
PM2	7	19	7	11	4	4	7	4	8	4	5	9	89
TOTAL	76	55	37	26	9	20	23	29	27	14	32	25	373

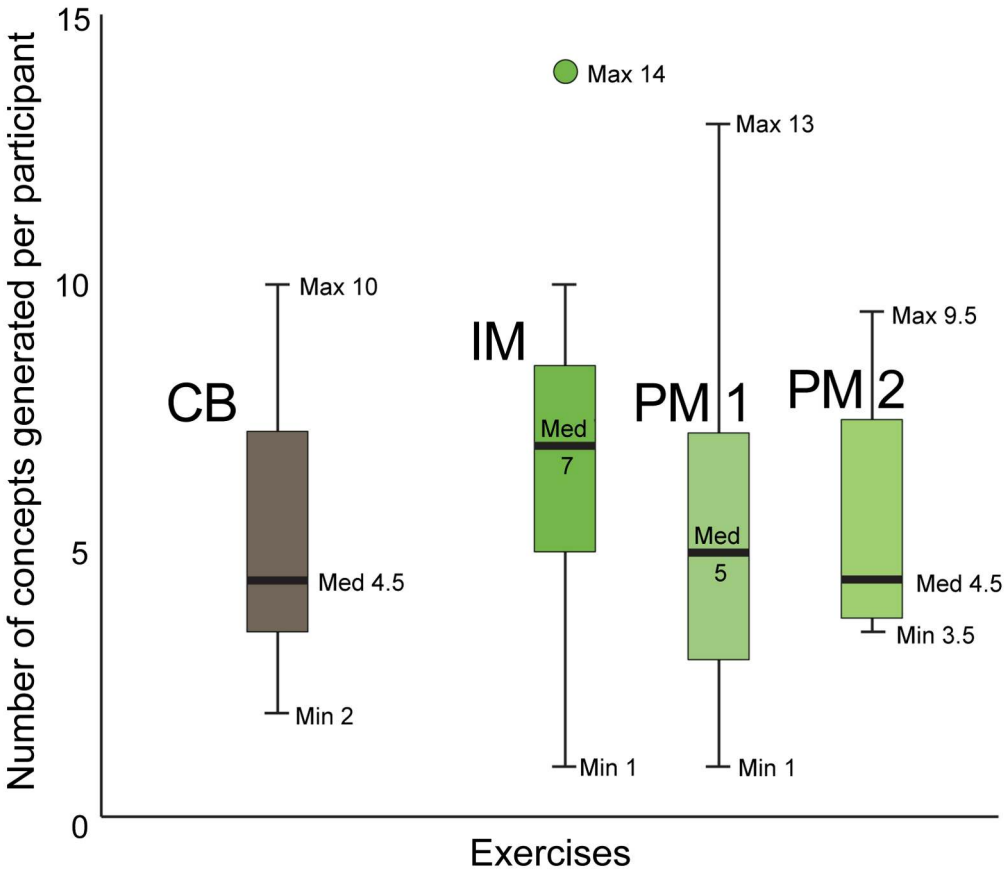


Figure 5.7: Box plot of the quantity of concepts generated per participant in the four exercises. CB: conventional brainstorming; IM: inspiration mode use of the toolkit; PM1 and PM2: prescription mode use of the toolkit, guided and self-guided respectively.

the main exercise, and so it may be that in the cases described here, the CB exercise acted as a warm-up for the IM exercise.

In this sense, it would be safer to suggest from the quantitative results that, in general, when CB was followed by IM, a greater number of concepts were generated in IM than when CB was carried out on its own. While this is not a strong conclusion, it would not be unreasonable to make the recommendation that brainstorming using the toolkit in inspiration mode could be preceded by a warm-up exercise using conventional brainstorming. In practice there may not always be time to carry out such an exercise, however.

Qualitative assessment of the concepts themselves

Tables 5.6–5.9 summarise some of the (subjectively) most interesting concepts generated by participants using the toolkit (i.e. in the IM, PM1 and PM2 exercises).[9] Some of the ideas suggested do already exist in a similar form, either on the market or as concepts—such as the two-tank EcoKettle, transparent Kenwood Energy Sense kettle, Tefal QuickCup kettle, GreenPrint printing software which offers the ability to choose parts of a document to print more easily beforehand, and coloured lighting in the water stream and a meter on the tap (both found in MIT's WaterBot project (Arroyo et al, 2005)).

However, there are some genuinely novel ideas in Tables 5.6–5.9. Figure 5.6 shows a selection of participants' sketches for B4 (the tap brief)—these are 'idea sketches' to use Pei et al's (2011) terminology.

Was there a qualitative difference between the concepts arising from conventional brainstorming and those generated using the toolkit? Certainly a number of the same ideas recurred for the same brief (from different participants), especially around some of the simpler feedback mechanisms (e.g. lights warning people that the curtains were open, or that the kettle was overfilled). But where concepts were directly related to particular patterns from the toolkit, they only occurred after the toolkit had been used—for example, the use of METAPHORS and the idea of SIMULATION AND FEEDFORWARD were not present in any of the CB concepts from any participant, but inspired a number of concepts directly once the toolkit was used. A more detailed attempt was also made to investigate the diversity of the concepts generated for one of the briefs (B1), by classifying concepts according to the 'Leverage Points' system, based on Meadows (1999), outlined in section 2.1.4, and this is included in the Appendix.

Problem-framing and problem-solving

One aspect apparent was how participants framed the roots of the problems differently, putting their own interpretations on the rather meagre information given in the briefs. Partly the differences in interpretations may have been due to 'cultural biases', a challenge which Gill (2009) notes as important when designers seek to address users' needs.

For example, a number of participants who were international Master's students (primarily from south-east Asia) saw the overfilling problem in brief B1 as being related to limescale ('disgusting') in kettles—something they had not encountered before coming to the UK. In their understanding, overfilling was often done deliberately in an attempt to make sure only boiled water from the 'top' of the kettle chamber (far from the limescaled element) would end up in their drinks. During the discussion afterwards, it was freely admitted that due to the nature of boiling, it was likely that the water at the top of the kettle would still have come into contact with the element anyway, but that the behaviour satisfied a need, on some level, to feel that the water was not 'dirty'. As

[9] Concepts generated in the CB exercise have been excluded from these tables.

Table 5.6: A selection of concepts generated by participants using the toolkit for brief B1, with the patterns noted by participants as inspiration.

	PATTERNS	CONCEPTS	EXERCISES
B1: Kettle	PORTIONS	Make kettle fill chamber same diameter as a cup, so the fill level matches it exactly	IM
	SELF-MONITORING; FRAMING	Use cup markings, outlines of real-size cups and mugs, or water needed for tasks e.g. how much to boil for 1 portion of spaghetti, on scale, as well as litres / fl oz	PM1
	SELF-MONITORING; FRAMING	Energy usage or 'Cost per cup' displayed on kettle or base unit	IM
	DEFAULTS; INTERLOCK; EXTRA STEP	Kettle where default fill level is 1 cup, and valve closes when filling, unless explicitly set to a greater volume; resets itself	PM2
	SEGMENTATION & SPACING	Two-tank kettle that stores water in one tank but only boils as much as needed in the other, with rotating chambers and set of transfer ports between	PM1
	SELF-MONITORING; COLOUR & CONTRAST	Temperature indicator – lights or thermochromic finish – to reduce unnecessary reboiling	PM2
	SELF-MONITORING	Kettle beeps as it is filled, once for each cupful	PM1
	SIMULATION & FEEDFORWARD	Electronic 'Time to 'destination' scale display on side as kettle is being filled & boiled	PM2
	EXTRA STEP	Fill valve 'pauses' while you're filling for every cup / mugful reached, so you have to think before filling further	PM2
	PROMINENCE & VISIBILITY	Make kettle transparent or easier to see the 'real' volume of water inside compared with the small bit typically visible on a narrow scale	IM / PM2

Table 5.7: A selection of concepts generated by participants using the toolkit for brief B2, with the patterns noted by participants as inspiration.

	PATTERNS	CONCEPTS	EXERCISES
B2: Curtains	INTERLOCK; DEFAULTS	User can't switch heater on unless the curtains are closed first, or curtains automatically close by default when heating is switched on	IM
	IMPLIED SEQUENCES	Number the curtains (large figures on them) so it's obvious when they're not all closed, and gives people a sequence to follow in going round closing them	PM1
	CONDITIONAL WARNINGS; COLOUR & CONTRAST; SELF-MONITORING	Illuminated red strip across the window at night to remind you that curtains are still open; or temperature sensors inside and outside to detect energy loss and suggest closing curtains	IM
	FEEDBACK THROUGH FORM; OPERANT CONDITIONING	A pattern, picture, or congratulatory message on the curtains so they are more attractive when closed; or use the curtains as a high-quality projector screen for the TV	IM
	KAIROS	A beep or loudspeaker suggesting 'Close the curtains' as it starts to get dark, or Public Service Announcement on TV at appropriate time in the evening 'Close your curtains now'	IM
	POSITIONING & LAYOUT; INTERLOCK	Position light switch for the room behind the curtain	IM
	FRAMING; METAPHORS	Curtains promoted as insulation rather than just for shielding light, styled to look like a jumper – warm, woollen material – that actually zip snugly together to close them	IM
	SOCIAL PROOF	Low-powered LEDs reflecting on the outside of curtains to indicate to other people (neighbours) that the house's curtains are closed (so yours should be too)	IM
	ORIENTATION	Curtain rail angled in a V-shape so the curtains close more easily than they open	IM
	MATERIAL PROPERTIES; AFFECTIVE ENGAGEMENT	Windows with glow-in-the-dark spooky face on them, so it is scary/unpleasant at night unless curtains closed	PM1

Table 5.8: A selection of concepts generated by participants using the toolkit for brief B3, with the patterns noted by participants as inspiration.

	PATTERNS	CONCEPTS	EXERCISES
B3: Printing	REDUCTION; TUNNELLING	Simplify the usability of the print dialogue for different choices; use wizards for common tasks	PM1
	SEGMENTATION & SPACING; PORTIONS	Extra tray for used / scrap paper to be easily re-used for draft prints; or extra A5 / small size paper tray for printing smaller items or drafts	IM
	DEFAULTS	Make duplex (double-sided) or 2-up printing the default setting	IM / PM1
	SIMULATION & FEEDFORWARD; INTERLOCK	Better Print Preview window showing exactly what it's going to look like when printed, won't print unless it's confirmed	PM1 / PM2
	METAPHORS; SELF-MONITORING	Use a tree being cut down to a stump gradually as a metaphor for paper usage	IM
	SEGMENTATION & SPACING; DEFAULTS	Make it easy to choose and scale the parts of a document you actually want to print; default for email printing should be to leave off signature and previous correspondence	PM1
	SELF-MONITORING; SCARCITY	Speedometer or fuel gauge-style display on-screen, showing how quickly you're using resources and how much paper / ink is left	IM
	EXTRA STEP	Move the higher quality settings to 'Advanced' tab	IM
	SURVEILLANCE; SOCIAL PROOF; POSITIONING & LAYOUT	In an office, position printers where everyone can see them, with a display (e.g. a pie chart) indicating who's printing the most and what settings they're using	IM
	EXTRA STEP; KAIROS	Require user to go through every step of process in order with confirmation at each stage – a dialogue that actually asks the user 'Do you want double-sided?' etc at right moment	PM1

Table 5.9: A selection of concepts generated by participants using the toolkit for brief B4, with the patterns noted by participants as inspiration.

	PATTERNS	CONCEPTS	EXERCISES
B4: Tap	DEFAULTS; FEEDBACK THROUGH FORM	Sink where the plug is, by default, closed, or a sink that is very flat / shallow: users will see the amount of water being wasted quickly	PM2
	WHERE YOU ARE	Proximity sensor so tap only on when hands underneath	PM1
	DEFAULTS; PORTIONS	Gas tap-style taps that spring to the off position when not in use, or 'Dual-flush' tap that turns left for teeth, right for continuous flow	PM1 / PM2
	SELF-MONITORING; FRAMING; SCARCITY	Meter showing water use instantaneously when tap is on; or cumulative meter for water usage over course of day or week; scale could be framed in everyday measure, e.g. cups	IM
	THREAT OF DAMAGE; WHAT YOU'VE DONE	Tap that squirts user in the face through hole in top of spout if left on for too long	IM
	MATERIAL PROPERTIES; COLOUR & CONTRAST	Basin surface changes to bright red like a bloodstain when water has been running on it for too long	IM
	SELF-MONITORING	A container or tray that catches the water being wasted: 'You can see how much you are using, then you will stop!'	IM
	SELF-MONITORING	Beeping or coloured light shining in water indicating flow rate	IM
	METAPHORS; PORTIONS	Tap working like an ale pump or old-fashioned water pump, changing the on/off mental model: a small 'shot' of water	PM1
	POSITIONING & LAYOUT	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	PM1

such, one of the Q4 concepts was an easily replaceable element for kettles which would allow the 'dirty' bit to be removed and replaced by a pristine one.

Personal factors also affected the interpretation of brief B2 in discussing behaviour with curtains: in one pair, one participant said that she routinely closed the curtains almost as soon as she got home, for privacy ("people can see me from the other building") while the other contrasted that he "leave[s] it all open, all night: I don't want to live in a scary atmosphere all the time; that's why there is no social connection between people: all strict, closed off".

The essentially ethnographic observation component of the problem-solving process—how designers understand the nature of 'behavioural' problems and the 'users' (a category which may well include themselves) in the first place—generated some intriguing insights, and suggested a slightly different form of study. **[B3]** develops this theme with an investigation of how designers model users, and the implications for design for sustainable behaviour.

Would the concepts work?

Overall, there were some very interesting (and in some cases—such as the 'bloodstain' sink—*dramatic*, along the lines of Gargiulo, 2008) concepts generated by participants, many of which were technologically feasible, though of course without knowledge of how effective they might be at influencing user behaviour in practice.

The ideal result of implementing any of the concepts generated would be that the unnecessary environmental impact due to user behaviour is reduced to zero. However the contextual nature of interaction behaviour makes it impossible in many cases to quantify the exact energy savings expected: for example, deciding whether or not someone has printed something as 'optimally' as possible for B3 (the printing brief) is not feasible—the optimal solution would be different for different people and circumstances.

Even B1 (the kettle brief), which on the face of it seems clear-cut (any water boiled which is not used is wasted—1.27 TWh per year according to the Product Creation (n.d.) figures)—would be made more efficient by changing behaviour at a higher system level, for example by altering people's hot-drink consumption habits entirely. It is unrealistic to assume that an intervention such as an energy use display on a kettle would (even if every kettle in the UK were retrofitted or replaced) lead to a saving of anywhere near 1.27 TWh per year (compare the literature on the effectiveness of feedback, e.g. Darby (2006)), but some concepts involving changing the actual affordances and constraints of the kettle design, so that only one portion at a time is transferred or boiled, could have a large effect.

There could, also, in practice, be the problem that only people already motivated to reduce their energy use would be likely to buy a new device marketed along these lines, and so there may be an element of 'preaching to the converted'. This would further reduce the impact a redesigned device might have, since the people who buy it may not be the same people for whom a change in behaviour would have the most impact.

5.3.3 Exploratory applied workshops

The most important test of an idea generation tool is probably whether it is found of use by its users—whether they choose to use it, or continue to use it, and embed it in their business or organisational decision-making processes. The workshops described in section 5.3.2 were carried out in a university setting rather than an industrial or public sector context, and the utility and usability of the toolkit in this latter 'real world' situation is essential to its further development.

In response to invitations, some exploratory workshops applying the toolkit to 'real' (and otherwise externally set) behaviour-related problems were carried out, using DwI v.0.9 in card, worksheet and on-screen form, in 'inspiration mode'. These acted as a precursor to the larger applied trials with v.1.0 described in section 5.4, and were facilitated by both the author and others. In the following sections, the 'act' and 'observe' stages of the action research procedure are summarised together.

Workshops with IDEO, the RSA and the NPIA

In September 2009, an invitation was received from the RSA to run two workshops using the DwI toolkit as part of a collaborative project with the National Policing Improvement Agency (NPIA). The aim of the project was to explore "a set of new approaches to the engagement of the police and citizens in local policing" (RSA, 2009a), with contributions from consultancies IDEO, live|work and Campbell Keegan as well as fieldwork run by the RSA Projects team. One of the strands of work involved a persuasive technology approach, using design to address behavioural issues around public confidence in the police—from the points of view of both the public and the police themselves. Specifically, there were six behaviours to be addressed (RSA, 2009b), listed in Table 5.11.

The first workshop would be run at IDEO London, with a mixture of IDEO designers, RSA and NPIA staff, while the second, larger session, at the RSA itself, would involve serving police officers and a range of community representatives. In the IDEO workshop, which involved nine participants in total (though not all present the whole time), the project background, the six behaviours and the DwI patterns were introduced via presentations by Jamie Young from the RSA, Lydia Howland from IDEO and the author. Then, both the larger-format cards and worksheets were distributed by lens, so that each participant (or pair of participants) had a different lens—architectural, errorproofing, persuasive, visual, cognitive and security. The session proceeded with each participant/pair 'becoming acquainted' with the lens and then discussing the patterns and the approach to influencing behaviour in the context of the police and public with the rest of the room, so that everyone present was familiar with the range of ideas. Then, collectively, the session was run along the lines of a conventional IDEO brainstorm, following the rules discussed in section 2.4.1, with each of the six behaviours considered in turn and ideas generated being recorded on Post-It notes and read out for constructive discussion.

The details of the concepts will not be discussed here (a representative sample is shown in Table 5.11); from the point of view of this thesis, apart from exploring an explicitly social rather than environmental behaviour change context, the main purpose of the workshop was to observe and take part in an IDEO brainstorm, and to see how the DwI toolkit performed and was used in this kind of situation. Observation of how the toolkit was actually used in this workshop suggested that most participants did not work through the patterns or lenses in sequence in order to generate concepts—rather (as might perhaps have been expected), they tended to build on top of others' ideas, sometimes referring back to the DwI patterns and examples, but mainly using DwI as a kind of 'priming' of inspirational ideas around behaviour change and design to set up the brainstorm. The A3 worksheets seemed to be used more than the cards. Lydia Howland kindly gave some feedback on the usefulness of the DwI patterns and her priorities for brainstorming at IDEO:

- The DwI toolkit was "very useful" in the workshop; the main possible improvement would be a more structured way of navigating the patterns—it would be helpful to see something along the lines of "these types of behavioural challenges are often best approached through these levers"

- For IDEO, a brainstorm's 'successfulness' is judged by both the facilitator and the client, but the facilitator (through experience) is often a harsher judge than the client
- Quality of ideas is the most important criterion for 'success' in a brainstorm, followed by diversity and then quantity. Quality is assessed by an idea being desirable to users, filling a need while also being viable/feasible to implement—criteria which may depend on user research specific to the brief being addressed. At the point of the brainstorm itself therefore, diversity and quantity may be easier to assess.
- She always uses method cards or inspiration material of some kind in brainstorming

In the second RSA / NPIA workshop, around 20 participants from the police and community organisations—none of them designers (other than the facilitators)—addressed the same six behaviours, with the benefit of an outline of some of the most promising concepts from the IDEO session at the start of the workshop. Divided into three tables of six or seven people, each table worked on two of the behaviours, with each person receiving one of the DwI lens worksheets as initial stimulus material, generating ideas together and recording them on Post-It notes. This workshop was primarily intended to allow the 'client' participants to take part in (and comment on) the idea generation process used in the IDEO session; some of the behaviours were potentially controversial, and the workshop involved a significant degree of discussion of the issues rather than aiming to generate a large quantity of concepts.

Discussing the NPIA project and the workshops from the RSA's point of view, Jamie Young emphasised the use of DwI as something to assist with transposing ideas from one context to another, particularly where non-designers are involved:

> "One of my frustrations [about behaviour change research] is that we need to put more of this research into action—behaviour-change theory is fascinating, but it's only half the challenge. We need good ideas for how we can convert knowledge into practice. [...] One of the strengths of the DwI toolkit seemed to me to give those who aren't professional designers the confidence to come up with new ideas. By looking at how others have used design to influence behaviour it is easier to transpose those ideas to the behaviours that you are trying to change.
>
> It's methods like DwI that are one of the components missing from much of the behaviour change discourse. We need that idea-generating process to help policy makers work with designers, behaviour experts and people to make the leap into practice" (Young, 2010).

Other applications of DwI v.0.9 cards and worksheets

Five other trials with the DwI v.0.9 cards and/or worksheets were carried out, the details of which are summarised in Table 5.12 for brevity. While these were not formal trials, some feedback was received from each as to how well participants understood and were able to apply the ideas from the toolkit, and how the cards and worksheets were used in practice. The exercises with Brunel design students led to some incorporating elements of DwI or the patterns into their own projects (see section 5.4.5 below), and a number of the Design for Conversion 3 participants subsequently followed the development of DwI,

Table 5.10: Some concepts from the NPIA workshops (text paraphrases RSA, 2009b)

BEHAVIOUR	SOME CONCEPTS GENERATED IN WORKSHOPS
Pre-empting & preventing officers from losing their temper	• Heart rate monitors for officers, signalling through earpiece when they might be in danger of losing their temper • Wearable cameras, so the officer knows that other people might be able to see the way he or she handles an exchange
Encouraging officers and staff to keep individuals updated	• Enable people to update themselves on the progress of their case via police website. Make triage of cases and priorities clearer for the public • Different methods of update provision, e.g. text messages
Helping officers to be more responsive and engaged with their local area	• Greater smart phone use so officers can do 'desk work' while in the community and a visible presence; or hot-desks for officers in public places such as libraries and doctors' surgeries • Smart phone applications overlaying police database information on maps of area to help officers be more aware of vulnerable people or crime hot-spots
Encouraging the public to contribute to the setting of neighbourhood priorities	• Offer different methods of engagement for segments of society, such as local radio station discussions and text messages as well as neighbourhood meetings • Shops could give the public voting tokens along the lines of Waitrose's charity scheme, to allow people to vote publicly on their policing priorities using transparent bins
Encouraging the public to police their own neighbourhoods	• Open local crime data to allow people to create their own crime maps, applications and community interventions, and make it easy to keep evidence diaries on anti-social behaviour • Encourage people to challenge anti-social behaviour by pledging to match small groups of volunteers with a PCSO
Encouraging the public to treat the police with greater fairness & respect	• Police badges could show the officer's name as well as number, and perhaps also characteristics such as languages he or she speaks • Real-time signs on police stations or in other public spaces could show how many officers are currently out in the community and could correct misperceptions of the levels of crime and anti-social behaviour

Table 5.11: Brief details of some trials with DwI v.0.9 cards and worksheets

ORGANISATION / CONTEXT	PROBLEMS ADDRESSED	COMMENTS
Brunel University, London BA / BSc Design Environmentally Sensitive Design module, 2009-10	Encouraging / influencing people not to spend so long showering, and / or to reduce the temperature of water used	Run by the author together with David Harrison. A lecture theatre exercise carried out with around 80 students, in small groups, after a lecture about design for sustainable behaviour. Each group received all six DwI v.0.9 worksheets as inspiration material for concept generation. Groups generated ideas and then presented them back to the room, with discussion.
Brunel University, London MSc Integrated Product Design Sustainable Design module, 2009-10	Encouraging / influencing people not to spend so long showering, and / or to reduce the temperature of water used	Run by the author together with David Harrison. A workshop with around 20-25 students, divided into groups, with each group receiving all six DwI v.0.9 worksheets as inspiration material for concept generation. The 'pinball', 'shortcut' and 'thoughtful' approaches (see Chapter 10) were introduced, and each group was asked explicitly to consider the merits and implications of each when developing their ideas.
Design for Conversion conference 3 'the mobile edition', Amsterdam, 2009	Issues around mobile phone user experience, e.g. persuading users to sign up to services	Run by Arjan Haring of Hogeschool Utrecht. 150 participants, divided into 10 teams, were provided with copies of the DwI v.0.9 cards as inspiration and reference material for idea generation and development.
Hogeschool Utrecht, Netherlands, Design for Security module, 2010	Issues around community engagement in crime and security—taking a 'user-centred design' approach to policing and public safety	Run by Arjan Haring of Hogeschool Utrecht. Students were provided with copies of the DwI v.0.9 cards and headline patterns poster as inspiration. One activity involved arranging the cards on a whiteboard (attached with magnets) and sketching concepts and notes around each one, allowing easy cross-links between concepts and patterns, and collaboration between groups of students.
UFI Learndirect, interactive presentation to staff, Sheffield, 2009	Specific problem of keeping students motivated and engaged with online courses, collaborating with other students (who may be distant geographically) and reducing distractions from family members	The author presented a subset of the DwI v.0.9 cards (on-screen) to an audience of Learndirect staff, and collaboratively worked through applying the patterns to the problem, with the audience generating ideas and recording them on a flip-chart. The SIMULATION AND FEEDFORWARD pattern proved particularly productive.

downloading or buying a printed pack of the DwI v.1.0 cards when released. Where the author was able to observe the activities directly, it was evident that there were structural elements to some of the trials which seemed to make them run more smoothly (e.g. introducing worksheets to participants with a recommendation that one person in each group become familiar with each lens him or herself for a couple of minutes, before talking together as a group, rather than simply putting six information-dense A3 sheets in front of everyone at the same time) or which made certain aspects easier or more difficult (e.g. the cards, even in the larger size, were difficult for more than one person to look at together at the same time).

Section 4.4 reflects on the insights from the workshops and other applications of v.0.9, and considers how improvements based on these can be incorporated into the next version of the toolkit, v.1.0.

5.4 Evaluating Design with Intent v.1.0

Sections 4.4.1 and 4.4.2 detailed the 'reflect' and 'plan' stages of the process in developing DwI v.1.0. In this section, the toolkit's application is described, in workshops, an externally requested worked example, and case studies of early users. A survey of 100 early users is also detailed and analysed, with its implications for further development of the toolkit examined. For the sake of brevity, the 'act' and 'observe' stages are combined in some sections below.

Section 4.5 reflects on the insights from the workshops, applications and survey described in this section.

5.4.1 Applied workshops with v.1.0: environmental and social briefs

While 'academic' workshops at Brunel (see section 5.3.2) had led to useful insights for the toolkit's development, it was considered important to run trials in 'applied' settings closer to the practical contexts where the toolkit was intended ultimately to be used: with design consultancies, with stakeholders (both designers and other interested parties), at industry events, and in design education, including a range of environmental and social briefs based on 'real' problems identified by participants or third parties. Section 3.5.1 describes the methodological context of this approach, and the research questions addressed.

The applied workshops covered a range of environmental and social briefs; this section describes one in detail, and others more briefly.[10]

Twente workshop: Act

In November 2010, an opportunity arose to run a workshop using DwI v.1.0 at the University of Twente in Enschede, Netherlands, addressing the problem of encouraging office building users to be comfortable with a wider range of temperatures. The brief came from the EMPOWER project (2010-12), a collaboration between Brunel and Warwick Universities and More Associates, on which the author was a research assistant and later research fellow. Funded as part of the Technology Strategy Board's 'User-Centred Design for Energy Efficiency in Buildings' programme, the project aimed to reduce the carbon footprint of workplaces through design for behaviour change, and embodied a number of the principles discussed in this thesis (**[G1]** and **[G2]**).

The opportunity to run the workshop came as an invitation from organisers of the Design for Usability project, a collaboration between the three Technical Universities of The Netherlands (Delft, Eindhoven and Twente) and companies including Philips, Océ, T-Xchange and Indes. Each year on the Usability Professionals' Association's World Usability Day, the DfU project runs a symposium, with workshops, on specific emerging areas of theory and practice relating to design and usability. 2010's focus was on 'product impact'—effectively, how design can be used for social benefit through behaviour change, and the possibilities and implications for users, designers, industry and society. It seemed opportune to use the workshop to apply the toolkit to address some of the behavioural issues that the early stages of the EMPOWER project were investigating, and capture some of the ideas generated informally by an 'outside' group of designers and researchers.

Procedure

Twenty-eight participants took part—a mixture of industrial designers, interaction designers, user experience and web designers from industry (including Brabantia and ING

[10] This section has been published as part of **[G1]**.

Figure 5.8: The University of Twente workshop.

Bank), strategy and consulting staff from industry (including a former senior manager at Philips) and current design, psychology and computer science students and researchers from Delft, Eindhoven and Twente. The author introduced some of the insights around heating, cooling and a comfortable work environment that had emerged from the early stages of ethnographic work on EMPOWER, and (following More Associates' recommendation) framed a number of these into a single challenge: "Getting people to feel happy in a building with more variations in temperature".

Example approaches given were "wearing different clothes", "sitting in different places" and "being more tolerant of other people's feelings". Participants organised themselves into four groups, each with a mix of academics and industry staff. Each group received copies of the eight DwI 1.0 worksheets as inspiration material, and over 30 minutes, they discussed both the challenge and generated concept solutions to address it, sketching and noting them down. The suggested procedure was for the groups to talk briefly about the brief itself, and their own experiences in workplaces around heating, cooling and comfort, then for each person in the group to take one worksheet, become 'familiar' with the patterns and ideas for a few minutes, and then talking back to the rest of the group, running through the possibilities of applying the patterns to the brief. Radical ideas were encouraged, but so were more realistic interventions. After this brainstorming, representatives from each group presented some of their ideas to the room and there was a brief discussion about the merits (and in some cases, the ethics) of the concepts.

Twente workshop: Observe

Approximately 38 separate ideas were generated by the four groups, with some duplicates or very similar concepts. Tables 5.13–5.15 provide a rough categorisation of the ideas,

and Figure 5.10 is a montage of some participants' sketches. Not all of the concepts were explicitly noted as inspired by the DwI patterns, but the majority were, sometimes 'post-rationalised' by participants explaining them, as being "inspired by that pattern when we came up with it, but actually it fits this one too". It is noticeable that none of the concepts appears to have been inspired by the Machiavellian or Security lenses. As with some of the earlier workshops, the more obviously 'controlling' or 'anti-user' patterns are less often chosen by designers; in this particular workshop, where groups were generally six or seven people rather than a full eight, the Machiavellian and Security lenses seemed to be the worksheets not chosen by anyone, and only looked at cursorily, if at all.

Some of the concepts included are only indirectly about behaviour change—dealing with changes to building layout or working practices which would have a behavioural effect, but not at the level of designing interfaces or product features. Perhaps surprisingly, none of the participants emphasised the environmental angle on reducing energy use—there were concepts about attitude change around empathy, but nothing about engendering pro-environmental attitudes in order to cause behaviour change, which is a common approach in UK discussions of encouraging more sustainable behaviour. Some of the concepts are impractical, and some relate to building fabric changes rather than influencing behaviour (i.e., they are 'Q4' concepts in the terminology of section 5.3.2), but overall the exercise was considered useful in increasing the 'idea pool' for this aspect of the EMPOWER project at a relatively early stage. Aspects of concepts around temperature voting and keeping people informed about temperature have been taken forward and developed further as part of the project, at the time of writing only to paper prototype stage.

Student workshops at NTNU, Trondheim, Norway, and at Brunel University

In February 2011, the author was invited by Casper Boks, Professor of Product Design at NTNU (the Norwegian University of Science and Technology) to run a Design with Intent workshop with Sustainable Product Design students. In small groups (mostly groups of four), students were working on projects focusing on understanding both the material and behavioural aspects of everyday consumer practices, and the workshop, coming relatively early during their projects, was intended not so much as a concept generation session, but a way of exploring some of the issues involved and explicitly introducing behavioural considerations into the research.

The three practices were: coffee consumption, including understanding the environmental impacts of different methods of brewing coffee, users' needs and desires, the social aspects of coffee, transporting coffee (e.g. in insulated flasks) and substitute services (such as coffee shops); shaving, including comparing the environmental impacts of electric and non-electric solutions, elements of practice such as using hot or warm water, shaving oils or foam, habits and rituals and people's reasons for shaving in the way they do; and oral healthcare—the different ways people maintain dental hygiene, manually or electrically, with differences in routines, frequency of brushing, frequency of changing toothbrushes, and the rationales behind these practices, including feeling fresh and the fear of visiting the dentist. The oral healthcare brief was included based on the current project of Gøril Storrø, an NTNU Master's student on placement with Philips Research in the Netherlands.

Assisted by NTNU's Johannes Zachrisson and Dr Erica Löfström, the workshop involved each group receiving the set of eight DwI v.1.0 worksheets, and thinking about some of the patterns in relation to the practice they were investigating, then discussing the ideas with the whole class. The workshop started with an introductory presenta-

Table 5.12: Concepts generated by participants, roughly categorised

CONCEPTS	PATTERNS NOTED AS INSPIRATION
Allowing staff to adjust or affect the temperature in different ways	
Voting scheme on temperature for each floor or area: everyone gets votes for hotter, colder or OK throughout the day and a democratic compromise results	PEER FEEDBACK; RECIPROCATION
Rolling voting scheme where 10 people must vote the same way before temperature changes	PEER FEEDBACK
Placebo button allowing people to 'increase' or 'decrease' the temperature (that actually does nothing)	FAKE AFFORDANCES
Allow people to adjust the thermostat, but only by ± 1 °C or only every 30 minutes, so that 'thermostat wars' do not develop	PORTIONS; SLOW/NO RESPONSE
Use peer pressure – the most productive employee or team gets to choose the temperature setting for the day or week	SOCIAL PROOF; PEER FEEDBACK
Keeping people informed about the temperature	
Progress bars on thermometers / thermostats so people can see the trend of temperature in the building, and how long it will take to reach the setpoint (to avoid constant changes or unachievable settings)	PROGRESS BAR; REAL-TIME FEEDBACK
'Temperature forecasts' for the next day for different areas of the building, so people can plan to wear appropriate clothes ("Tomorrow is t-shirt weather!")	SIMULATION & FEEDFORWARD; TAILORING
Intranet should show current temperature for every area of the building so people can know exactly where to go and work if they're currently uncomfortable	REAL-TIME FEEDBACK
Visualisation in each room showing how hard the heating or air conditioning system is working to maintain the current temperature (so people realise how much energy it uses)	REAL-TIME FEEDBACK
Coloured lighting in different areas of the building signalling the temperature of that area, with flexible workspaces so people can choose to work where they are most comfortable	COLOUR ASSOCIATIONS
Inform people in advance of temperature trends in the building, so they can adjust clothes or move to a different place to work	SIMULATION & FEEDFORWARD

Table 5.13: Concepts generated by participants, roughly categorised

CONCEPTS	PATTERNS NOTED AS INSPIRATION
Different temperatures in different parts of the building	
Have cold and hot areas, entered through different doors. Even areas with a breeze from open windows, insulated from areas where people don't want it	SEGMENTATION & SPACING
Chart exactly where the hot and cold spots are in the building, and devise a seat-shifting game visualized through a 'sliding square' grid	PEER FEEDBACK
Allow people to book or subscribe to particular workspaces in advance with the temperature they prefer	TAILORING
Interior atmosphere could be changed somehow to better match the outside, so people feel less disconnected from the weather (managing expectations)	TRANSPARENCY
Different (concentric) seating areas for 'hot people' (nearer windows – that can be opened) and 'cold people' (nearer the centre of the building)	TAILORING; POSITIONING
Allow people on other floors to 'request' heat or cooling, and move the air around the building	
Exercise bikes which can warm up the people pedalling, while driving fans to cool people elsewhere who are too hot	
A 'cool path' through the building that takes people into unheated areas to allow them to cool down, feel refreshed and get some exercise before returning to their desks (or alternatively, a 'warm path')	MAZES; IMPLIED SEQUENCES
Give people points for sitting in hot spots or unpopular places that they can trade for sitting in a comfortable spot later – could have 'hot' and 'cold' points	SCORES; REWARDS
Flexible workspaces clearly labelled with the temperature, so over time it will be possible to see which areas are unpopular due to their temperature	SUMMARY FEEDBACK
Have 'social corners' with water coolers or coffee machines which encourage people to get up and move around (warming themselves up)	
Provoking empathy / peer awareness	
Out of office notification – "I am going outside for some fresh air" – to provoke empathy	PROVOKE EMPATHY
Avatars or puppets sitting on desk for every member of staff representing how happy / hot / cold / satisfied everyone is (raising empathy)	PERSONALITY; PEER FEEDBACK
'Ultrarelativism' concept – if you're too hot, you can video chat with someone who's much too hot (perhaps even in another country)	PROVOKE EMPATHY; EMOTIONAL ENGAGEMENT
'Chatboxes' where people can discuss the temperature, etc	
A t-shirt or badge that changes colour with people's body temperature, to drive empathy and show others that people do have different comfort levels	FEEDBACK THROUGH FORM; PROVOKE EMPATHY
Animated display showing employee satisfaction and happiness each week	SUMMARY FEEDBACK

Table 5.14: Concepts generated by participants, roughly categorised

CONCEPTS	PATTERNS NOTED AS INSPIRATION
New working practices / organisational initiatives	
Rota of working at home, so that on any one day fewer people are present and fewer computers switched on	
Encourage people to work in their cars instead, where they can control the temperature personally (the 'office drive-in') – or achieve the same effect with personal booths in the office	
Somehow make it fun or pleasant to experience a wider temperature range, e.g. themed days where people can dress up to match different climates, maybe with appropriate food and drink in the canteen	PLAYFULNESS
Simply encourage people to work from home at times of extreme temperature when the energy demand on heating or cooling the office will be too high	
Heating and cooling the immediate workspace	
Heated (or cooled) wrist rests on desks, to allow a 'point source' of heat or cold in people's immediate workspace	
Allow desk and chair height to be changed to raise people who are cold up into the warmer air towards the ceiling – or have it happen automatically to maintain a constant temperature in airspace around the person	TAILORING
Establish a habit of people opening the windows for a few minutes every hour in colder weather, to get fresh air and feel refreshed without letting too much heat out – could be a beep or flashing light to remind people to close them again	HABITS; CONDITIONAL WARNINGS
Remove handles entirely from all windows so people sitting next to them aren't tantalized by feeling they could have control but don't	FEATURE DELETION
Have rocking chairs or desks which both warm up the person doing the rocking, and create a draught to cool others and improve air circulation in general	
Heated (or cooled) chairs and footrests to allow localized temperature control in people's workspaces	

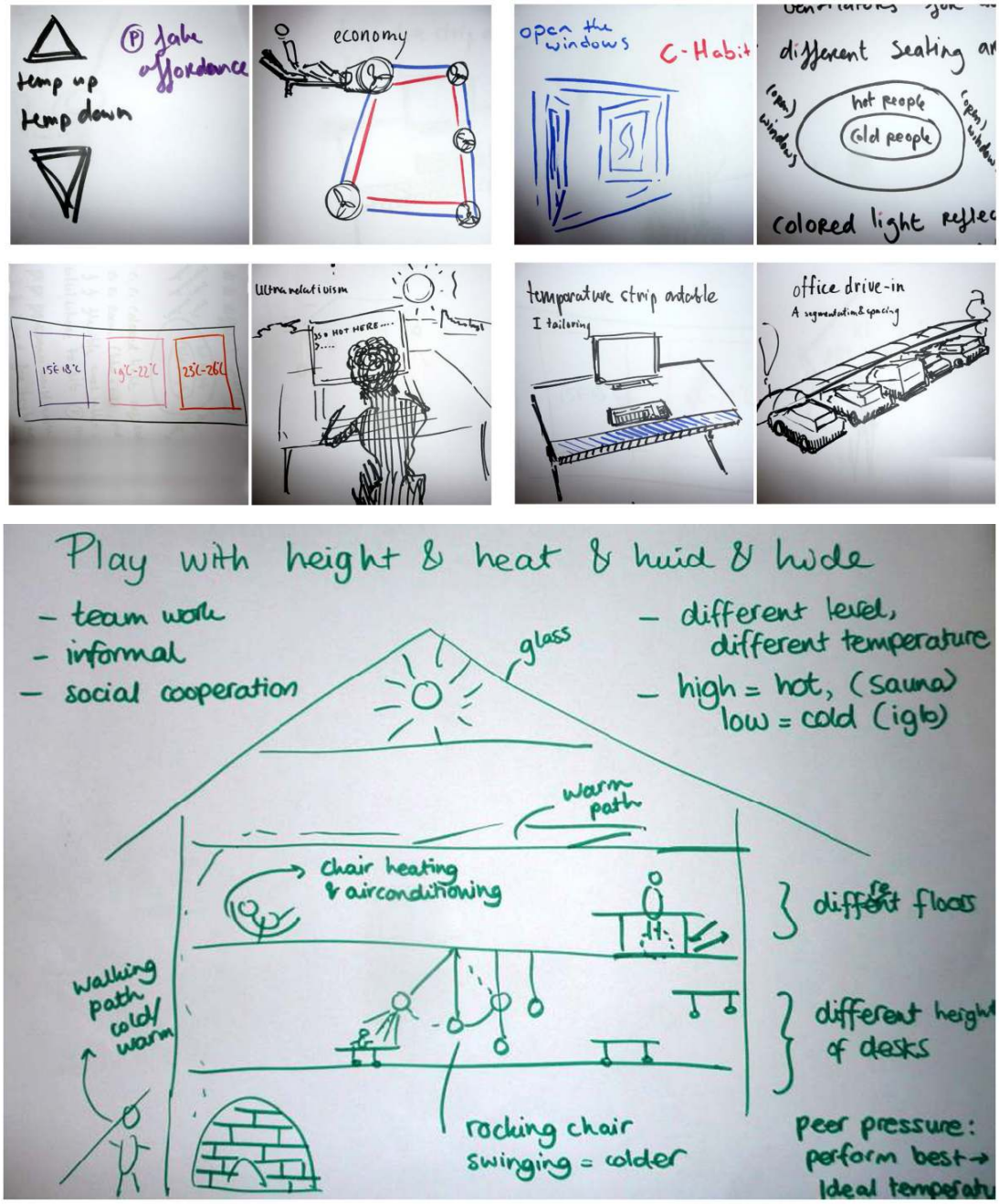


Figure 5.9: A selection of participants' sketches from the University of Twente workshop

tion about design and behaviour, then (in the same manner as the Twente workshop) each person in each group took worksheets for two of the lenses for 10-15 minutes, and individually tried to become a 'mini-expert' on the ideas contained in them, and how they might relate to the group's project. Then, each person talked back to the group in sequence about what he or she had learned, which provoked a discussion within each group; for the next 40 minutes, each group worked together on exploring the ideas, brainstorming and building on each other's ideas, and capturing via sketches and notes what they thought was useful, and planning how to present these ideas to the whole class. Finally, each group did a quick presentation of how their ideas had evolved and some of the behavioural issues they had uncovered and considered.

The workshop generated plenty of discussion around behavioural aspects of the practices under review to help the students progress their projects—and while the idea was to explore these rather than generate solutions, in some cases, the DwI patterns led directly to suggested ways of redesigning artefacts and systems. For example, one of the groups studying coffee consumption considered that one of the reasons that many students did not use insulated coffee mugs or flasks, instead paying for coffee from vending machines, was that the appearance of the insulated mugs did not make it clear enough whether or not they were leakproof, leading to anxiety about spillage. Concepts for redesigned flasks, inspired particularly by the Perceptual and Errorproofing lenses, included ideas such as demonstrating the flask was leakproof through the process of filling it—e.g. a flask with a domed lid, which is filled up, the lid put on and then has to be turned upside down to stand up properly. This would help reassure users that it is leakproof.

The NTNU workshop demonstrated the potential for using DwI as a teaching tool on design courses where behaviour could be an important consideration—in this example, ecodesign, but also possibly interaction design or other similar courses. The particular focus here was really helping students to see the connections between design and behaviour directly, through plenty of examples. Indeed, as sections 5.4.3 and 5.4.5 below show, a number of educational institutions have adopted it and used it in different ways, not just for idea generation.

At Brunel, following the use of DwI v.0.9 in BSc/BA and MSc classes, v.1.0 of the toolkit has also subsequently been used in the same classes the next year, introducing students to the behavioural aspects of environmentally sensitive design usually through a quick brief. A version of brief B3 on helping office staff use printers more efficiently (section 5.3.2) was used in autumn 2010 for an MSc class, with the express suggestion that groups could 'act' the scenarios they were discussing, playing the roles of different users interacting with the device. This allowed some of the concepts generated using the toolkit to be 'simulated' and the intended effects on user behaviour demonstrated via role-playing. Combined with rapidly mocked-up interface elements, this provided something beyond simply sketched concepts, and is particularly appropriate when it is behaviour of a product or service in use which is being addressed rather than just appearance or function. The author has since developed this 'acting' element in workshops at the dConstruct and UX People 2011 conferences, where participants were asked to act as 'devices' and 'users', each following strategies making certain assumptions about how the other will act in turn.

One consequence of using DwI in teaching is that students may adopt and build on some of the patterns in developing their own projects, particularly where these have an environmental or other behaviourally-related theme. A number of undergraduate and postgraduate Brunel design projects have made use of DwI in the past few years: section 5.4.5 includes a case study.

5.4.2 Worked example: improving financial decision-making

In July 2010, Sendhil Mullainathan, co-founder of Harvard University's Ideas42 think-tank—specializing in applying behavioural economics principles for social benefit—invited the author to explore applying the DwI patterns to questions of improving financial decision-making for mainly low-income households. In particular, a brief was given around mitigating mortgage foreclosure through loan modification. This work is included, as a worked example, in the Appendix.

The main insight for the development of DwI resulting from this exercise was that, given familiarity with the patterns, it is relatively easy to translate and apply the ideas in traditionally 'non-design' contexts. This was also evident to some extent from the workshop with West Sussex County Council (see below).

5.4.3 Applied workshops and other applications of DwI v.1.0

Tables 5.18 and 5.19 summarise, briefly, six other 'workshop' applications of DwI v.1.0 to social and mixed benefit briefs. In the case of the Modern Built Environment KTN event, although the scope covered lots of aspects of user behaviour in buildings, a number of the briefs were environmentally as well as socially related, often about influencing social behaviour to achieve reduced energy consumption as an indirect result.

5.4.4 Survey of DwI v.1.0 users

The public release of DwI v.1.0, in both printed and online form, presented the opportunity for a detailed survey of 'early users' of the toolkit—people who had downloaded it or acquired a printed copy, and used it in their work. Section 3.5.3 explains the survey methodology, structure and research questions in detail; section 5.4.4 here explains the 'act' and 'observe' stages.

Act

In January 2011, a Google Docs-based survey was put online and announced via the blog and an email to all the purchasers (and those who had received free copies) of the printed packs at that stage. Throughout 2011, further emails and announcements were sent to draw the attention of subsequent downloaders and purchasers; in some cases, packs were given to particular people on condition that they provided feedback once they had used the toolkit. The main purposes of the survey were to find out how the toolkit was being used, and how it could be improved (in both usefulness and usability), and as such the questions were centred on exploring certain aspects of these questions.

Limitations of the survey

The survey has a number of limitations. The respondents were a subset of people who have used the toolkit in various forms, but some had downloaded the PDF or browsed the wiki without actually 'applying' it to a problem or brief, so their comments, while welcome, were not necessarily representative of what they would say after having 'used' the toolkit for longer. Some respondents had been given a free printed copy of the toolkit on a (tacit or explicit) agreement that they would provide feedback, which may have biased the comments towards the positive.

Since respondents had chosen whether or not to take the survey, it may be that only the most and least satisfied (those with "a point to make") completed it, which could suggest a tendency towards extreme ratings. However, qualitatively it is respondents' comments and suggestions (rather than numerical ratings) which are most valuable in

Table 5.15: Other social and mixed applications of DwI v.1.0 during 2010-11 (part 1)

ORGANISATION / CONTEXT	PROBLEMS ADDRESSED	COMMENTS
UX London 2010 conference, London. User experience industry conference run by Clearleft. Author invited to run two (paid) workshops on consecutive days, with approximately 140 participants in total (70 each day). See also discussion in Chapter 10.	Influencing users' behaviour while interacting with (mainly) services. Briefs were mostly suggested by participants themselves, and included: • Encouraging visitors to an independent film website to commit time to watching movies with unfamiliar actors and names • Influencing people to look where they're going when walking on pavement while using a smartphone • Getting 'genuine' and more thoughtful reviews on a restaurant review website • Encouraging cyclists and HGV / bus drivers to look out for each other • Encouraging people to use a clothing retailer website where they can preview images of themselves wearing the clothes • Encouraging people to stay on line with automated phone menus and not hang up	Eight DwI worksheets used with each group; initial presentation included many web examples to help make relevance clearer. Very large workshops meant there was a risk that some people would be disengaged but in the event, groups produced many dozens of ideas, and the workshops received generally positive feedback. Participants were extremely creative, mostly from design backgrounds, and as well as sketches, produced storyboards and even site wireframes to record their ideas. These workshops demonstrated the potential for running DwI sessions in a 'corporate training' context. Making it clear that participants could annotate the worksheets—directly, or with Post-It notes—seemed to make the idea generation process quicker. However, 70 participants per workshop is probably too many for the facilitator to be able to engage with directly—walking around and talking in depth to every group was difficult.
Persuasive 2010 conference, Copenhagen, Denmark. Author invited by Stanford Persuasive Technology Lab to run workshop alongside sessions on other aspects of persuasive technology. 17 participants, mixture of academic and industry; mostly domain experts with few designers.	A mix of social and commercially beneficial briefs around a diverse set of behaviours, suggested by the participants, including: • Encouraging people to donate to charity • Encouraging people to buy clothes from an online clothing retailer [note similarity to a brief from UX London] • Encouraging cycling to and from work • Getting more users to contribute work to a collaborative website • Influencing people to give up smoking	Eight DwI worksheets used with each group. Small number of participants meant that each group of 3 or 4 people had to consider all eight lenses, which was too many in the time available, particularly given lack of familiarity with design terminology. Many of the (relatively few) ideas generated were discussed in detail (and the pros and cons debated immediately) rather than brainstorming as many as possible. Too many briefs for such a small workshop—although it meant that participants could work on things that interested them, the field of possible concepts to address each was barely explored in the time available. Some better workshop management would have been useful, e.g. appointing one person in each group as a 'recorder' or making sure each group had someone comfortable with sketching.
Brighton & Sussex University Hospitals NHS Trust. Workshop at Design Council, London, 2010. Author invited by BSUH NHS Trust to help run a workshop with 25 healthcare staff and staff from project contractor for new hospital extension.	BSUH had a number of (staff) behavioural issues it wanted to address in the design of a new hospital extension, including: • Improving staff eating behaviours • Encouraging exercise in the workplace • Encouraging team working • Encouraging alcohol gel handwash usage However, although these were introduced, the actual choice of behaviours to consider was open-ended: participants, in groups assigned to different areas of the hospital (wards, outpatients, public areas) were asked to consider "Which behaviours do we want to influence in our area, and how can these be enabled, motivated or constrained through effective design?"	In this workshop, six groups of 4 or 5 people were each assigned one of the DwI worksheets (Architectural, Errorproofing, Interaction, Ludic, Perceptual and Cognitive; Machiavellian and Security were not used) and different areas of the hospital. Thus, each group could focus on a smaller set of patterns rather than potentially being overwhelmed. This is potentially a useful structure. As with the Persuasive 2010 workshop, groups generally tended to discuss ideas in depth as they were generated, rather than brainstorming as many as possible, but at least in some groups a range of possible ideas were generated. The major problem with the workshop was that asking groups to decide what behaviours they wanted to address within the same time slot as actually generating concepts simply took too much of the limited (25 minute) time available.

Table 5.16: Other social and mixed applications of DwI v.1.0 during 2010-11 (part 2)

ORGANISATION / CONTEXT	PROBLEMS ADDRESSED	COMMENTS
West Sussex County Council, Horsham, Sussex, 2010 With Warren Hatter (Ripple PRD) and Oliver Payne (The Hunting Dynasty) and the author, workshop run with 13 participants inc. facilitators. Most participants WSCC staff, but also visitors from Institute for Government, London Borough of Barnet and Univ. of Manchester	For a day's event titled 'Behaviour Change: What Next?', Warren Hatter together with WSCC identified 18 'desired public behaviour changes' that could be important for the council's work in the near future, either to save money or reduce environmental impact, or both, covering areas such as: • Encouraging more volunteering • Helping people coordinate journeys and car-share • Encouraging people to borrow 'eBooks' rather than physical library books • Reducing food waste • Children walking or cycling to school The purpose here, for which Ripple PRD had been commissioned by WSCC, was to help the council build its behaviour change 'capacity', in terms of in-house knowledge and expertise on the subject, rather than trying to solve any of these problems immediately.	The unusual feature of this workshop (from the point of view of this thesis) was that rather than using the DwI cards or worksheets, Warren Hatter, Oliver Payne and the author selected a subset of patterns (the term 'gambits' was used throughout the workshop) felt to be especially relevant to the briefs to be addressed by the council. The gambits LOSS AVERSION, PRIMING, GOAL DILUTION, TEMPORAL DISCOUNTING and PRICE PERCEPTION were added, together with combining certain other patterns, to give a total of 18 gambits, presented (largely in text form, phrased as "Can you...?" questions) as inspiration for the idea generation part of the day. In two groups, each addressing 3 or 4 of the behaviour briefs, participants used a large matrix to try to apply each of the gambits systematically to each brief, recording and then presenting their ideas together with a discussion of the feasibility or implications. This workshop demonstrated in particular the potential for aspects of the DwI approach to be built into other frameworks and processes, and adapted for use in 'non-design' situations with other kinds of stakeholders. It also highlighted that in the era of the Behavioural Insights Team, there is scope for other public sector organisations to build their own behaviour change capacity and understanding.
Modern Built Environment KTN & Creative Industries KTN event on Changing User Behaviour in Buildings, at Royal Statistical Society, London, 2011. Organised by BSRIA, the Building Services Research and Information Association; 70 participants approx.	As part of a day of presentations by companies and researchers (including the author) working on different aspects of behaviour in buildings, delegates took part in 'warm-up' idea generation exercises addressing briefs set by the speakers: • Encouraging interaction, understanding and empathy between different groups of people within workplaces • Reducing use of lights in the home • Encouraging people to spend more time together in the same room at home • Adapting CarbonCulture (see section 5.4.1) for domestic use or other organisations	Delegates (seated in groups of 7 or 8) each received a selection of the DwI v.1.0 cards (rather than worksheets) distributed among tables so that each had a good mix of patterns. This was intended primarily as a warm-up, ice-breaker exercise for delegates, with the cards remaining as inspirational talking points for the rest of the day. Each table had an appointed facilitator / recorder, which meant that a significant number of concepts and ideas were recorded (and later published on the BSRIA and MBE KTN websites). The aim was not necessarily to generate useful concepts, being rather about getting people to discuss the problems and share their expertise, but some interesting ideas were provoked. This exercise showed that using small subsets of the DwI cards can work as a rapid, easily digestible method for stimulating thinking and discussion around behaviour.
Philips Research, Eindhoven, Netherlands, 2011. Author invited by Gøril Storrø, an NTNU Master's student on placement with Philips, to run a workshop with staff. 17 participants, a mixture of Philips Research and Philips Design staff.	The three briefs related to different aspects of behaviour around oral health (with attendant social and potentially environmental benefits), the field in which Gøril's project was based, but the exact details are subject to an NDA.	Three groups each addressed a slightly different brief, receiving a set of eight DwI worksheets and working through them in a similar manner to the Twente and NTNU workshops. With a high proportion of designers present, most of whom were experienced with brainstorming, and some of whom had used the DwI cards before, a very large number of concepts were generated in the time available. One group in particular worked through each worksheet methodically and efficiently, generating concepts to address their brief for almost every single pattern, annotating the worksheets with sketches on Post-It notes. This workshop further demonstrated the potential for using DwI in corporate settings, particularly where participants are adept at idea generation and recording.

understanding how the toolkit is being used, and how it could be improved, and the survey has provided these in abundance.

Observe

The survey has been left online, receiving a small stream of responses since January 2011. For the purposes of writing up this thesis, the first 100 valid responses (i.e., discarding some submissions which appeared to be blank or duplicates) received, a figure reached in early September 2011, have been analysed here—conveniently allowing numbers of respondents to be used directly as percentages.

Formats and use contexts

A small majority of respondents (56) had used the toolkit on-screen via the PDF or wiki, but there was an overlap (14) with those who had used printed packs of cards, or who had printed the toolkit themselves (Figure 5.11). Some had ordered a printed pack, or printed their own after using the cards on screen. One respondent, James Christie, had loaded the wiki pages onto his iPhone as a reference—he subsequently developed a free iPad and iPhone app version of this, which was released on Apple's iTunes store in September 2011.

All of this information helps address the element of the research questions (section 2.3.2) concerning whether the toolkit was 'of use' to practitioners—uncovering the use-cases, both expected and unforeseen. The largest use-case for the toolkit (Figure 5.12) was 'brainstorming / idea generation' (71) of which 49 were individual and 22 group brainstorming. Informal inspiration, browsing/reading through the cards like a book, use as a reference, and use to analyse or classify existing ideas followed in order of popularity—most respondents mentioned more than one way they had used the toolkit, with only 21 listing a single use-case. Respondents including their own comments on other ways they had used the toolkit included "As a guide for business marketing, website and brochure design," "Classroom tool for hotel design students" and "Teaching material".

Figure 5.13 shows the context in which the toolkit had been used: a small majority (55) used the toolkit for personal interest, but 42 had used it commercially (8 with clients, 34 internally) and 37 had used it at an educational institution (presumably either as instructor or student). Smaller numbers of respondents had used the toolkit at conferences or workshops, or in the public or voluntary sectors. Other contexts mentioned by participants included "Theatre", "Research Institute" and "Content inspiration (writing)".

Comments on the kinds of problems addressed and the most useful patterns

Table 5.20 lists, verbatim, all the 'kinds of problems' respondents mentioned (72) addressing with the toolkit. These range from very specific projects to more general uses, including energy, healthcare, architecture and web design applications. Again, this helps address the 'of use' criterion in the research questions (section 2.3.2), demonstrating the diversity of ways in which practitioners have found the toolkit of use to them.

Some respondents presumably understood 'problems' in "Can you describe the kind of problems you've used the cards to address?" to mean 'difficulties with using the cards', so these responses are considered in the section on usability, below.

Respondents who answered the question, "Were there particular patterns or lenses that you found especially useful or applicable to your problems?" in the affirmative listed all the lenses and a wide range of individual patterns—there do not appear to be

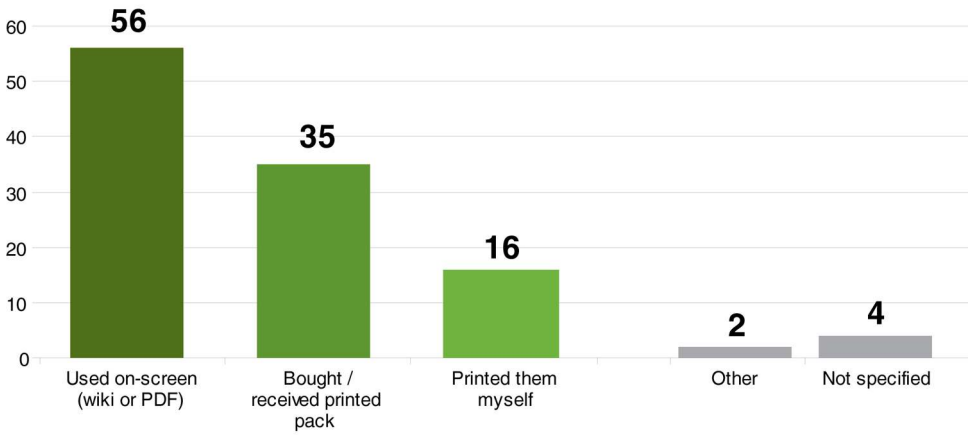


Figure 5.10: The DwI toolkit formats that survey respondents had used.

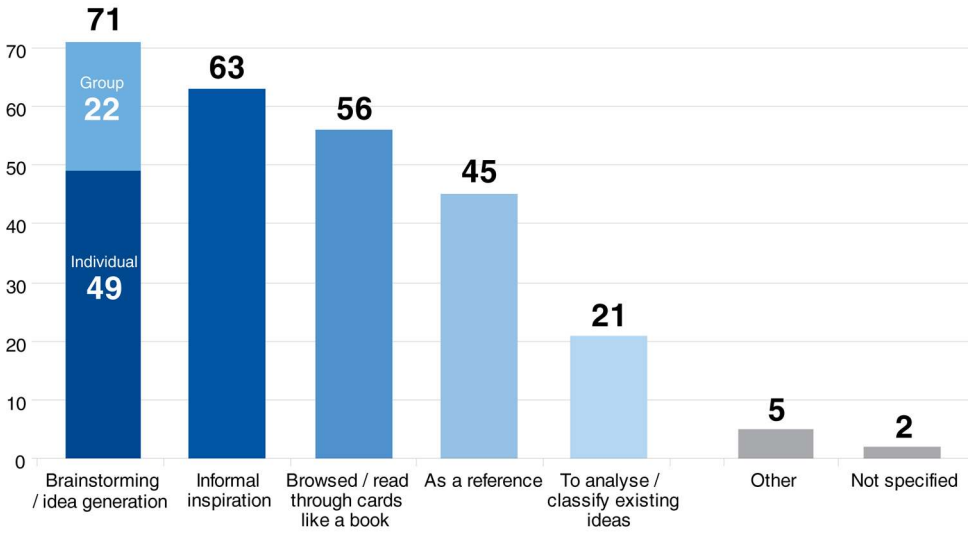


Figure 5.11: How survey respondents had made use of the toolkit.

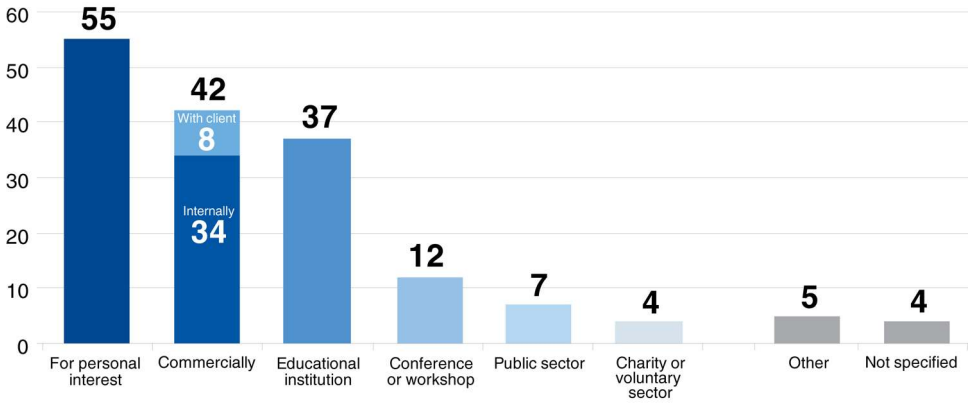


Figure 5.12: The context in which respondents had made use of the toolkit.

Table 5.17: Answers to "Can you describe the kind of problems you've used the cards to address?"

Just thinking about problems rather than specific solution	To inspire elaboration of existing design
General learning about design. Practice thinking outside the box.	Web application
Trying to find *something* that would work	Giving a presentation on persuasive design
During idea generation, I regularly use the cards to encourage alternative approaches to solving design problems. In short, for inspiration.	Helping make decisions on what to drop / refine / add during the Alpha and Beta stages of development and as input to paper-based designs and pitches for future projects
Website design, marketing ideas	Energy consumption
Trying to seek new ways of thinking about challenging UI problems	Brainstorming, idea creation
Website and app design	Understanding different perspectives on how design can guide / affect the user
Promote physical activity/healthy food intake/medication management	Example based classifications
Inform a systematic approach to considering design approaches to behaviour change	To show people new ideas to improve their website designs
Clarifying ideas, explaining	UX/UI design
Better design of health behaviour change technology	Writing microcopy for websites, explaining to colleagues why we need to change designs
Developing persuasive mobile app, developing airport security services	Management :)
Not use per se, but use the idea of the cards to show possibilities	Graphic design problems, specifically for web users
I deal a lot with the consequences of bad decisions. These help me present information more effectively	Reviewing design decisions to validate comprehensive understanding and reason for their decisions
Developing a new working method for sketching infrastructures from a business point of view	No specific problem. Just to highlight to manufacturers how they should approach designing sustainable solutions differently.
Conscious usability	Is my thinking about UX design (not my specialist area) broad enough?
Focused marketing of ideas; better slide design in teaching	Clarify half-known concepts
User experience	Creating of interior
Silly brainstorm problems	Web site analysis and brainstorming.
Workflow in software development	Design analysis—helps to see if something is designed with a particular intent
Sustainable design. User behaviour	Simplifying and making things ergonomic
Designing for behaviour	Haven't used them to address specific problems yet
Seeing design from a different perspective	I'm just looking into persuasive design for my masters dissertation
To influence nurses' behaviour	Idea generation
Designing a socially driven space—humanistic design	Innovation
Service design in education	Service design problems
Analysing an idea	Nothing in particular, just for inspiration, for future reference
Recipe website ideation	Ways to make individuals save energy.
School project	Public behaviour change
I'm designing a building and always wanted to incorporate behavioural manipulation techniques to 'control' the users of my theoretical facility	Designing digital platforms that help people eat better, move more and generally adopt healthier behaviours
Will be using them next week to promote lateral thinking	I've only just begun to explore how we could use them.
Major projects	Thermal comfort practices, sustainable behaviour, selling things on eBay!
Developing features in our web app	For persuasion enhancement
Generate ideas how to design a feature better. To stimulate creativity, out of the box thinking for a totally separate task	Used in the design of new media device to engage gay men with the topic of health promotion
We're thinking about ideas at the start of a project and want all possible ideas	Help design students notice how people's behaviour is shaped
I have just use the cards as reference and [as] yet I haven't used them to solve a particular problem	Giving examples of design considerations that a hotel planner might think about during the design process

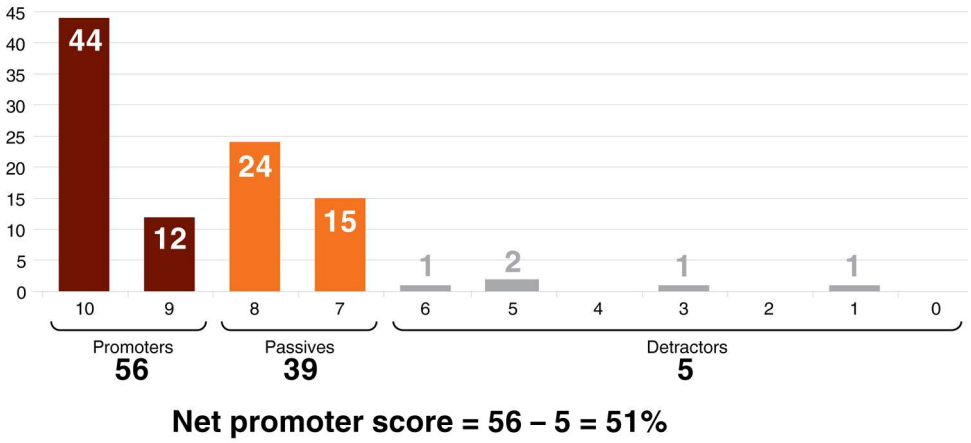


Figure 5.13: Respondents' assessments of how likely they would be to recommend the toolkit to friends or colleagues, where '10' is 'Would definitely recommend' and '0' is 'Would not recommend'.

any particular trends. The Architectural, Errorproofing, Interaction, Ludic, Perceptual, Cognitive, Machiavellian and Security lenses were all mentioned individually by different respondents, with some listing a few and others naming only one (or none). Individual patterns named included METAPHORS, EMOTIONAL ENGAGEMENT, PAVE THE COWPATHS, ANTIFEATURES & CRIPPLEWARE, INTERLOCK and HABITS. Some respondents noted that they used certain lenses to challenge their own or their colleagues' ways of thinking about behaviour, while others suggested that the lenses did not really mean much to them, and they organised cards useful to them following their own schema. One respondent mentioned combining the DwI cards with the Business Model Generation canvas (Osterwalder & Pigneur, 2009), to explore new business models.

Reaction and NPS

Figure 5.14 shows respondents' assessments of how likely they would be to recommend the toolkit to friends or colleagues. The majority of respondents (56) were 'promoters', with 39 'passives' and 5 'detractors'. The NPS calculation here gives a score of 51%, which—although in completely different contexts—compares with companies such as Southwest Airlines (51%), FedEx (56%) and American Express (50%) (Reichheld, 2006, p.20). It would be interesting to compare the NPS for other kinds of 'training' courses or even design toolkits (if it has ever been used in this way) but these data are, understandably, rarely made public by companies using NPS.

While an NPS of 51% is considered a 'good' score, the reasons given by detractors and passives about why they gave the toolkit lower ratings need to be addressed. The main criticisms fell into around seven clusters:

- opposition to the idea of influencing behaviour through design in general [difficult to address given the nature of the toolkit]
- too much focus on the areas and examples not of interest to the respondent (products rather than environments, environments rather than digital, etc)
- poor visual design of cards
- poor quality printing / paper stock of cards

- not enough recommendations about when to use particular patterns
- too specific (not abstract enough)
- too abstract (not specific enough)

The final two conflict, but this is perhaps to be expected: some users will want very specific recommendations relating to the exact context in which they are working (including differences for products, services and environments), while others will be frustrated by this and prefer a more general, higher-level set of patterns. It is difficult to see how the examples could be made more abstract and still exist as real examples; Anderson's *Mental Notes* cards (2010; see section 4.4.1) manage to be phrased at a more abstract level than DwI, but at the expense of being able to use real examples as illustrations.

The aesthetic criticism of the cards centres on the visual design and the quality of the printing. It is true that fitting the varying length question text onto the cards for all 101 patterns led to some having more cramped text than others, something which should be solved for a future version, and the text size was large to make it easier for multiple workshop participants to read the card at once, at the expense of white space. Equally, although the paper type was stated on the online order form, some respondents who had bought the cards were clearly disappointed that they were printed on photographic paper rather than card, and did not have rounded 'playing card' corners. The main reason for using the photo-printing method was (up-front) cost: it is an on-demand method which required no initial outlay and could respond to orders directly. With some up-front investment in ordering a larger print run, it would be possible to have postcard printing, on heavier stock, at a similar cost per item. This too is something to consider for a future version.

Likewise, the point about the relative lack of recommendations on when to use particular patterns is well-made: other than the brief introductory cards introducing the pinball, shortcut and thoughtful models (see section 4.4.2) and target behaviours, the pack does not give recommendations. As has been a running theme throughout this thesis, something along the lines of a *BehaviourTRIZ* would be a significant undertaking, but worthwhile attempting.

What about more positive comments from promoters (and some 'passives')? Again, clustering some of the comments, respondents valued different features of the toolkit:

- breadth of ideas / comprehensiveness of coverage
- disruptive inspiration through transposing ideas from different disciplines
- uniqueness of the scope / focus of the collection reference library of examples—"a toolbox of persuasive mechanisms"
- visual nature of examples
- breaking down perspectives on behaviour into "manageable chunks"
- "useful over-simplifications"
- free [referring to the PDF and wiki]
- "giv[ing] name to many processes designers do without thinking"
- "student friendly (quite)"

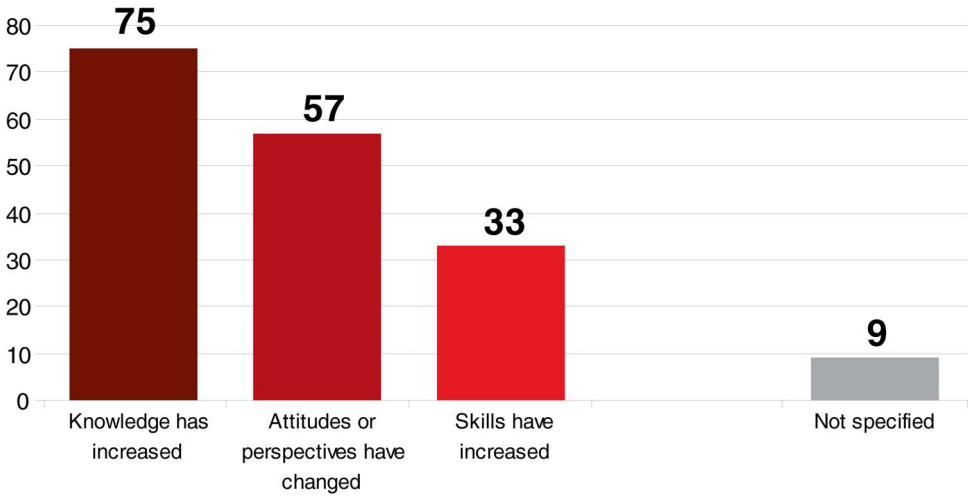


Figure 5.14: Respondents' assessments of what they had learned from the toolkit, based on Kirkpatrick's categories

It is important that future versions of the toolkit retain and build on these desirable features, while addressing some of the criticisms mentioned above.

Learning

Respondents' answers to the question about knowledge, attitudes and skills are shown in Figure 5.15. Only nine respondents did not specify any of the three answers; 35 specified only one answer, with the remaining 56 selecting more than one answer.

Most respondents (75) said that their knowledge (in the field of design for behaviour change) had increased as a result of using the toolkit, with 57 stating that their attitudes or perspectives had changed, and 33 having improved their skills. It was not necessarily expected that using the DwI toolkit would lead to an increase in skills per se anyway; it would have been interesting to find out what skills those 33 respondents felt had increased.

Suggested improvements and other comments

In addition to the detractors' comments mentioned above, improvements suggested by respondents included:

- More international examples ("a bit UK-centric right now")
- Better quality card stock
- Multiple examples for each pattern rather than just one
- Smaller cards
- Larger text on the introductory cards
- "Stronger graphic design" and typography
- Add extra examples on the wiki, and allow readers to do the same
- Less use of colour for a version that people can print themselves (to save ink)

- Stickers with each pattern name on, to make brainstorming easier
- Formal disciplinary categories such as "IA, UX, ID" rather than the lenses
- An algorithm for when to use which patterns, or caveats about when particular patterns are unsuitable
- A flow-chart for how to use the cards
- Games or activities built around using the cards
- Suggestions for how to test and measure behaviour change
- Numbering of the cards
- A poster, ring binder or book version to allow multiple patterns to be scanned more easily at once
- Videos, animations and interactivity ("find out more" links) on the online version
- More patterns / cards / details
- Fewer patterns / cards / details
- Make it easier to scroll through the patterns online [presumably referring to the wiki, where it is not easy to scroll quickly through the patterns]
- Make them available as business card designs at Moo or other online printers [the author has done this for his own business cards]
- Make an iPad or iPhone app [this has subsequently been done by James Christie]
- Regular review of the examples to keep them current [more likely to be a problem with website examples]
- Use both sides of cards—more details on the back
- A cut-down summary of the cards "for less developed users"
- More recognizable examples for some patterns

Some of these suggestions point to different use-cases, but all are reasonable comments. The implications of some otherwise contradictory suggestions probably hint at the need for multiple versions of the toolkit—smaller cards for individual use, larger cards or posters for group use, detailed background information for users who want it, with simpler summaries for those who do not. Most of these suggestions fit well with the possible 'longer term improvements' suggested at the start of this chapter; it is intended that once the PhD is completed, the toolkit will be revised and updated, and feedback solicited from future users.

5.4.5 Case studies: How others have used DwI v.1.0

As a consequence of making the toolkit available online free of charge, a number of external parties have made use of it. Via a number of prominent design, technology and business bloggers—including Seth Godin, Cory Doctorow, John Maeda and Tim Harford—linking to and recommending the downloadable PDF, the number of downloads has been quite high.

Estimates based on server logs from the author's website suggest that from April 2010 to September 2011, the main PDF of all the DwI v.1.0 cards has been downloaded approximately 149,000 times, in addition at least 77,000 extra downloads of alternative PDF versions such as the worksheets and versions of the main PDF broken into separate files for each lens. The PDF has also been mirrored on a number of other websites such as Scribd. While these numbers are large, there is no reason to believe that anything more than a small percentage of those who have downloaded the PDF have actually 'used' the toolkit—many probably downloaded it primarily because it was free.[11]

However, based on web statistics and communications from people involved, it is known that DwI v.1.0 has been adopted as recommended reading or as part of class projects at a number of educational institutions worldwide, including London College of Communication, Emily Carr Institute of Art & Design, TU Delft, University of Twente, Full Sail University (a Florida-based film and media school), University of Limerick, Dublin Institute of Technology, University of Nevada and University of Southampton. It has also been used in schools, including Royal St George's College, Ontario. In most cases, this has been on design courses (including specific ecodesign courses and interaction design courses), but the toolkit has also been listed on an advertising psychology course (Technische Universitat Dresden), used to provoke discussion about behaviour change on a politics course taught by Professor Gerry Stoker (University of Southampton), and set as reading on an STS-type course on 'The Secret Lives of Technology' (University of Nevada). Away from the education sector, the toolkit has also been referenced in presentations by the Design Council and in the Central Office of Information's behaviour change newsletter.

Printed packs of cards have been purchased for internal use by organisations including the BBC, EDF R&D, Futerra, Philips Research, Cooper Interaction Design, JustGiving, Bayer Healthcare, CBS Interactive, Fox, EMC Consulting, Sony Computer Entertainment Europe, European Bioinformatics Institute and the Ecodesign Centre Wales.

The remainder of this section will give brief details of some projects where designers, students and educators have used the toolkit in practice.

Alexander Ambridge: Twist Kettle

Alexander Ambridge, a final year BSc Product Design student at Brunel, used the DwI cards for brainstorming 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 (as in brief B1 in section 5.3.2) but by encouraging users to set the required temperature (between 65° and 100° C) to suit different kinds of drinks, before the water can be 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...
>
> 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) although I didn't want the users to feel constrained. The dial base interface [Figure

[11] It would have been sensible to include a link to the survey in the PDF, but unfortunately this was not considered at the time. As well as downloads, from May 2010 to September 2011, approximately 280 printed packs of DwI cards have been sold or given away.

Figure 5.15: Alexander Ambridge's Twist kettle—requiring the user to set the desired water temperature by rotating the base.

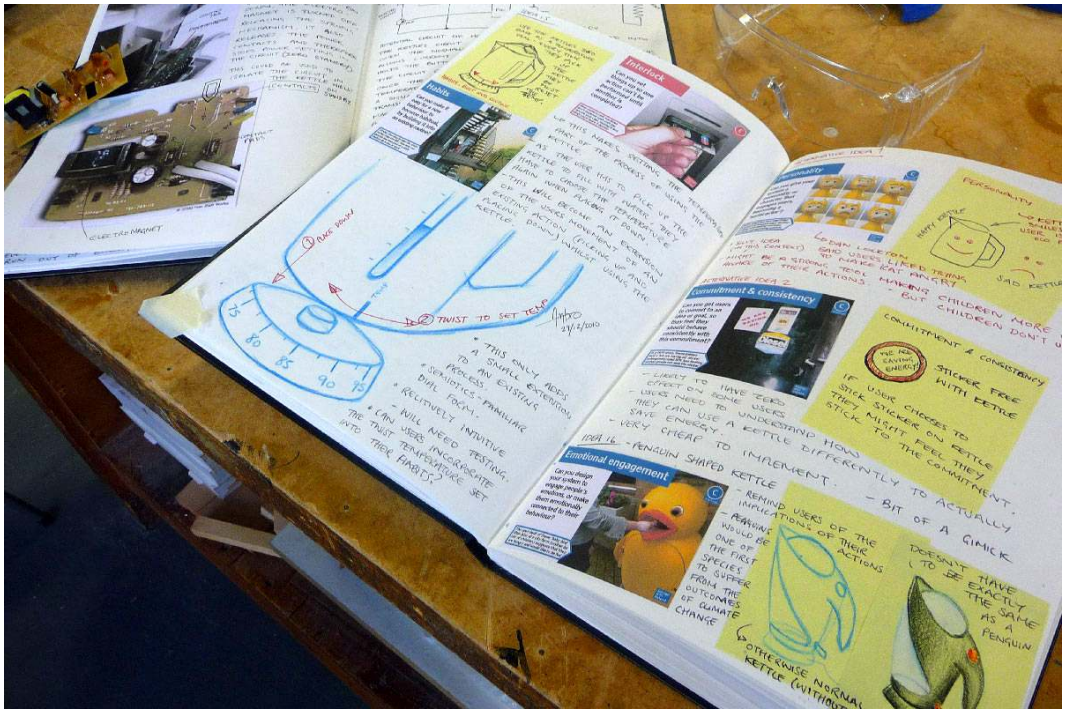


Figure 5.16: Alexander Ambridge's sketchbook showing how the DwI cards were used directly to inspire concepts.

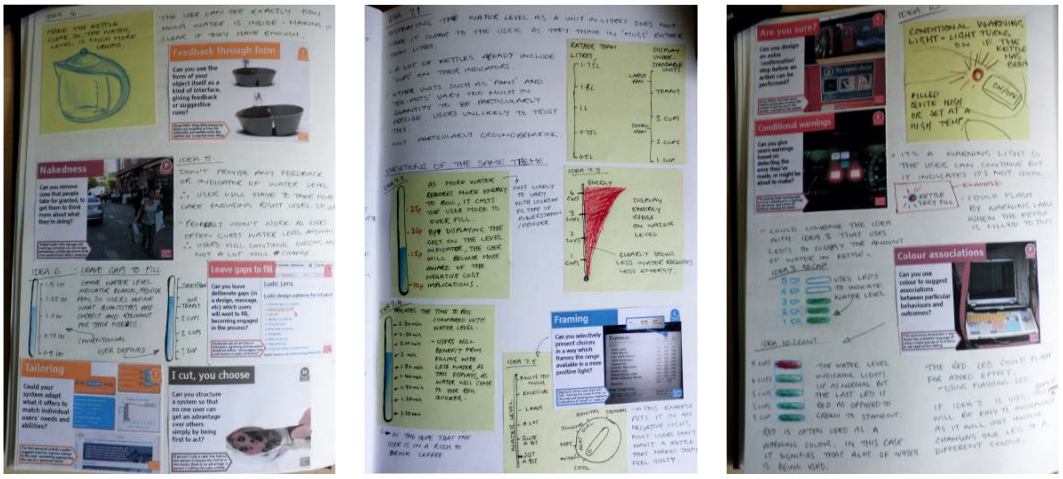


Figure 5.17: Alexander Ambridge's sketchbook showing how the DwI cards were used directly to inspire concepts.

> 5.16] 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)

Before arriving at the 'twist' concept, Ambridge used the DwI cards for a comprehensive individual brainstorming process (Figures 5.17 & 5.18) in which he went through the cards on screen, first noting and sketched 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 & CONSISTENCY, FEEDBACK THROUGH FORM, NAKEDNESS, FRAMING and CONDITIONAL WARNINGS. He commented in his response to the DwI survey (section 5.4.4) that "It would be useful on some occasions to see more than one example of each card in practice and/or more information than the grid allows, potentially a 'find out more' option with more layers or links to suitable sources of extra information. I use the cards on-screen, the virtual cards could be made interactive to reveal more."

It is intended that future developments to the wiki (and the iPad / iPhone app) can address some of these points.

Anson Cheung: StairTalk

Anson Cheung, a Rhode Island School of Design student on exchange at the Köln International School of Design in Germany, made use of the DwI toolkit v.1.0 in a group service design project. The StairTalk project "uses people's everyday environment to encourage more physical activity", specifically through "help[ing] people incorporate stairs [as opposed to using lifts] into their daily routine. Since most people encounter stairs in their daily routine, we believe that something small and relatively easy to do like taking the stairs can be an important first step to incorporating exercise into one's daily routine" (Cheung et al, 2010).

The project was based on a four-month research programme, including a study of school staff and students which found that 85% would only take the stairs for up to two

Figure 5.18: Images from the StairTalk project.

floors, with the percentage declining to 28% for three floors and 12% for four floors. Interviews and 'movement journals' given to building users helped uncover their motivations behind using the lift rather than the stairs, including perceptions that the lifts were always quicker than the stairs, that lifts were better as a 'social space' than the stairs, and that the health benefits of using stairs were not worthwhile. The StairTalk project thus aimed to address these perceptions through a series of design interventions.

Along with Thaler & Sunstein's *Nudge* (2008; see section 2.2.3), the team used the DwI toolkit to help structure the possible ways of developing interventions, extracting four design approaches—a 'perceptive framework' (about changing perceptions), a 'ludic framework', a 'cognitive framework' and a 'commitment/reward framework'. Cheung commented (personal communication) that "[the] DwI Toolkit was very useful for us when developing the project, because it gave us some structure to work within for such a complex problem."

Based on the four approaches, a concept was prototyped with multiple elements (Figure 5.19) including: using coloured arrows on the floor to 'direct' users towards the stairs; speech bubble posters on the staircase walls that users were encouraged to write on, sharing ideas; information about health benefits (including how many calories using the stairs burns) and time comparisons between lifts and stairs; and a challenge to KISD students and staff to use the stairs at least once a day, making use of two-part stickers, half of which would be worn to demonstrate commitment to the challenge, and the other half (with the person's name on) publicly displayed on a 'leader board'. In a week-long implementation, compared with the baseline figures, each of these interventions showed an increase in the percentage of building users taking the stairs three or four floors, with statistically significant averages of 17 percentage points increase for three floors and 11 points increase for four floors (Cheung et al, 2010). The StairTalk project has since won €10,000 in funding from "What makes us healthy?" a German competition, enabling it to be developed further in partnership with local companies.

It is interesting to see the DwI toolkit being used here primarily to help structure approaches to a problem, rather than directly as an idea generation toolkit (although

perhaps contributing in this way too). The four approaches adopted make use of some of the DwI concepts, including three of the lenses but also aspects of some of the individual patterns. As noted by some of the survey respondents (section 5.4.4), the classification method offered by the lenses has proved of use in some contexts, even though it is in no way definitive. This kind of use does suggest that some structure can be valuable to some users, compared with less categorized ways of organising design principles (e.g. the alphabetic approach used by Lidwell et al, 2003).

Frederick van Amstel: Faber Ludens Institute

Faber Ludens is a Brazilian organisation which runs graduate-level interaction design courses in partnership with local universities alongside consultancy for companies including Electrolux and Volkswagen. Frederick van Amstel, co-founder of Faber Ludens, made use of the DwI toolkit in running a field study for the interaction design foundations course. Called 'The Critical Shopping Centre', the project involved new students visiting a nearby shopping centre and examining critically how designed elements of the environment affect and shape consumers' behaviour (Faber Ludens, 2011).

The students were divided into groups, with each group receiving a set of cards from one of the DwI lenses, and set the challenge of finding situations where the patterns could be seen in action. On return to the classroom, the cards were stuck on a whiteboard and annotated with sketches of the situations identified (Figure 5.20), and the issues involved discussed. The groups then were set the task of "redesigning the observed situations to stimulate customer reflection about the behaviour shaping mechanisms" (van Amstel, personal communication) and creating 'comic strip' storyboards showing how Janet, a typical customer, would experience the situations. For example, one group, in seeking to stimulate customer reflection on STYLE OBSOLESCENCE (from the Machiavellian lens)—and ultimately, perhaps, the nature of 'need' itself—devised a kind of in-store 'museum', making use of the STORYTELLING and CONTRAST patterns to show the customer how quickly fashions change and yet how 'obsolete' styles are still functional (Figure 5.20).

The initial use of the cards in this project—as a way of triggering students to find similar patterns in their environment—is an interesting use-case which, although obvious in retrospect, the author had not previously considered explicitly. If it were to evolve further in this direction, the DwI toolkit could become something of an 'Observer's Guide' to the strategies for influencing behaviour embedded in the designed environments, products and services around us, potentially being useful as a critical tool as well as a guide for creating the designs in the first place. This would indeed be a worthwhile angle to explore in future evolution of the toolkit.

5.5 Conclusions of the evaluation chapter

This chapter was was paired with Chapter 4 as part of the 'spiral' *plan–act–observe–reflect* approach to action research methodology. While Chapter 4 covered the *reflect* and *plan* stages of the spiral, for each version of the toolkit, this chapter concentrated on the *act* and *observe* stages, exploring the iterative evaluation of the toolkit in use, through workshops, worked examples, a survey of early users and case studies. The insights from each stage of evaluation were fed back into the development of the next version of the toolkit in Chapter 4.

Figure 5.19: Images from 'The Critical Shopping Centre' project. Comic strip by Viviane Delvequio and Rafael Giuliano.

5.5.1 Which parts of the research questions were addressed?

In section 2.3.2, a gap in the literature was identified as the first research question of this thesis:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

The form in which the ideas were brought together—the toolkit, as was described in Chapter 4—answered parts of this 'How?' question, while the *act* and *observe* stages described here in Chapter 5 also addressed a second research question:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

Of the first question, the main sub-questions the *act* and *observe* stages here in Chapter 5 have answered is the question of the toolkit being "*of use* for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour". This is strongly linked to the second research question, around the effect that the introduction of the toolkit had.

5.5.2 How Chapter 5 addressed parts of the research questions

The focus of this chapter has been on answering the linked sub-questions, through a process of evaluating the toolkit in use, mainly via workshops, case studies and surveys:

- Whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour"
- What effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs"

The evaluation stages described in Chapter 5 included:

- DwI v.0.7: Feedback sought and received from live|work, a service design consultancy with experience in design for behaviour change
- DwI v.0.8: Pilot study workshop sessions run with students and recent design graduates to investigate the usability of the toolkit in this form, applying it to behaviour change briefs around lighting use and printing
- DwI v.0.9: Academic workshops with students and design practitioners investigating how participants made use of the toolkit, empirically, to uncover insights which would be useful for improving it, addressing issues such as how participants applied patterns to briefs concerning printer use, electric kettles, curtains and water taps, how well different aspects were understood, how the inspiration and prescription modes were used, and the quantity and nature of the concepts generated; exploratory applied workshops with practitioners; and a worked example around interaction behaviour.
- DwI v.1.0: Applied workshops with design practitioners from industry, the public sector and academia, applying the toolkit to a wide range of social and environmental behaviour change briefs; case studies; and a survey of 100 early users of the toolkit.

The DwI v.1.0 applied workshops and case studies described towards the end of the chapter represented a maturation of the toolkit to a form suitable for wider application, demonstrated via its use on 'real' problems, and briefs set externally, by participants from industry, the public sector and academia, generating diverse sets of concepts for influencing user behaviour through design, and facilitating discussion of behavioural issues.

This work provides an answer to the sub-question of whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour": it is indeed, in its final form, of use in this way. Section 4.5 in Chapter 4 reflects on insights from the evaluation process, and their implications for future development of the toolkit after the conclusion of this PhD; Chapter 6 broadens the reflection to discussion more generally of the research process and the place of the toolkit in design for behaviour change practice.

In terms of answering what effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs", the public release of DwI v.1.0 in both printed and online form, on a larger scale than with v.0.9, presented the opportunity for a more detailed online survey of design practitioners making use of the toolkit—how the toolkit was being used, and how it could be improved (in both usefulness and usability). Elements of Reichheld's 'Net Promoter Score' (2006) and Kirkpatrick's model for evaluating training programmes (1998) were used to analyse the responses of the first 100 respondents.

The largest use-case for the toolkit was in the early stages of the design process—brainstorming and idea generation—both individually and in groups, with respondents also using the toolkit for informal inspiration, browsing or reading through the cards like a book, as a reference, and to analyse or classify existing ideas. The kinds of problems addressed included energy, healthcare, architecture and web design applications. Respondents valued different features of the toolkit, including breadth of ideas, disruptive inspiration through transposition of ideas, and "giv[ing] name to many processes designers do without thinking", but also made a wide range of suggested improvements. The majority of respondents said that they were likely to recommend the toolkit to colleagues ('promoters'), with a low percentage of 'detractors', using Net Promoter Score terminology. Most respondents also said that their *knowledge* had increased as a result of using the toolkit, with more than half stating that their *attitudes or perspectives* had changed, and some also having improved their *skills* (aspects of the Kirkpatrick Model).

Aside from the specific insights involved, it can thus confidently be asserted that not only has the DwI toolkit has been "of use" to some design practitioners (answering the first sub-question again) but also that it has had particular effects on them and their work, in terms of increasing knowledge, changing attitudes or perspectives, and improving skills. Both sub-questions have thus been answered through the evaluation process described in this chapter.

5.5.3 Summary of chapter's outcomes

In summary, Chapter 5 answered:

- Whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour"
- What effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs"

through a process of evaluating the toolkit—in a range of iterations—in use, mainly via workshops, case studies and surveys. These showed that the toolkit is "of use" to design

practitioners tackling the early stages (including idea generation) of a wide range of environmentally and social behaviour change briefs, and also that it has had particular effects on early users of the toolkit and their work, in terms of increasing knowledge, changing attitudes or perspectives, and improving skills.

6 Discussion

Influencing people's behaviour for environmental and social benefit is a challenge for designers (Chapter 1). The problems lie at the intersection of a number of academic fields, drawing on multiple disciplines, and applying the insights—to the practical context of responding to design briefs—highlights the importance of the process of *transposition* (Chapter 2). The research introduced in this thesis has sought to develop a toolkit as a way of presenting techniques and examples together in a form which designers can use to generate concepts addressing this kind of brief. Through multiple iterations of an action research *plan–act–observe–reflect* cycle (Chapter 3; Robson, 1993), Chapters 4 and 5 described the development and evaluation of the toolkit through workshops and feedback from early users.

This chapter reflects on the toolkit development and how the toolkit fits into the design process. It also considers how this research compares with other work in the field addressing similar problems, the potential generalisability of some of the insights around toolkits and idea generation workshops, and some ethical issues raised around design intent and behaviour change.

6.1 Reflection on the toolkit development process

The iterative action research development process for the toolkit (Chapters 4 and 5) meant that the process was not directly about formally testing any particular theories—the possible specification points for the toolkit, outlined in section 2.4.4 and reproduced below, were almost akin to a set of 'possible concepts for exploration' via the plan–act–observe–reflect cycle, rather than a formal programme of research determined in advance. The findings at each stage of the process fed directly into the development of the next iteration.

6.1.1 Evolving the toolkit specification

The directions taken in development at each stage were primarily driven by insights from running workshops using the toolkit, and by feedback from participants or early users. From DwI v.0.7 onwards (where live|work's comments heavily influenced the form adopted for v.0.8), the development process was mainly based on empirical insights. So, how were the possible specification points from section 2.4.4 incorporated or tested during the development process?

- *The basic idea is to produce a 'gambit' toolkit or library of strategies and mechanisms for influencing behaviour through design, with examples for each, which should allow designers to explore the ideas and relate them to the problem at hand, trigger new thinking and find different ways of looking at problems as well as solutions, helping to generate ideas during a brainstorming-type process.*
  - The final toolkit (v.1.0) is essentially a gambit library as suggested here—a (loosely-) categorised set of ways of influencing behaviour, with examples. The wiki, in particular, if developed further with readers' input, could fulfil the library role more extensively, with cross-referencing, a greater level of

detail, and more examples. The results of the workshops, applied trials and survey described in Chapters 5 suggest that the toolkit does enable designers to relate the ideas to the problems under consideration, particularly in an idea generation context.

- *It would be usable both individually and in group brainstorming sessions, with different activities possible; it could allow group members to take different perspectives, both to ensure multiple viewpoints and to keep the inspiration process flowing.*
  - Both individual and group brainstorming using the toolkit has been tried; the results of the survey in Chapter 5 show that many early users of the toolkit are using it for individual inspiration.
- *Different formats, including cards, should be tried to establish what is of most use in different circumstances.*
  - A number of formats have been tried, including posters, worksheets, cards (of different sizes) and a wiki, although 'which is of most use in different circumstances' has not been formally assessed.
- *It could use elements of the pattern form, with varying degrees of detail. This could allow it to be a reference guide as well as an idea generation toolkit. The level of detail—more or less text, more or fewer examples, and so on—is a variable to adjust.*
  - Ultimately the toolkit only uses a relatively minimal pattern form, with little of the detail that Alexander et al's originals featured (section 2.4.2). However, this paring-down resulted from workshop insights: participants did not have time to read detailed treatments during brainstorming, although as a reference, a more detailed format (e.g. the wiki) could be valuable, as mentioned above.
- *It could take a more structured 'prescription' process, along the lines of* TRIZ*, or be a less structured (even random) provocation method such as Oblique Strategies or de Bono's* PO *(not necessarily mutually exclusive—it could be designed to be used in a number of different ways)*
  - The initial stages of the toolkit development (sections 4.1–4.3) followed the more structured approach, but the evaluation (sections 5.1–5.3) showed that a less prescriptive, more inspiration-based format enabled (for most participants) a greater quantity of ideas to be generated. The prescription mode remains possible, however.
- *It would make it easier to transpose concepts across disciplines, enabling pattern recognition via the use of metaphor or analogy where possible*
  - The lenses, evolving in scope and number, aimed to address this point—transposing ideas between disciplines by enabling different 'worldviews' on behaviour, although the use of analogy was not investigated explicitly.

The applied workshops and worked example described in sections 5.4.1–5.4.3 represent a maturation of the toolkit to a form suitable for wider application, demonstrated via its use on 'real' problems, and briefs set externally, by participants from industry, the public sector and academia, generating diverse sets of concepts for influencing user behaviour through design, and facilitating discussion of behavioural issues.

The survey (section 5.4.4) suggested that the toolkit is found of use by many practitioners who have incorporated it as part of their ideation process, and indeed a majority of respondents stated that they had increased their knowledge, skills or changed their attitudes as a result of using it. The toolkit is thus, in DwI v.1.0, in a form which, in the author's opinion, satisfies the brief set for its development as part of this PhD. Nevertheless, there are further improvements to make (outlined in section 4.5.1) in future development of the toolkit once this PhD is completed.

6.1.2 Evolving the research approach

Considering that the choice of an action research methodology for the research and development process (section 3.4.4) was flexible enough to allow evolution of the process itself, how could this have been done differently? The workshop format was evolved over the course of the iterations (section 4.5.1), but was there a better way to do the research overall?

Why not formal, controlled workshops?

Initially—naïvely—it seemed as though it would be both appropriate and relatively straightforward to run formal 'controlled' workshops of a sort, scaling up the approach taken in the v.0.8 pilot studies (section 5.2.2) and applying more rigorous procedures. These would have measured how many concepts were generated under different conditions (using the toolkit, not using the toolkit) by participant samples chosen to have similar levels of background knowledge, pre-existing 'creativity', and so on, addressing the same briefs. A significant difference in the quantity of concepts generated, or the quality (assessed by an independent panel of 'experts', with their scores normalised and agreement levels ascertained), would have suggested that using the toolkit has particular effects on participants. This is the kind of method that has been used in some studies of brainstorming (e.g. Nemeth et al, 2004), and enables claims such as "X is *proven* to increase creativity in brainstorming".[1]

However, in practice, there are major difficulties with this approach, at least in the context of the scale of research the author was able to organise. Organisationally, recruiting enough participants, testing characteristics such as their pre-existing creativity, and assigning them to groups to create similar profiles, before then running the actual workshops under multiple conditions (either within-subject—in which case the 'control' condition should come first, as was done with the 'conventional brainstorming' exercises in section 5.3.2—or between-subject, in which case a potentially even larger sample size would be needed) was simply not feasible in the circumstances of this PhD, with the very limited budget available to compensate participants and the small population of potential participants to draw upon. It would have required a population with the right background (experienced design students or recent graduates) larger than exists at most design schools, and all would need to be assessed beforehand in order to create the samples. Perhaps there were ways of using pre-existing academic grades to segment the population to create the samples, but it is doubtful whether these can be considered to be a valid assessment of 'creativity'.

The sample sizes actually achievable in the academic setting, even without this kind of pre-selection, were small, and in practice, even some of the workshop sessions described in section 5.3.2 almost didn't run because of participants turning up late or cancelling at the last minute. The nature of group brainstorming also presents many possible confounds due to interaction effects between participants (Rossiter and Lilien, 1994),

[1] It is perhaps noteworthy that even companies selling TRIZ, Synectics or similar training rarely make explicit claims along these lines.

such that the efficacy of the toolkit would not necessarily have been 'proven' in a reliable way—it might be that one group, despite having the same 'creativity profile' as another, had personal issues between group members, or had previously worked together, or all manner of other issues which would affect the group's performance on the day.

Ecological validity

Aside from practicality, probably the greatest argument against this approach is—as outlined in the discussion on *naturalistic enquiry* in section 3.6.1—that it *simply does not reflect how design processes work in real life.* Even if a toolkit were proven 'in the lab' to have a major effect on creativity, that would not necessarily follow through to the practical everyday work context: the lab setting lacks ecological validity, and therefore possibly external validity too.

The only way to test the toolkit's effectiveness and whether it was of use in real-life design contexts was to put it in the hands of designers, both in applied workshops (still, nevertheless, artificial) and in their own everyday work contexts (and let them use it how they saw fit). This is what the author decided to do with DwI v.0.9 after the Brunel workshops (section 5.3.2); from section 5.3.3 onwards, the toolkit was made available for practitioners to use, and it was observation and analysis of their use of the toolkit, via applied workshops[2], a major survey, and case studies (section 5.4) which formed the basis of the evaluation.

Addressing behaviour change directly

It is perhaps to be regretted that a way was not found directly to address the actual *behaviour-changing effects* of design within the scope of this PhD. In the original vision, the 'best' concepts generated by workshop participants, using the DwI toolkit, for addressing a particular brief (probably B1, concerning kettles, described in section 5.3.2) would have been prototyped and controlled user trials run over the course of a few months to measure the actual effects on behaviour that different design interventions had.

However, the limited time available, and the prospect of the EMPOWER industry collaboration (see section 5.4.1) in which different behaviour change techniques would also be applied to influencing more sustainable behaviour, meant that it was decided that further development and evaluation of the toolkit (section 5.4 and 4.5) was a more sensible route to take to conclude the PhD.

6.2 Comparison with other work, and fitting DwI into the design process

Since the literature review on current work on design for sustainable behaviour (section 2.1) was initially undertaken, a number of other researchers have published work in this field, taking a range of approaches. Where possible, these were incorporated into the review in section 2.1—for example Tromp et al and Zachrisson et al's work—to allow comparison with the prior literature and the developing specification for the toolkit.

However, it is useful here to reflect on the similarities and differences between the work in this thesis and other work in the field, to introduce comparisons with more recent work, and also to consider how DwI can fit into the design process—can a process be recommended for incorporating the toolkit into designers' process for addressing behaviour change, in the light of other work in the field? Section 6.2.3 below considers this

[2] An effort was made to run applied workshops with designers in multiple areas of the design industry (including user experience, interaction design and architecture), the public sector and academia.

last question with reference to two researchers who have explicitly included DwI as part of their recommended process for designing behavioural interventions.

6.2.1 Comparisons in structure and content

Not all work in this field aims at producing a method, framework or procedure for designers to use, and even where it does, this is sometimes a means to an end (designing and/or testing an actual intervention) rather than the main research outcome.

Some researchers (e.g. Tang, 2010[3] and Elias, 2009[4]) have developed models in conjunction with detailed user research studies around specific kinds of behaviour, presented in a detailed, well-illustrated form (e.g. Tang (2010)) rather than the relatively minimal format of DwI v.1.0. However, the emphasis of the projects is different: the succinctness of DwI v.1.0, the question format (see section 4.4.1) and the use of cards were all developed, through iterative workshops and feedback from designers (Chapters 4 and 5), into a form directly oriented towards use in the idea generation phase of the design process (see section 6.2.3 below) by practitioners, and made available in this form to evaluate practitioners' responses—explicitly intended to go beyond the academic context.

The author would argue that the process of making DwI available to design practitioners, while somewhat 'messy' in terms of the diversity of evaluation approaches possible (see sections 5.4 and 4.5 in particular), gives it greater empirical value, even if the development process becomes less academically rigorous. Other work aiming directly at use by design practitioners includes Fogg and Hreha's (2010) *Behavior Wizard* (see **[F9]**) and Zachrisson and Boks' (2012) *Principles of Design for Sustainable Behaviour*, a booklet taking designers through the process of investigating existing behaviour, selecting appropriate design principles, generating ideas and evaluating the results. These are both also part of a process of continual improvement based on practitioner feedback, and it will be valuable to see how they are developed in the years ahead.

Patterns and lenses

The DwI toolkit is the only one of the 'sustainable behaviour' or 'design for behaviour change' approaches to make explicit use of design patterns (section 2.4.2) as a method for describing and illustrating techniques and examples for influencing behaviour. However, outside academia, Brignull's (2010) collection of *Dark Patterns* (Machiavellian Lens-type web design patterns for deceiving and manipulating users) also uses a pattern format, and as explored in section 2.4.2, the format is not uncommon in interaction design overall. Likewise, the DwI toolkit's use of *lenses* to categorise the patterns based on 'disciplinary worldviews' is unique in this field, though as noted in section 4.1.2, there are parallels with work by de Bono and Schell. The lens structure, in conjunction with the specific patterns, affords particular activities within the workshop format (see section 4.5.1) which are perhaps less clearly evident in work less directly focused on workshop use by practitioners, for example, Tang's (2010) model. As Lidman and Renström (2011, p.25) suggest, DwI's "eight lenses are an example of how to assemble design strategies in a way that suits design practice".

[3] Tang's (2010) *Design Behaviour Intervention Model* draws on elements of social psychology (particularly Triandis's (1977) Theory of Interpersonal Behaviour—see **[F5]**—to link Bhamra et al's (2008) seven 'design for behavioural change' strategies (reviewed in section 2.1.3) to three 'elements of behavioural change' (intention, habits and control, 'guiding the change', 'maintaining the change' and 'forcing the change' respectively). The model is applied to a case study around the redesign of a household fridge.

[4] See section 2.1.2.

Integration: Lidman and Renström's work

It is possible, of course, to attempt an integration of the various approaches and methods of classification. This has been most comprehensively undertaken by Lidman and Renström (2011), who proposed a model incorporating aspects of Bhamra et al's (2008) and Tang's (2010) seven strategies and elements of Wever et al's (2008) classification, along with a range of psychology literature, design projects and other material (including DwI) to give five categories of design strategies for influencing more sustainable behaviour: *Enlighten, Spur, Steer, Force* and *Match*. As with Elias et al's (2007) distinction between changes in product behaviour and changes in user behaviour (see also section 5.2.3), a line is drawn between product adaptation (the *Match* category) and (user) behaviour adaptation (the remaining four categories). These each comprise a number of individual strategies—for example, in the category *Spur*, there are sixteen strategies including PUBLIC COMMITMENT, GOAL SETTING, ORDER AND AESTHETICS (citing DwI) and PROVIDE OPTIONS.

Overall, there are 40 strategies listed, and the project goes on to assess the empirical evidence for the effectiveness of each, before narrowing down to four strategies on which concepts are based for further development and testing, addressing the problem of influencing the correct dosing of laundry detergent. The assessment of effectiveness, and the 'narrowing down' process are valuable, and suggest a possible model for developing the DwI toolkit further—gradually, perhaps, converging on the *BehaviourTRIZ* suggested so many times throughout this thesis.

Dimensions

A spectrum of control, axis of influence, or similar dimension is included in many models and approaches, as examined in section 2.1.3. Lidman and Renström's (2011) model reformats this as a modified circle, to emphasise that neither end should be considered a 'starting point', but the basic poles of the designer being 'in control' or the user being 'in control' are retained.

However, as explored by Zachrisson and Boks (2012), Tromp et al (2011) and indeed by the development of the enabling / motivating / constraining and pinball / shortcut / thoughtful models in this thesis (sections 4.2.1 and 4.4.1 respectively; and **[B3]**), a simple linear dimension does not fully capture the nuances of 'who is in control'. The perspective on 'control' experienced by the user is not necessarily the same as that intended by the designer; equally, what one user experiences as useful guidance, another may interpret as interference. This issue is discussed further in **[B3]**, but it is the problematic nature of a simple linear approach which explains its absence from the DwI toolkit.

Multidisciplinarity

Overall as outlined above, the DwI toolkit differs in a number of ways from other work in this field, while sharing some similarities. The multidisciplinary scope of material covered (section 2.2) in order to extract behavioural design implications has led to a collection which includes patterns and examples from fields as diverse as architecture, behavioural economics, games and digital rights—much broader than the product and interaction design on which most other design for sustainable behaviour work has focused. This should only be considered an advantage for DwI if it is found relevant and of use by practitioners, but the results of the workshops, case studies and survey (Chapter 5) suggests that designers are indeed happy and able to transpose principles from other disciplines when they are presented in a format which is easily applicable in a design context. Thus, the author would argue, this is a distinctive and worthwhile feature of the toolkit.

6.2.2 Fitting DwI into different use contexts

Where does the toolkit fit in the design process? Can a process be recommended for incorporating DwI into what designers do? Jones (2003, p.255), discussing her tools developed for early-stage eco-innovation workshops, suggested that "[t]ools are more likely to be adopted in industry if they can be integrated non-intrusively into existing design processes," and this seems a sensible criterion.

It also seems important that the toolkit is used and developed in both academic and industrial contexts, since the kinds of insights derived from each context may well be useful in the other. Steering the line between industrial usefulness and academic rigour is perhaps a challenge here.

The variety of responses to the question about use contexts in the survey of DwI v.1.0 users (section 5.4.4) indicates that respondents had found different ways of incorporating the toolkit into their processes, including—at one extreme, a designer developing an iPad app version of the DwI cards to fit more smoothly into his workflow.

The largest use-case for the toolkit was individual and group brainstorming and idea generation, as originally intended, but respondents had also found it of use for other forms of informal inspiration, as a reference guide, browsing the patterns "like a book", and as a tool for classifying existing ideas. Indeed, most respondents mentioned more than one way they had used the toolkit, with only around a fifth listing a single use-case. While a small majority had used the toolkit for personal interest, over 42% had used it commercially.

Reports of how the toolkit has been used range from the informal—e.g. the v.0.9 poster simply being put up on the office wall as a kind of informal inspiration resource[5] (at a design consultancy, a mobile phone company and an energy monitor company), and someone making his own 'book' version, with tabbed pages, by printing out the cards and sticking them to a notebook (Figure 6.1)—to making use of DwI formally as part of a design process at Philips, in order to frame desirable behavioural effects in terms of existing patterns (mentioned in Shrubsole et al, 2011).

A respondent who contacted the author directly to offer more detail on how he had incorporated DwI into his process as a commercial designer is Brian Suda, a designer and web developer working in Iceland for two companies specialising in online community management and analytics (CLARA) and educational testing and assessment software (Skólapúlsinn). He comments:

> "I have used the cards in two or three brainstorming sessions for two companies I work with. CLARA has trips out to a cabin 2-3 times a year. We go for 2-3 days at a time to do some planning about the vision for the company, and products. At this time we used the cards to help us brainstorm and get the ball rolling. There are about 10 of us in the company, so we shuffled the pack and gave everyone a few cards. It was their task to change or implement our system to include that facet.
>
> Sometimes we disagreed both personally and professionally about including the result, but it started the dialogue. For instance, we didn't want to cripple our software on purpose, we are trying to make the experience better for our clients, but directly or indirectly, it got us discussing different pricing models and packages we could sell our customers. We've reviewed the cards time to time for brainstorming, but never as much as we did at the cabin trips.
>
> In my other company Skólapúlsinn, we do education testing and assessment software in Iceland. We are a 3 man team, so we don't do fancy weekend

[5] Zoë Stanton of Uscreates, a London service design consultancy, suggested using two patterns a week, for year, as a kind of 'inspiration calendar' to be displayed on the office wall.

Figure 6.1: DwI card 'book' produced by Brian Erickson of the 'Scattered Focus' blog, 2010

> team-building trips. I've shown the team the cards and we've read them through. As a group we would pull one card out and discuss its relevance. The other two team members are from academia so these exercises were not like anything they would do normally—not sure how well it went down, but I enjoyed it and I know subconsciously we keep some of the results in mind.
>
> Again, we are very-client driven and our product is a web-based survey, so some cards work better than others. In both of these examples, the cards have probably sparked discussions about sales and features more than other aspects like tracking usage and monitoring" (Suda, personal communication).

So in this case, the cards are used at a non-specific, informal stage of the design process—not necessarily on any particular project, but for general brainstorming around improving companies' products to take better account of user behaviour and how it might be influenced.

6.2.3 A more formal place in the process

The above example describes an informal use of the toolkit. But can it be incorporated formally into a design process? Where should it be used?

It is worth looking first at where two other researchers working in the field of design for behaviour change and persuasive design, Gram-Hansen (2010) and Zachrisson et al (2011), see DwI fitting in their models of the design process.

Gram-Hansen (2010) includes DwI alongside Oinas-Kukkonen and Harjumaa's Persuasive Systems Design model (2008; see also **[F9]**) as part of her suggested development process for persuasively designed products (Figure 6.2). Importantly, the process includes ethical considerations throughout both the design process and afterwards (i.e., when a product is being used), even though the designer's intention ends at this point.

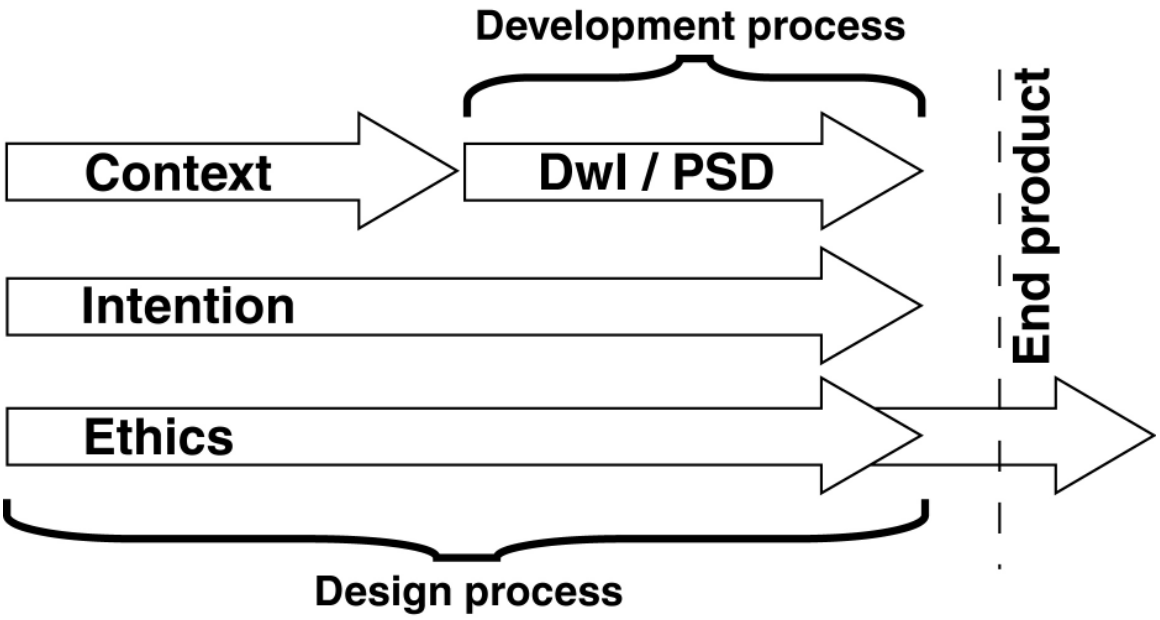


Figure 6.2: Gram-Hansen's Platform for Persuasion, Ethics and Context Awareness in Persuasive Design (2010). Design with Intent is listed alongside Oinas-Kukkonen and Harjumaa's Persuasive Systems Design model (2008; see also **[F9]**) as part of the development process.

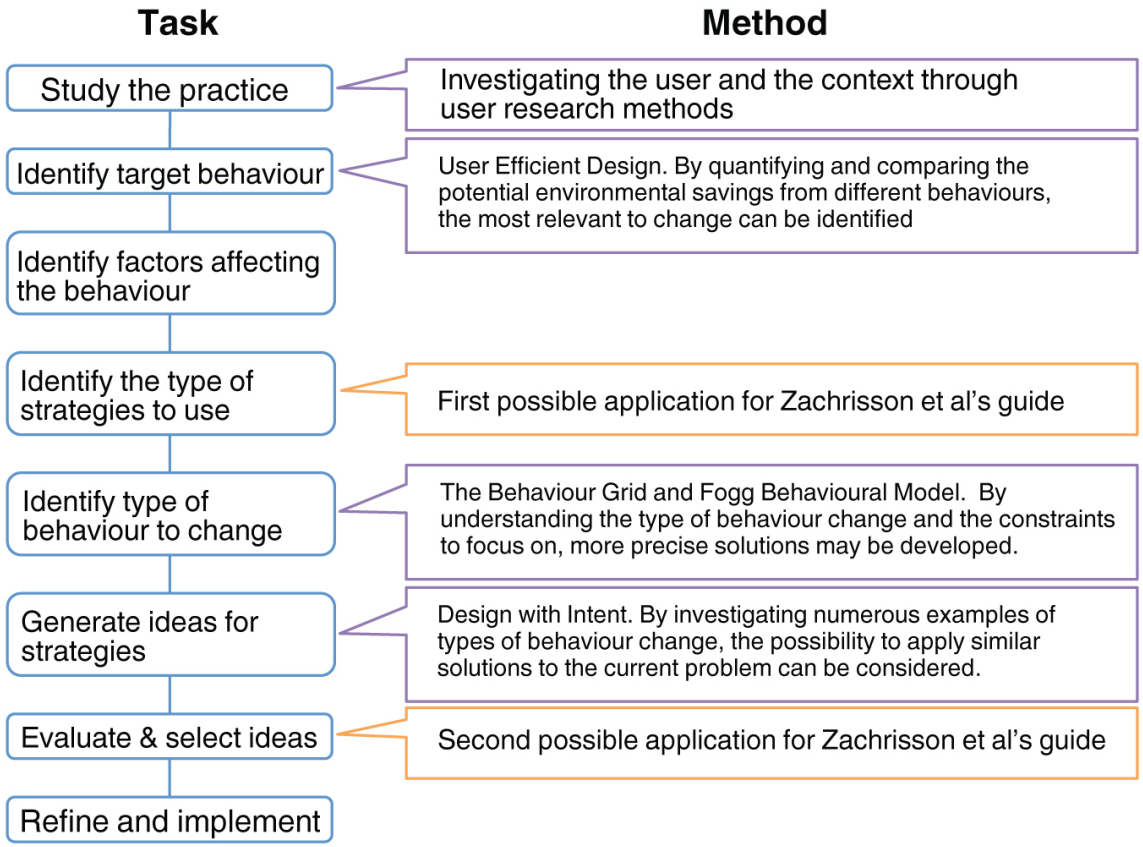


Figure 6.3: "Sketch of a design process" for sustainable behaviour design, from Zachrisson et al (2011)

From this perspective, DwI is seen as something to be used once the context of the desired behaviour change is established (through user research), and this accords well with the role for it seen by Zachrisson et al (2011), who place DwI as a relevant method for the task of "generat[ing] ideas for strategies" in their "sketch of a design process" for design for sustainable behaviour (Figure 6.3), to help understand where their guide (under development) fits. Zachrisson et al's process is detailed, and manages to find useful roles for Elias et al's User Efficient Design (see section 2.1.2) and Fogg's Behaviour Grid (see section 2.2.3) at different stages of the design process, alongside DwI. The start of the process involves studying the practice or behaviour and the factors affecting it in context and identifying opportunities for intervention, before creating possible solutions to address it.

The evolving variations of workshop format—understanding what 'works' and what doesn't, with different groups of participants—have helped narrow down the scope of how to run idea generation workshops using the toolkit, focused on behaviour change, and identify aspects which seem to inhibit idea generation. While the DwI patterns or gambits themselves are essentially a set of ideas for inspiration at the idea generation stage, there have been various attempts made throughout this thesis to introduce a more structured process, from the use of target behaviours and the 'prescription' mode (section 4.3.2), the enabling / motivating / constraining approaches (section 4.2.1), and the pinball / shortcut / thoughtful models (section 4.4.1). The intention with each has been that they could be used before idea generation (or in parallel with it) to help specify or at least guide the kinds of pattern or technique which might be appropriate for influencing different kinds of behaviour, but at least as trialled in workshops so far, it is the simple use of the patterns and lenses in a relatively unstructured form which appears most successful. However, a more structured process may be desirable for a number of reasons.

Understanding users first

In particular, the pinball / shortcut / thoughtful models of the user introduced in section 4.4.1 could help with a process of reflecting on (and perhaps challenging) the assumptions being made about user behaviour, before applying the DwI toolkit to generate 'solution' ideas.

For example, if most of the ideas being generated during a session are representative of a particular model of behaviour—say, assuming a pinball-like model of the user—introducing the provocation of considering a different way of thinking about people (say, the thoughtful model) could spur the creation of another field of possible ideas for influencing behaviour. 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. Matching (some of) the DwI patterns to the models is possible, but by no means definitive.

A tentative recommendation might involve doing ethnographic research with users, to help develop a set of 'behavioural personas' for a particular context, perhaps segmenting users by the degree of engagement they have with an activity (e.g. as discussed by Colborne, 2010), or by mental models demonstrating different levels of technical understanding, and then deciding, for each persona, whether it is appropriate to design interventions which: ignore the degree of engagement (or understanding) a user has (close to the 'pinball' model); try to work with the engagement and understanding a user has (close to the 'shortcut' model); or try to change the degree of engagement (shifting users from 'shortcut' to 'thoughtful', perhaps). In different situations, it is inevitable that the same users will have different degrees of engagement—someone interested in his or her exercise routine may be highly engaged by a behaviour change mobile app centred on

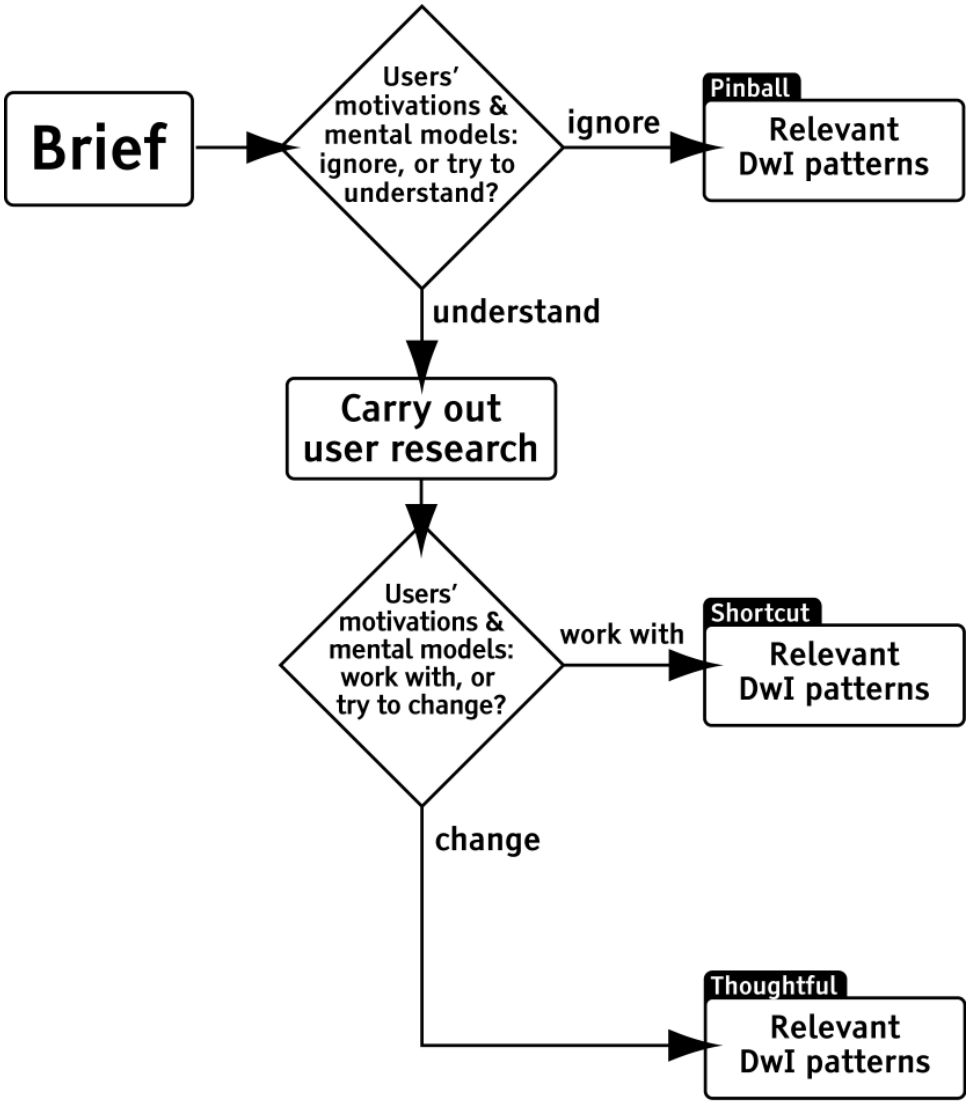


Figure 6.4: A process linking the pinball, shortcut and thoughtful DwI patterns to decisions about user research.

gym activities, but have very low levels of engagement with a home electricity monitor.

As networked sensors of various kinds become cheaper and more easily deployed, it may be possible to uncover 'behavioural personas' more directly by actually measuring and analysing patterns of use on a large scale, at least with physical products and environments. To some extent, web analytics and 'metrics-driven design' already offers this potential online (e.g. Porter, 2010).[6]

[6]The EMPOWER project (see section 5.4.1) has provided an opportunity to attempt a basic process of mapping 'behavioural personas', attempting to uncover building users' levels of engagement and behaviour patterns with heating systems (and energy-using building systems in general) through ethnographic research, as a precursor to a design process to develop interventions to match the different persona types (applying a number of DwI patterns). While this work is still ongoing, the aim is that this could be generalised as a suggested process for incorporating both user research and the DwI idea generation stage into design for sustainable behaviour.

A simple approach

Much as the enabling / motivating / constraining approaches (see section 4.2.1) were devised in response to an invitation to explain design for behaviour change to a 'non-design' audience, in February 2011 an invitation to give a presentation on the toolkit at a 'London IA' evening—a regular series of talks on information architecture and allied subjects—triggered the need for a simple way of fitting the toolkit into the presentation of a design process familiar to the audience of information architects, user experience designers and web developers.

Following the approach of section 6.2.3, a simple diagram was produced (Figure 6.4) linking the pinball / shortcut / thoughtful models (section 4.4.1) to a decision about whether the design process will involve detailed user research, to understand users' motivations, levels of understanding, and mental models as a precursor to trying to influence behaviour. If not, users' motivations and mental models are essentially *ignored*: the pinball DwI patterns are most relevant. If research is undertaken to understand users' motivations and mental models, a decision can then be made about whether to *work with* existing understandings (the shortcut model), or try to *change* users' understanding (the thoughtful model).

The process outlined by the diagram is not definitive, but provides a simple way of assessing something like the *depth* of research considerations in selecting different patterns for influencing behaviour. **[B3]** provides more detail on the characteristics of the different models and how they relate to the DwI patterns.

6.3 Generalisability

While the initial motivation behind this PhD was influencing more environmentally sustainable behaviour, as noted in Chapter 1 the broader social impacts of design on human behaviour made an expansion of scope to quite a broad definition of 'sustainability' eminently sensible. The briefs addressed in workshops, case studies and worked examples (Chapter 5) cover a range of social and environmental benefit contexts, and indeed some—particularly those applications highlighted by survey respondents (section 5.4.4)—which are entirely commercial, with no explicit social benefit aim.

6.3.1 Abstraction

The patterns have all been described in ways which, intentionally, could apply to a wide range of behaviour change contexts—the toolkit is not specifically about 'ecodesign' or 'product design', but in a very general sense, about redesigning elements of *systems* (product, services, environments) to influence people's interaction with them. The author would not claim that anything like the 'universal' applicability of TRIZ (see section 2.4.1) has been reached, but there has been an effort to balance the abstract nature of formal descriptions of principles, with real-life examples which help a practitioner apply the principle to his or her own design context. The choice of the pattern format goes a long way towards balancing these approaches.

Some attempts were made at more abstract general modelling of behaviour change in systems (see **[B3]**), drawing on principles from cybernetics, but the very abstractness of the models' representation makes them less easy to apply practically; as with the target behaviour selection process trialled in the prescription mode of DwI v.0.9 (sections 4.3.2 and 5.3.2), the extra layer of abstraction does not necessarily make idea generation easier, and indeed may well make it more difficult.

6.3.2 Insights from development and evaluation

What about generalisable insights from the toolkit development and evaluation process? What can be said about the role of toolkits in design and idea generation?

Recommendations about workshop processes and toolkit design

It is possible, from the reflections on the workshop process in section 4.5.1, that insights uncovered about running workshops with DwI could be applied to idea generation workshops in general. Indeed, none of the recommendations is specifically linked to the 'behaviour change' theme of the workshops; some are linked to specific elements of the toolkit (such as the lenses) but the majority are general enough to apply to any idea generation session using some form of structured inspiration guide (cards, worksheets, etc)—covering issues such as group size, number of briefs and timings. The author is more confident about running workshops and idea generation sessions in general as a result of the experience from the DwI sessions.

Equally, the design recommendations summarised in section 4.5.1, around the format of the toolkit itself, are mostly not directly related to behaviour change, but are about the toolkit's usability in practice. Issues such as enabling the toolkit to be used in a variety of ways, variants for different disciplines and the appropriate levels of detail and numbers of examples to provide would surely be common to the development process of many similar idea generation tools and collections.

Involving practitioners

Tool development needs to involve the tool's users—as the quote from Graham (2009) in section 5.1 suggests, putting a tool 'out there', even if it is unfinished, can be a way of "getting users to start talking to you", and this is certainly the case with the DwI toolkit. Seeking feedback from practitioners was important to the development and evaluation process from DwI v.0.7 onwards, and particularly central with v.1.0, where workshops were run with, as far as was practical, practising designers in industry and the public sector, addressing realistic briefs. This is not to dismiss the value of workshops and trials within academia, since in many cases a toolkit's ultimate users will be students—but as a generalisable insight around tool development for practitioners, the importance of consulting those practitioners is difficult to overstate.

Use-cases

The issue of enabling the toolkit to be used in a variety of ways was thrown up most clearly by the results of the survey of early users of DwI (section 5.4.4), with the majority of respondents (79 out of 100) describing more than one way in which they had used the toolkit—the largest use-case was 'brainstorming / idea generation' (71), individually and in groups, but informal inspiration, browsing/reading through the cards like a book, use as a reference, and use to analyse or classify existing ideas followed in order of popularity. This potentially has generalisable implications for the role of toolkits in the design process: accommodating and affording these multiple use-cases is important. While the 'toolkit for brainstorming' may be the largest single use-case, such toolkits need to be designed in such a way that other use-cases such as use as a reference are feasible and easy to do.

Sometimes considering the opposite case can help: a 'toolkit' in bound book form would clearly enable browsing the patterns, and use as a reference, but make group brainstorming difficult; cards too small to allow more than one person to read them at once (as with one size of the DwI v.0.9 cards in section 4.3.2) only facilitate individual

activities rather than group work; but a large poster format (as with DwI v.0.7 and 0.8 in sections 4.1.2 and 4.2.2) make individual use more difficult. These insights are perhaps trivial, but would potentially be missed without getting feedback from users on how they have actually used the toolkit. They are also probably generalisable: for a toolkit or similar to be usable during the design process, it needs to be usable in a range of use-cases, or at least have versions easily available which suit the different contexts.

Do designers need toolkits?

Do designers need toolkits? As evinced by the many guides and toolkits discussed in section 2.4, the notion of 'collecting' inspirational or reusable examples, principles and provocations together in a form which can be applied in other similar (often analogical[7]) contexts has clearly been considered important by many authors and researchers. The DwI toolkit fits into this canon, focusing on a specific kind of design goal (behaviour change) but drawing on both principles from many disciplines within and without design, and elements of the formats of many other collections and approaches.

Design toolkits in general are essentially ways of presenting reusable, transposable knowledge—an externalised folk memory for a discipline, potentially enabling practitioners with less experience to benefit from the 'repertoire of tricks' (Lawson, 2004) that experts are able to bring to bear on a problem. While the most experienced designers may no longer really 'need' a toolkit except perhaps to trigger initial thoughts (as was apparent during the IDEO workshop discussed in section 5.3.3), it can enable less experienced practitioners to get 'up to speed' more quickly, and act as an ongoing reference for those who need it.

6.4 Reflection on intent and the ethics of behaviour change

A question that often arose during feedback from workshop participants was around *cause and effect*, and *intent*: features of a design might lead to certain behaviours being influenced, but if this is not being done deliberately, should it count as 'Design with Intent' or not?

One approach would be to ask *cui bono*?—who benefits from this behaviour change? If a user's behaviour is influenced through the design of a product, and that change benefits the manufacturer or retailer, the *cui bono?* approach would suggest that this is more likely to be by design than by accident. Greenfield (2011) suggests that "every act of design involves choices that are deeply interested, in the sense that they necessarily serve someone's needs before (or to the exclusion of) those of other parties. This is not a particularly profound point, but you might be surprised how much pushback it generates."

Nevertheless, the question of 'who benefits?' does not always enable a straightforward analysis, particularly where the behaviour being influenced has larger social or environmental consequences. Does a designer working on influencing reduced energy use, or improved health behaviours benefit from the behaviour change? Ultimately, he or she may well do, if enough behaviour change occurs that future society uses less energy or is healthier, but it is not a simple case of immediate self-interest.

[F3] reviews a number of relevant perspectives here, including Berdichevsky and Neuenschwander (1999)'s application of Rawls' (1973) 'veil of ignorance' concept to the

[7] Hofstadter (1995, p.63) suggests that in many ways "analogy-making lies at the heart of intelligence"; in this vein, references and collections which can enable analogies to be drawn more easily (such as DwI's crossover between physical and digital interaction design contexts) can perhaps help designers become more 'practically' intelligent. It would be an interesting project to devise a perhaps 'general' design or idea generation toolkit which took analogical transfer as its central theme.

ethics of persuasive technology, Mill's *harm principle* (1859) in the context of influencing behaviour change, interpreting 'meaning' in buildings, products and systems, and the questions of intentionality and unintended effects in the example of Robert Moses' low parkway bridges on Long Island (Caro, 1975; Winner, 1986).

6.4.1 POSIWID and determinism

The review goes on to introduce the possibility of rejecting any necessity of interpretation, and *looking purely at the effects* on behaviour caused by a design. This follows the approach taken by the operational researcher and management cyberneticist Stafford Beer, whose maxim "the purpose of a system is what it does" (POSIWID) cuts through layers of interpretation, meaning and intentionality. This "bald fact... makes a better starting point in seeking understanding than the familiar attributions of good intentions, prejudices about expectations, moral judgements, or sheer ignorance of circumstances" (Beer, 2002).

An implication of POSIWID is that it *doesn't matter* why a system was designed, or whether the intention was to influence behaviour or not. All that matters are the effects: if a design leads to people behaving in a different way, then that can be considered the 'purpose' of the design. From a design point of view, this potentially supports an attitude of *responsibility*: behavioural outcomes of our design decisions are still our responsibility even if we have made the utmost effort to predict and model possibilities and yet (due to the failure of determinism, or our modelling abilities) have not managed to predict particular behavioural eventualities.

[F3] draws parallels with the idea of *teleonomy* ('apparent purpose') in evolutionary biology, in contrast to *teleological* language, which may seem to imply that an adaptation has developed 'for' a particular purpose or goal rather than as a result of natural selection. From the point of view of constructing and structuring libraries of possible design methods for influencing behaviour (e.g. Zachrisson and Boks, 2012; Lidman and Renström, 2011), a teleonomical approach would justify the wisdom of looking at situations where people's behaviour *appears* to be influenced by aspects of systems around them, in addition to situations where the influence is known to have been designed intentionally into the system.

Another related concept covered by **[F3]** is the idea of *determinism* in design and architecture—often finding its expression through 'grand plans' such as New Towns and ambitious social housing projects. Ittelson et al (1974, p.345) explain that "[i]n its simplest interpretation, [determinism] holds that man can manipulate environments to produce specified behaviours." On one level, this is what design for behaviour change is about: if it is 'successful', then design will have led to behaviour changing as intended. It has been argued (Buchanan, 1985; Redström, 2006) that *all* design is intended to influence user behaviour, in the sense that the artefacts around us contain socially constructed 'scripts' for users (Akrich 1992)—e.g. if we position a chair at a desk, we are influencing a user to 'follow the script' and sit down. Nevertheless, systems intentionally designed to influence behaviour different from that usually associated with the situation, or in situations where a user would not otherwise have a strong idea of what to do (e.g. with an unfamiliar interface), represent a degree of designer intent beyond this.

The level of determinism represented by many projects is perhaps something closer to an eminently reasonable recognition that the way people live their lives is directly linked to the designed environments in which they live, and so a thoughtfully designed environment can act as a facilitator for a more contented, happier lifestyle for inhabitants. This is essentially little more than human-centred design, in current terminology.

6.4.2 Taking a position

Designers discussing influencing behaviour are sometimes met with the question of whether design should be involved in this area at all—whether design should concentrate on fulfilling people's needs rather than trying to change people's behaviour. One response to this is discussed by Sunstein and Thaler (2003, p.1,164): in *any* design process, some decisions will have to be made which will affect user behaviour, whether or not the designer intends any particular behaviour change to result. By this argument, *designers cannot help changing behaviour*: ethically, therefore, it is incumbent on us to consider the impact of design decisions, and try to achieve a 'good' outcome (by whatever standards are applicable). *Choosing not to think about influencing behaviour is still a decision about influencing behaviour.* As the Nuffield Council on Bioethics (2007, p.42) puts it, "it is not the case that the option of 'doing nothing' requires no justification, as deciding to 'do nothing' is itself a value judgement and may have adverse consequences for some."

So far as the author has taken a position in this thesis, it is that design is unavoidably going to affect people's behaviour, so as socially and environmentally responsible designers it is vital for us to consider—and demonstrate that we have considered as best we can—the possible impacts on socially and environmentally relevant behaviour which our designs produce. Further, we must attempt to ameliorate those impacts where the design methods available to us afford influencing behaviour more beneficially. This assertion sidesteps questions of 'when?' and 'where?' and 'why?', but as Pask (1969, p.496) notes, design goals are generally underspecified, with the designer (and the systems he or she designs) often needing to be "an odd mixture of catalyst, crutch, memory and arbiter" for users, supporting them but also, potentially, making decisions for them.

The designer should, then, as Gram-Hansen (2010) suggests, bear ethical considerations in mind throughout the design process when seeking to influence behaviour, not only up to the point of 'delivery' to users, but also afterwards, evaluating the effects on user behaviour (the 'what it does' of POSIWID) and the ethical consequences of these. As designers we cannot 'wash our hands' of a product once the design is finished; regardless of the intentions embodied, our responsibility extends into use. Facilitating aspects of that responsibility is exactly what the DwI toolkit aims to address.

6.5 Recommendations for further work

As seems relatively common with PhD theses, the author comes to the end of the process with a whole new set of questions, some uncovered and recognised during the research process but not possible to address within the scope and available time, and others suggested by the implications or practical application of the work. Some are suitable for future investigation, but with others it is difficult to see how to resolve them.

Certainly, the research process has been an opportunity to engage with some fascinating areas of knowledge and research from disciplines which designers do not normally have the chance to study, and this has both widened the author's scope of awareness and deepened his knowledge. Inevitably, though, this fleeting engagement with other disciplines provokes a lot more questions.

It may be a self-evident truism that every academic field believes that its approach holds the answers to why things are as they are—why the world works as it does—but this is complicated further when thinking about human behaviour, since each of us brings his or her own perspective based on how *we* behave, and it is almost impossible to avoid mentally testing every behavioural theory one comes across against one's own (expected) behaviour, and making judgements about how complete or predictive it is based on this

subjective thought experiment.[8]

This is perhaps a roundabout way of saying that this thesis has focused on something other than discovering a definitive model of how to influence people's behaviour. Nor indeed has it concerned developing a definitive way to specify which design techniques are most relevant to influencing which kinds of behaviour, despite this being an ever-present question throughout the PhD—whether it is possible to create something like an evidence-based *BehaviourTRIZ*, that could suggest the 'right' techniques for the situation. As discussed in section 2.4.1, this would be a massive project, and humanity lacks the equivalent of a patent database for behaviour; equally, it perhaps implies a level of determinism which is ill-suited to what may be 'wicked' problems.

Nevertheless, the prospect is tantalising. It is possible to see future development of behavioural personas, segmentation and different models of user behaviour (section 6.2.3) converging together with empirical data towards something which, if not fully prescriptive, at least suggests which design techniques might be most effective in which situations, with which people.

There are a number of possible avenues of work which could help with this convergence, some of which are already in progress by researchers, and others which could be. The field of behaviour change research appears to have accelerated in its growth and expanded significantly in scope (and political attention) since this PhD project started in 2007; it is heartening but also poses questions of whether certain aspects may be seen as political fads. A pairing of rigorous academic research with practically based industry application should help the field maintain its momentum and deliver useful results. Below, a small number of possible research directions are suggested, arising in particular from questions uncovered in this thesis.

6.5.1 Meta-analysis or systematic review of the effectiveness of behaviour change techniques

In fields such as medicine, with established controlled trial procedures which allow direct comparison between studies, it is possible to produce analyses combining the results of multiple studies to establish better the effects of different interventions. This allows future interventions to be evidence-based.

This kind of work is rare in design, and rare in design for sustainable behaviour, but if it were possible to plan studies so that they were more directly comparable, it would permit something approaching a more systematic review. In some aspects of behaviour change, reviews have been produced incorporating a range of studies—for example, Abrahamse et al (2005), reviewed 38 studies on interventions to influence household energy use. The recent commitment by the UK Cabinet Office's Behavioural Insights Team to use randomised controlled trials where possible (e.g. in household energy feedback—DECC, 2011) raises the prospect of this sort of work being more commonly done, although integrating it with a 'design' perspective may be challenging.

6.5.2 Aspects of segmentation and profiling

Understanding better how different people behave in response to different behaviour change techniques, in which circumstances, would directly inform a kind of segmentation

[8] This is probably why concepts such as the *fundamental attribution error* (see section 2.2.1) are so fascinating, since they provide a structure for thinking about how we think about how others think—*meta-metacognition*, essentially. **[B3]** is also to some extent about this—thinking about how others (designers) think about how others (users) think. Grist (2010, p.5) argues that "[t]he very act of 'thinking about thinking', in which people develop an understanding of how brains and behaviours work, has the potential to empower people as part of a new model of active, 21st century citizenship".

like that often used in advertising to target campaigns most effectively. Behavioural segmentation could go beyond existing forms of attitude-based segmentation (e.g. that developed for DEFRA's framework for pro-environmental behaviour, 2008), by measuring how people actually respond, and building up a 'persuasion profile' (Kaptein and Eckles, 2010) for each person.

For example, one person may be more motivated to respond by social proof—that lots of his or her friends are doing something—while for another, it may be the fact that it is simply the default choice and little motivation is required. Understanding these profiles could be especially valuable in online 'conversion' for retailers and advertisers, a market being explored by the startup Science Rockstars. Equally, though, something similar could be attempted with 'real world' behaviours, and would provide a formalised counterpart to the everyday idea that we modify the strategies we use when talking to different people who we think will respond in different ways to different kinds of arguments. The concept raises significant ethical issues, which in themselves would be a valuable area of research.

6.5.3 Behavioural personas

As mentioned above, *behavioural personas*—finding patterns in the different ways that different people use the same product or system, and clustering them into something like 'specifications' for how each cluster is likely to behave with that or similar systems—would be a useful tool. Unlike the profiling described above, the personas would be developed via user research and ethnography in the context of specific applications, such as 'how people interact with their home heating system', or 'how people in public places dispose of their litter'. The personas/specifications essentially then become models which are addressable via different kinds of design techniques—pinball/shortcut/thoughtful or even enabling/motivating/constraining techniques could be selected accordingly. Elements of this research have been incorporated into the EMPOWER project on workplace energy use (see section 5.4.1).

6.5.4 Mental models and behaviour change

A related area of research, also being investigated to some extent as part of the EMPOWER project, is how users' mental models of the systems around them, and how they understand how to interact with them, might affect the design techniques that are most applicable to influencing behaviour. The classic study here is Kempton's (1986) 'Two theories of home heat control', which estimated the percentage of Americans who use their home heating thermostats like a 'valve', operating them as if they 'pumped out heat' at a greater rate when turned all the way up, and consequentially the extra billions of dollars in energy costs resulting from this behaviour. This sort of work suggests that in some circumstances, helping people change their mental models of systems, where their current model leads to inefficient or suboptimal behaviour, could be effective at changing behaviour.

As with the discussions in section 4.4.2 and 6.3.3, the question arises whether it is better to design something to work with existing understanding and mental models (e.g. a thermostat that really does work like a valve), or to try to shift people's understanding through design, in the process educating them better about the technology around them and their impacts on the environment. Or, alternatively—and as has been suggested many times during the EMPOWER project—design the user out altogether, and build completely automated systems which remove the opportunity for human error. Each of these approaches would suggest a different set of relevant design techniques, similarly to the pinball / shortcut / thoughtful models described in section 4.4.2.

A structured method for understanding users' own understanding and mental models of the world in general—not just heating systems!—could be an important part of the research phase of a design for behaviour change process, and this is certainly further work with which the author intends to be involved.

6.5.5 Developing the Design with Intent toolkit further

There are, of course, opportunities to develop DwI further. It has always been made clear to buyers and downloaders of the current version of the toolkit that it is work in progress, and the aim is to continue to develop it once this PhD is complete. A number of possible improvements were suggested by the survey reported in Chapter 5 and discussed in section 4.5.1; not all the suggestions are mutually compatible, but, continuing the aim of making a contribution to knowledge in design practice, the aim will be to develop it in accordance with practitioners' needs as far as possible.

One aspect which will be increasingly possible to incorporate as the field of design for sustainable behaviour (and other behaviour change) develops is more detailed case studies and examples, from both academia and industry/public sector, which explain the design process as well as the resulting product. Whether these would be included as cards, or as part of an accompanying book (more likely), case studies of this kind, ideally with background context information on the behaviour concerned, and data on the effectiveness of the intervention, would significantly enhance the credibility of the toolkit, and directly provide designers with deeper examples of 'how to do it' (and perhaps how not to), in the process encouraging research with users and a more reflective approach to the idea generation process, including aspects such as ethical considerations and questioning assumptions held about the users.

6.6 Conclusions of the discussion chapter

This chapter reflected on the toolkit's development and evaluation with the benefit of perspective from after the process, discussing how the toolkit fits into the design process (particularly in the light of others' work), the potential generalisability of some of the insights around toolkits and idea generation workshops, and some ethical issues raised around design intent and behaviour change, and possible further work developing and expanding the line of research described in this thesis.

Conclusions drawn in Chapter 6 included: a recognition that the DwI toolkit differs in a number of ways from other work in the field, while sharing some similarities, with the multidisciplinary scope of material covered and the use of design patterns and examples from diverse fields representing a distinctive and worthwhile feature of the toolkit; insights into the use of design toolkits in general as ways of presenting reusable, transposable knowledge, potentially enabling practitioners with less experience to benefit from the 'repertoire of tricks' that experts are able to bring to bear on a problem; and a stance that the designer should keep ethical considerations in mind throughout the design process when seeking to influence behaviour, not only up to the point of 'delivery' to users, but also afterwards, evaluating the effects on user behaviour and the ethical consequences of these.

7 Conclusion

In this conclusion chapter, the outcomes of each chapter of this thesis are restated, together with a discussion of how the research questions have been answered, and the thesis's contributions to knowledge in the design discipline.

The research questions identified in section 2.3.2 were:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*
>
> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

This thesis has sought to investigate and answer these questions, through the iterative development and evaluation of the Design with Intent toolkit via an action research methodology. In the most recent form, DwI v.1.0, described in section 4.4.2, this is a collection of 'gambits' or patterns for influencing behaviour through design, arranged in the form of a pack of cards or a worksheet (with online equivalents).

This thesis, and the Design with Intent toolkit, in answering the research questions, make a contribution to knowledge in both design practice and design research. As discussed in section 7.2 below, the research has advanced knowledge through synthesising and organising, into a design pattern form, a diverse set of behaviour change techniques and examples from a range of disciplines, in a way which has helped design practitioners create concepts for tackling a wide range of environmental and social behaviour change problems through design. The toolkit and its content represent a contribution to design practice, while the iterative development and evaluation of the toolkit represent a contribution to design research.

7.1 Conclusions drawn from each chapter

Figure 1.1 in section 1.5 showed the structure of the thesis; here it is worth summarising the conclusions drawn from each of the preceding chapters, to understand the overall path the thesis has taken.

7.1.1 Chapter 1: Introduction

The introduction covered the background to design for sustainable behaviour—the environmental and social impacts of behaviour, and the challenge for designers. The contention is that all design affects our behaviour, whether it is intended to do so or not. The use of products (and services and environments) can have negative impacts on the environment and on society more broadly, but we could use design to influence more sustainable behaviour, for environmental and social benefit. The opportunity was identified for research addressing this challenge through design, through the iterative development and evaluation of a 'design toolkit', and the research questions were framed (the need for this is examined in Chapter 2).

The structure of the thesis was introduced, starting with a review of treatments of 'behaviour' in a range of fields, concentrating on transposable insights applicable in design, and idea generation methods and problem-solving in design, and an investigation of research methodology to determine the most appropriate perspectives and methods.

7.1.2 Chapter 2: Literature review

Following the identification of the challenge of influencing more sustainable behaviour through design in Chapter 1, the literature review first examined the field of approaches to influencing behaviour, through a summary of an extensive review **[F1-9]** of behaviour change concepts and principles from multiple disciplines, with their implications for designers. A set of insights around using context and cognition to influence behaviour through design was outlined.

Supported by a point made by Lilley (2007), regarding the need for inter-disciplinary knowledge transfer in design for behaviour change, an opportunity was identified for a guide, or 'toolkit', which brings together these insights around behaviour change in a form which is of use to designers during the idea generation phase of design processes, leading to the research questions:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*
>
> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

The literature review continued by investigating design toolkits, idea generation methods and problem-solving in design, to uncover formats and elements which could be useful in structuring the 'design for behaviour change' toolkit—and answering the research questions. A possible specification for the toolkit was elaborated, focused on developing a 'library' of gambits, strategies and mechanisms for influencing behaviour through design, with examples for each. It was suggested that this should allow designers to explore ideas around behaviour change, and relate them to the problem at hand, triggering creative thinking, enabling different ways of looking at problems as well as solutions, and helping designers to generate ideas during a brainstorming-type process.

The conclusion was that the research programme undertaken should thus centre on the development and evaluation of a design toolkit for behaviour change, which would constitute a contribution to design practice (see section 7.2 below).

7.1.3 Chapter 3: Research methodology

This chapter examined design research methodologies and relevant epistemological stances, theoretical perspectives, methodology and methods, and how to apply them in the research described in this thesis, along with the naturalistic approach to sampling employed.

Design research often draws upon and involves the application of approaches from multiple academic disciplines, as well as methods and methodologies from design practice itself. While methods used in this PhD have drawn from a number of fields and research paradigms, a mainly constructionist, interpretivist, practice-led action research methodology was considered most appropriate, developing and evaluating the toolkit through a 'spiral' *plan–act–observe–reflect* process. A fully grounded approach was not adopted, but the research plan evolved based on reflection on the results of previous stages.

The main research methods used were to be: workshops, mainly in the form of brainstorming, idea-generation or ideation sessions where multiple participants, from both industry (or the public sector) and academia were asked to generate concepts, individually or together, in response to a design problem or brief; worked examples and case studies; and surveys and interviews. The toolkit itself was also to be a research output.

Evaluating the toolkit was to be done both quantitatively and qualitatively. Quantitatively, this was primarily to be achieved through surveying early users, including breaking this down into a number of elements based on the Kirkpatrick model, a recognised model for evaluating training programmes, with reaction assessed using Reichheld's Net Promoter Score. Qualitative assessment was to be done through the workshops, focusing on the characteristics of participants' idea generation process using the toolkit. Multiple research methods would help bring a plurality of perspectives on the issues being researched, and enabled the triangulation of important issues and insights.

7.1.4 Chapter 4: Toolkit development

Following the identification of the research questions in Chapter 2, and consideration of appropriate research methodology in Chapter 3, this chapter described how the design for behaviour change 'toolkit'—which became known as the *Design with Intent toolkit*—was developed, essentially comprising the *reflect* and *plan* stages of the action research spiral, for each version of the toolkit from v.0.1 to v.1.0. This chapter was intended to be read in conjunction with Chapter 5, which covered the *act* and *observe* stages.

Chapter 4 addressed certain sub-questions drawn from the research questions identified in Chapter 2, in particular:

- How can behaviour change techniques and examples from a range of disciplines...
- ...be brought together in a form... for idea generation...
- ...for designers working to influence more environmentally and socially beneficial behaviour?

The overarching narrative of the chapter was around addressing the "...be brought together in a form... for idea generation" sub-question. While the chapter initially reflected on considerations for developing the toolkit which would allow designers to explore ideas around behaviour change, and relate them to problems at hand (the "How can behaviour change techniques from a range of disciplines..." and "...for designers working to influence more environmentally and socially beneficial behaviour"sub-questions), the majority of the chapter covered the *form* of the toolkit as it was developed, covering issues such as levels of abstraction, target behaviours, and mapping particular behaviours to particular design techniques. These considerations were incorporated these into a series of quick iterations leading to DwI v.0.7, which was the first version of the toolkit on which external feedback (from design practitioners) was sought. Drawing on that feedback (described in Chapter 5), the next version of the toolkit was developed, prior to subsequent further evaluation, and so on. This cycle iterated the toolkit a number of times, up to DwI v.1.0.

Each of these represented an evolution of the form, with evaluation of each from v.0.7 to v.1.0 described in Chapter 5. Each is an answer to the "...be brought together in a form... for idea generation" sub-question. The final section of the chapter returned to the wider "...for designers working to influence more environmentally and socially beneficial behaviour"sub-question, reflecting on lessons from the applied workshops, user survey and case studies with v.1.0 described at the end of Chapter 5, including implications for future development and the evolution of the workshop format in the context of designers working on behaviour change.

In summary, Chapter 4 answered:

- How can behaviour change techniques and examples from a range of disciplines...
- ...be brought together in a form... for idea generation...
- ...for designers working to influence more environmentally and socially beneficial behaviour?

through the iterative development of a toolkit which in its final form, brings together behaviour change techniques and examples from a range of disciplines into 101 'design patterns', grouped into eight lenses, in card, worksheet and online formats.

7.1.5 Chapter 5: Understanding and evaluating the toolkit in use

This chapter was was paired with Chapter 4 as part of the 'spiral' *plan–act–observe–reflect* approach to action research methodology. While Chapter 4 covered the *reflect* and *plan* stages of the spiral, for each version of the toolkit, this chapter concentrated on the *act* and *observe* stages, exploring the iterative evaluation of the toolkit in use, through workshops, worked examples, a survey of early users and case studies. The insights from each stage of evaluation were fed back into the development of the next version of the toolkit in Chapter 4.

The focus of Chapter 5 was on answering two linked sub-questions emerging from the research questions outlined in Chapter 2, through a process of evaluating the toolkit in use, mainly via workshops, case studies and surveys:

- Whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour"
- What effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs"

The evaluation stages described in Chapter 5 included feedback from a design consultancy, pilot study workshops and full workshops with students and design practitioners, applied workshops with design practitioners from industry, the public sector and academia, applying the toolkit to a wide range of social and environmental behaviour change briefs; case studies; and a survey of 100 early users of the toolkit.

The DwI v.1.0 applied workshops and case studies described towards the end of the chapter represented a maturation of the toolkit to a form suitable for wider application, demonstrated via its use on 'real' problems, and briefs set externally, by participants from industry, the public sector and academia, generating diverse sets of concepts for influencing user behaviour through design, and facilitating discussion of behavioural issues.

This work provides an answer to the sub-question of whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour": it is indeed, in its final form, of use in this way. In terms of answering what effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs", the public release of DwI v.1.0 in both printed and online form enabled a detailed online survey of design practitioners making use of the toolkit—how the toolkit was being used, and how it could be improved (in both usefulness and usability). Elements of Reichheld's 'Net Promoter Score' (2006) and Kirkpatrick's model for evaluating training programmes (1998) were used to analyse the responses of the first 100 respondents, finding that the majority of respondents said that they were likely to recommend the toolkit to colleagues ('promoters'), and that most respondents also said that their *knowledge* had increased as a result of using the toolkit,

with more than half stating that their *attitudes or perspectives* had changed, and some also having improved their *skills* (aspects of the Kirkpatrick Model).

Aside from the specific insights involved, it can thus confidently be asserted that not only has the DwI toolkit has been "of use" to some design practitioners but also that it has had particular effects on them and their work, in terms of increasing knowledge, changing attitudes or perspectives, and improving skills. Both sub-questions have thus been answered through the evaluation process described in this chapter.

In summary, Chapter 5 answered:

- Whether the toolkit is "of use for idea generation" by "designers working to influence more environmentally and socially beneficial behaviour"
- What effect "the introduction of the toolkit" has had on "designers in the early stages of tackling behavioural design briefs"

through a process of evaluating the toolkit—in a range of iterations—in use, mainly via workshops, case studies and surveys. These showed that the toolkit is "of use" to design practitioners tackling the early stages (including idea generation) of a wide range of environmentally and social behaviour change briefs, and also that it has had particular effects on early users of the toolkit and their work, in terms of increasing knowledge, changing attitudes or perspectives, and improving skills.

7.1.6 Chapter 6: Discussion

This chapter reflected on the toolkit development and evaluation with the benefit of perspective from after the process, discussing how the toolkit fits into the design process (particularly in the light of others' work).

The chapter also considered how the Design with Intent research compares with other work in the 'design for sustainable behaviour' field addressing similar problems, the potential generalisability of some of the insights around toolkits and idea generation workshops, and some ethical issues raised around design intent and behaviour change, as well as suggestions for future work. Conclusions drawn here included: a recognition that the DwI toolkit differs in a number of ways from other work in the field, while sharing some similarities, with the multidisciplinary scope of material covered and the use of design patterns and examples from diverse fields representing a distinctive and worthwhile feature of the toolkit; insights into the use of design toolkits in general as ways of presenting reusable, transposable knowledge, potentially enabling practitioners with less experience to benefit from the 'repertoire of tricks' that experts are able to bring to bear on a problem; and a stance that the designer should keep ethical considerations in mind throughout the design process when seeking to influence behaviour, not only up to the point of 'delivery' to users, but also afterwards, evaluating the effects on user behaviour and the ethical consequences of these.

7.2 Answering the research questions

In section 2.3.2, a gap in the literature was identified as the first research question of this thesis:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*

The intention was that the form in which the ideas were brought together (the toolkit) would be an output of the research, along with the research process described in this thesis—together, also answering a second research question:

> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

How has the thesis answered the two questions? The evidence is woven together, but can be broadly separated into overarching criteria:

- bringing together behaviour change examples and techniques
- effects of the toolkit in use by designers in the early stages of tackling briefs
- the behavioural component of the briefs

These three criteria are addressed below.

7.2.1 Bringing together behaviour change techniques and examples

The toolkit, evolving in form (Chapters 4 and 5) through an action research process, has managed to bring together insights—both techniques and examples—in a pattern-like format. While not all of the relevant behaviour-related 'implications for designers' (section 2.2)—were incorporated into the toolkit, the perspectives and disciplines covered, and 'transposed' into questions relevant to design, include aspects of both contextual and cognitive effects on behaviour, with coverage of ideas from disciplines such as architecture, interaction design, human factors, games design, behavioural economics, security and, not least, a number of branches of psychology.

It can perhaps never be considered 'complete', and some of the concepts overlap; the toolkit in its most recent form (DwI v.1.0) is not highly structured, and is more of a *smörgåsbord* of possible ways of addressing a problem than the more prescriptive approach of earlier versions which placed more emphasis on the use of target behaviours. However, it does represent a way of bringing together behaviour change techniques and examples from a range of disciplines, so at least the first part of the first research question has been answered.

7.2.2 Effects of the toolkit in use by designers in the early stages of tackling briefs

What effects did the toolkit have? Is it 'of use' as an idea generation toolkit for designers? A series of workshops and independent application of the toolkit by early users (Chapter 5) has shown that it is of use, and indeed *usable*, as part of a process of idea generation and brainstorming—the early stages of tackling design briefs. The workshops and applied trials all successfully generated a wide variety of ideas in response to a range of environmental and social behaviour change briefs.

Feedback from early users of the toolkit, in both printed and digital forms (section 5.4.4) also confirms that it was indeed found to be of use by a majority of those who have used it: the majority of respondents said that they were likely to recommend the toolkit to colleagues ('promoters'), with a low percentage of 'detractors', using Net Promoter Score terminology (Reichheld, 2006). Most respondents also said that their *knowledge* had increased as a result of using the toolkit, with more than half stating that their *attitudes or perspectives* had changed, and some also having improved their *skills* (aspects of the Kirkpatrick (1998) Model for evaluating training programmes).

Together with case studies of the toolkit's use directly in idea generation as part of a diverse set of projects (section 5.4.5), this suggests that overall, the toolkit has had

effects on, and is of use to, designers (and some others) as an idea generation toolkit; there is scope for improvement, but it has been developed to a form which practitioners find valuable enough to use, recommend and incorporate into their own workflow.

Some feedback has also been received on the use of the toolkit in an education context—as reading material and as a tool for use in teaching—not just ecodesign and interaction design but also advertising psychology, politics and science and technology studies. Away from the education sector, the toolkit has also been suggested in presentations by the Design Council and Autodesk and in the Central Office of Information's behaviour change newsletter as a useful tool.

7.2.3 The behavioural component of the briefs

The toolkit has been used to generate ideas in response to a wide range of briefs and problems relating to influencing behaviour for environmental and social benefit, in both academic and applied contexts. The environmental briefs have largely centred on reducing resource use, around products such as kettles, printers, curtains and bathroom taps, and wider situations such as heating workplaces.

A number of briefs have also related to wider social benefit (including increasing public confidence in the police, community engagement, improving financial decision-making, staff behaviour in hospitals and encouraging interaction in the workplace, as well as ATM design). Some workshops with industry have also applied the toolkit to briefs around influencing behaviour in more commercial contexts, which may or may not have concomitant social benefits.

Overall, then, the toolkit has been applied to the kinds of briefs originally envisaged by the first research question, but also a wider scope: essentially, it is potentially applicable to any situation where someone wants to influence someone else's behaviour through the design of a system.

7.2.4 Limitations

In considering how the thesis has answered the research questions, some limitations of the overall process become apparent: in its various iterations, the toolkit has provided a number of answers to the question of how behaviour change techniques and examples from a range of disciplines can be brought together—but there are many possible configurations not tried, and other ways the research could have been carried out. Are there formats which would have had more of an effect on designers, or different effects? Inevitably, there are many paths not travelled, within the constraints of time, finances and the requirements of the PhD. As explored in section 6.1.2, other approaches to carrying out the research would have offered some benefits, but were not feasible within the constraints of the project.

Limitations of the actual research methods used in this thesis were discussed in section 3.5 in the context of each method. Briefly, workshops are necessarily limited by the specifics of their contexts—the skills, interests, backgrounds of the participants and the time-constrained, artificial nature of the sessions means that ideas and outcomes generated may not be generally applicable outside of the context in which they were created; the 'applied' workshops, particularly those described in sections 5.3.3, 5.4.1 and 5.4.3, mitigate this somewhat, by focusing more on 'real' behaviour change briefs often set by the participating organisations. Nevertheless, they are still 'artificial'situations. Enabling practitioners to use the toolkit on their own problems, in everyday work contexts, and then providing feedback—as in the survey of early users reported in section 5.4.4 and the case studies reported in 5.4.5—helped further address these limitations, but introduced some of its own. The sample was necessarily biased towards people who

were of aware of the toolkit, and interested enough to use it and respond to the survey or provide the author with case study details. However, as discussed in section 3.6, this can be seen as part of a naturalistic sampling strategy: any new tool (or indeed toolkit) will have early adopters, and studying those early adopters' behaviour provided useful insights for the research process.

7.3 Contributions to knowledge

Employing Archer's (1995) terminology, as discussed in section 3.1, this thesis's contributions to knowledge in the design discipline centre on a *systematic research enquiry* into influencing more sustainable behaviour through design, which has produced *communicable new knowledge* in the form of a design pattern toolkit.

The contribution is articulated through answering the research questions:

> *How can behaviour change techniques and examples from a range of disciplines be brought together in a form* [a toolkit] *which is of use for idea generation, for designers working to influence more environmentally and socially beneficial behaviour?*
>
> *What effect does the introduction of the toolkit have on designers in the early stages of tackling behavioural design briefs?*

As outlined in section 7.2 above, the overarching criteria of the research questions have been answered—via an action research process—by the development and evaluation of the the Design with Intent toolkit, a collection of design patterns shown to be of use to design practitioners working on behaviour change-related problems for environmental and social benefit:

- The toolkit answers the 'How?' question, by synthesising and organising, into a design pattern form, a diverse set of behaviour change techniques and examples from a range of disciplines (Chapter 4).
- It has been demonstrated to have an effect, and to be of use for idea generation through a series of workshops and independent application of the toolkit by early users (Chapter 5). The workshops and applied trials successfully generated a wide variety of ideas in response to a range of environmental and social behaviour change briefs.

Together, answering these two questions represents a contribution to knowledge in both **design practice** (the toolkit itself, as a tool designed for and with design practitioners) and **design research** (the cycles of toolkit development, testing and evaluation, through a process of action research, with the insights arising from the process).

7.3.1 Contribution to knowledge in design practice

A contribution to knowledge in **design practice** is made by the toolkit itself, in synthesising and organising techniques derived from extensive literature research to bring insights on behaviour from other disciplines together in a single collection for use by designers:

- The work is original; the type of organisation of patterns for influencing behaviour exemplified by the toolkit does not appear to have been done before:
  - Previous approaches to classifying techniques and examples in design for sustainable behaviour, persuasive technology and similar disciplines (see sections 2.1 and 6.3) have not offered the same kind of toolkit format

  - Previous collections of design patterns and techniques (section 2.4) have not focused on behaviour.

- The toolkit has also advanced *understanding* in design practice:
  - It has helped design practitioners (and students) with a range of specialisms, from user experience to architecture, create concepts for tackling a wide range of environmental and social behaviour change problems through design, via workshops and designers' own practice.
  - Insights from the survey (section 5.4.4) and case studies detail how some designers have adopted the toolkit as part of their processes, for idea generation but also for a number of other use-cases.
  - The survey also demonstrates that designers' *knowledge* had increased as a result of using the toolkit, with more than half stating that their *attitudes or perspectives* had changed, and some also stating that they had improved their *skills* (all aspects of the Kirkpatrick (1998) Model for evaluating training programmes).

- The success of the toolkit, in terms of quantity of downloads and sales of physical packs of cards, supports the survey findings around how practitioners have found it of use:
  - There was an opportunity for a resource addressing design for behaviour change, as identified in section 2.3.2, and the DwI toolkit has made a contribution towards satisfying that opportunity.
  - Looking at the longer-term use of the toolkit in industry and education will help explore further aspects of the 'of use' question, and will suggest improvements and future directions for development—together with those identified in section 6.5—to make the toolkit more valuable to practitioners.
  - The practical findings have also enabled reflection on workshop processes, toolkit design, use cases and involving practitioners (section 6.3.2) and on ethics and intent of behaviour change in design practice (section 6.4).

7.3.2 Contribution to knowledge in design research

A contribution to knowledge in **design research** has also been made, through the action research cycles of toolkit development, testing and evaluation, with the insights arising from each stage of the process (Chapter 5) fed back into development of the next version of the toolkit:

- The use of an iterative 'spiral' *plan–act–observe–reflect* methodology—via a series of workshops, worked examples, case studies, surveys and interviews—provides an original contribution to the literature on toolkit development:
  - for general idea generation and design and workshop processes (section 6.3)
  - and specifically around the behavioural focus of the toolkit

- The toolkit has been demonstrated to be of use to designers through application to a range of environmental and social behaviour change problems, including:
  - briefs set by the author
  - briefs set externally by participants from industry (e.g. Philips, UX London)
  - briefs set externally by the public sector (e.g. West Sussex County Council)

  - briefs set externally by academia (e.g. NTNU, Brunel).

Design research issues also addressed in this thesis include:

- Exploration of dimensions, forms of spectrum and other methods of structuring and classifying design and behaviour change techniques, including:
  - comparisons with other concurrent research projects on design for sustainable behaviour and design for behaviour change (section 6.2.1)
  - introducing a focus on modelling users (e.g. via the pinball, shortcut and thoughtful models: section 4.4.1)
  - exploration of abstraction and analogy (e.g. section 6.3.1 and 2.4.1.5)
- Integrating the work with other relevant research projects and approaches to behaviour change through design (section 6.2.1) and reflection on the value of multidisciplinarity in this context.
- Fitting DwI into existing design processes (sections 6.2.2 and 6.2.3), including reflection on the importance of understanding users first through contextual research.
- Recommendations for further work in design research, building on the contributions and insights of this thesis, including investigation of:
  - Meta-analysis or systematic review of the effectiveness of behaviour change techniques
  - Aspects of segmentation and profiling, and behavioural personas
  - Mental models and behaviour change
  - Further development and evolution of the DwI toolkit

7.4 Concluding remarks

This thesis has barely scratched the surface of what is, in a sense, one of the fundamental characteristics of the human condition. We all behave, and we all try to affect others' behaviour, from trying to make vegetables more attractive on a child's plate, to setting chairs out at a party to encourage certain people to sit together (or apart).

Designers (along with advertisers, politicians and revolutionary thinkers, among others) are in a somewhat rare position in human history, where we potentially affect the behaviour of many thousands of people, in their everyday lives and practices. But we tend to do so in advance, maybe years before the influence actually occurs, by designing certain features into the products, services and environments that structure people's lives. And those design decisions, whether taken mindfully or not, have consequences, which on both local and global scales affect society and affect our environment, and leave a legacy for future generations which may not be what we intended (or even considered). We need to design with care, with thought, with intent: it's the least we can do.

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Appendix

Appendix to section 5.3.2
References are included in the main thesis listing

A brief diversion: the curtain problem in more detail

While the other briefs (B1, B3 and B4) cover relatively familiar areas for design for sustainable behaviour, the curtain problem, B2, is worth examining here briefly in more detail, as an example of part of a problem which is frequently addressed in sustainable design via *infrastructure* changes (better insulation) rather than necessarily considering influencing behaviour via design.

A significant proportion of household heat loss in colder climates is via windows, both the glass and surrounding frames. The UK's Energy Saving Trust puts the figure at 20% (Energy Saving Trust, 2003), while the University of Florida estimates that "20-50% of the total energy loss in a well-insulated structure occurs through and around the windows and doors" (Hammer, 2003). Aside from better insulation, human behaviour has the potential to contribute to energy saving in this context as in many others; the UK government's Foresight programme contends that "Human behaviour determines energy use as much as building design" (Department for Innovation, Universities and Skills, 2008).

Specifically addressing heat loss via windows, one of the behaviour changes frequently recommended is for householders to make sure curtains in every room are closed at night. The US Department of Energy goes so far as to make this a featured 'Energy Savings Tip' on the homepage of its public-facing website (Department of Energy, n.d.). There is scope for providing householders with financial savings without initial extra expenditure, unlike installing better insulation or glazing; the fact that not all householders routinely close their curtains at night suggests that a design intervention may be helpful.

Understanding the behaviour

From a behavioural point of view, there are at least three possible conditions where the curtains do not get closed: householders understanding conservation but forgetting to close curtains (oversight); householders not understanding conservation or the link with curtains, and thus taking no action; or householders finding it difficult to close curtains and therefore not carrying out the process.

Once learned, the process of closing curtains at night becomes a *rule-based behaviour* (Vicente & Rasmussen, 1992); the oversight error is a *lapse* (Norman, 1983) or an *error of omission* (Matthews et al, 2000) and the lack-of-understanding error a *mistake* (Norman, 1983) or perhaps a *sequential error of commission* (Matthews et al., 2000).

However, the third condition—inconvenience—may also be important: in certain rooms of a house it may be difficult to reach curtains to close (or open) them, for example due to furniture in front of them, or for people with impaired mobility. Since leaving curtains open all the time allows the room to be naturally

lit during the daytime, and, if the room is not used overnight, does not appear to give any disadvantages (other than the heat loss), this may become the default state. This is probably often the case in office buildings where employees leave before it gets dark for much of the year.

Possible solutions

Obvious technological solutions such as new glazing, or automatic systems, while 'solving' the problem, are a different form of intervention, not actually about influencing user behaviour (see the discussion in Chapter 1). Whether householders would voluntarily purchase or install new devices or systems to influence their behaviour is another matter, but there may be potential for inclusion in new-build housing and non-domestic buildings.

The use of curtains themselves as an interface, as suggested by a number of the concepts generated by participants in the exercises here, has been demonstrated by Müller (2005) in her 'Energy Curtain' project, which used photovoltaic cells to power fibre-optic displays on the inside face of the curtains or blinds. This project had an intention to influence user attitudes and behaviour: "by requiring a user to make a trade-off between letting the light in during the day or drawing the curtain to save the light for later, it... requires that a user act tangibly on the choice between consuming or saving energy on a daily basis" (Backlund et al., 2006).

An important consideration in 'sustainability' solutions is that they must preferably not introduce too high a level of extra resource use, mitigating the environmental benefit. Concepts using energy themselves to run, e.g. monitoring light levels or heat flows, or elaborate interfaces, would need to be subject to life-cycle analysis to determine whether a net energy use reduction actually does occur in practice, particularly given the variability of the human behaviour component. As heat generated by electrical equipment will contribute slightly to the house's heating, there is an extra level of complexity to consider if attempting to assess the merit of concepts addressing the curtain brief.

Appendix to section 5.3.2

Coding the concepts for the Kettle brief

A preliminary attempt was made to investigate assessing the diversity of the concepts generated by participants in the different exercises, for one of the briefs (B1). That is, did participants come up with a more diverse set of concepts when using DwI in different forms, compared with conventional brainstorming?

As with the quality of the ideas, diversity is something with no obvious objective measure, but it was possible to classify each concept generated according to the 'Leverage Points' system, based on Meadows (1999), outlined in section 2.1.4. This system has the advantage that is is independent of any of the Design with Intent patterns, lenses or other approaches, hence reducing the likelihood of the author trying to 'retro-fit' concepts to these categories. Comparing the Leverage Points classifications of concepts generated under the different conditions, for the same brief, would reveal if there were any differences in the categories of concepts that participants had produced.

The Q3 concepts generated in all four exercises for the 'Kettle brief', B1, were coded according to the *Affordances, constraints & rules* and *Information flows* categories (5.1-5.5 and 6.1-6.5) as described in section 1.2.4 and repeated here in Table 5.10 with a concept from the workshops exemplifying each category. Category 4, comprising adaptive versions of the other categories, was not used. This practical application of the Leverage Points system demonstrated how difficult it is to separate some of the sub-categories, and the table and graph are presented here with the caveat that for a number of the concepts, multiple sub-categories could arguably be applied.

Figure 5.8 summarises the breakdown of concepts in each category across the four exercises: there are no major patterns evident except that the IM exercise (using the toolkit) led to eight different categories being used, while the conventional brainstorming only involved six. On such a small scale, this is probably not that significant. One key difference between CB and all the exercises using the toolkit is that sub-category 6.5—*feedforward*—is present in all the toolkit exercises but absent from the conventional brainstorming.

An additional point evident from Figure 5.8 is that no participants under any condition suggested concepts involving explicit incentives & rewards (5.4) or punishments (5.5) for people using the kettle in a certain way. It would be interesting to know whether this would hold if the participants were from a different discipline (e.g. economics or law): it is possible to speculate that the emphasis on user-centredness in contemporary design education would make it unlikely that designers consider punishing users directly, but this does not explain the lack of incentives and rewards (other than the knock-on effect of reduced energy costs) as strategies put forward.

It was decided not to go through with coding all the concepts from the other three briefs at this point, primarily because of the author's dissatisfaction with the rigour of the coding method. In a future study of this kind, it would be

Table 1: Sub-categories of leverage points 6 and 5, extended from Meadows (1999), with examples from the workshops, addressing the B1 Kettle brief.

	LEVERAGE POINT	SUB-CATEGORIES		EXAMPLES FROM THE WORKSHOPS
6	Information flows	Antecedent information	6.1	Multiple units of measurement on gauge including cups as well as volumes
		Antecedent information with recommendation	6.2	Use language on scale describing the water level, e.g. 'A bowlful', ' National average', 'Too much', etc
		Simple feedback	6.3	Route water through handle when boiling so the more water boiled, the hotter the handle gets
		Comparative feedback	6.4	Show friends' / other people's kettle energy use on your kettle's display
		Feedforward	6.5	Cups and mugs should have their capacity marked on the, so people get to know sizes better, and can fill kettles more accurately
5	Affordances, constraints & rules	Actual user-level affordances & constraints	5.1	Slider that has to be adjusted to desired amount before kettle can be filled with water
		Perceived user-level affordances & constraints	5.2	Fill valve 'pauses' while you're filling so you have to think before filling further
		Built-in system structure & limits	5.3	Kettle that resets amount boiled back to single unit amount after use each time and has to be explicitly set to greater quantities
		Incentives & rewards	5.4	*None*
		Punishments	5.5	*None*

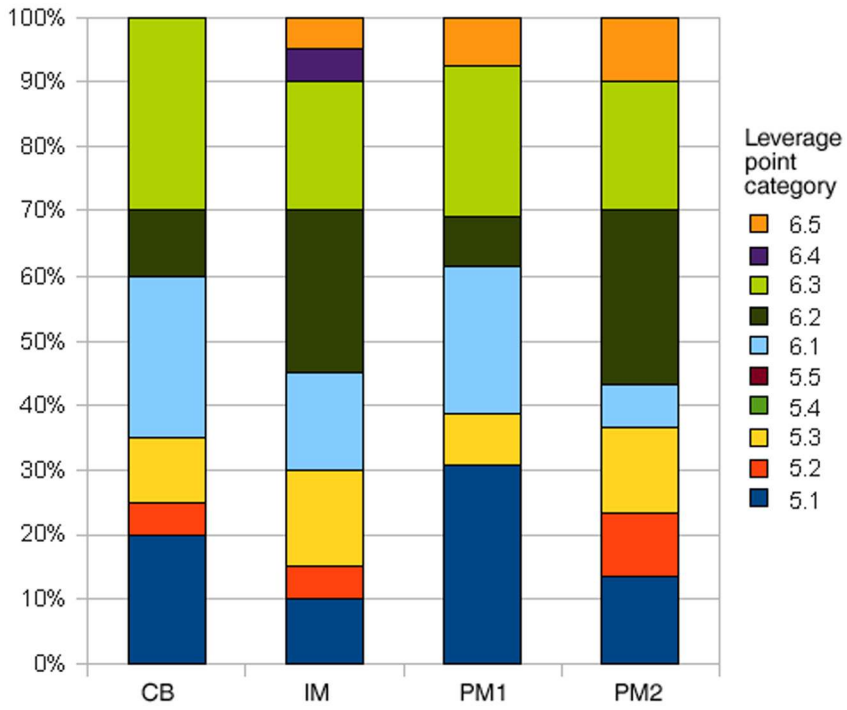

Figure 1: Concepts generated for B1 Kettle brief in each exercise, coded according to Leverage Points sub-categories. Note that no concepts generated match categories 5.4 and 5.5.

desirable to plan a more rigorous coding method into the design of the study from the start: multiple 'coders' independently assessing the concepts, with agreement required on which categories they fit into before any analysis was done.

Appendix to section 5.4.2.
References are included in the main thesis reference list.

Worked example: improving financial decision-making

In July 2010, Sendhil Mullainathan, co-founder of Harvard University's Ideas42 think-tank—specializing in applying behavioural economics principles for social benefit—invited the author to explore applying the DwI patterns to questions of improving financial decision-making for mainly low-income households. In particular, a brief was given around mitigating mortgage foreclosure through loan modification.

While the full background is beyond the scope of this thesis, the basic details (Mullainathan et al, 2010) are that: almost 1 in 6 US mortgage borrowers is either in foreclosure or delinquent (i.e. failing to make repayments); modifying loans has been supported financially by the US Treasury, but up-take is low; banks fear that many borrowers are 'strategic defaulters' who deliberately walk away; equally, banks' assumptions about the behaviour of borrowers often hold that they are behaving fully rationally and are able to calculate optimum strategies aligned with their own interests, while empirical research suggests that cognitive biases, inertia and 'ostrich' behaviour (e.g. not opening letters from the bank) may have a significant effect which leads to worse outcomes for borrowers and banks too. Mullainathan et al argue that currently, "the structure of loan modification offers is not sufficiently tuned to insights about borrowers' psychology," and therefore there is an opportunity to design more insightful strategies.

Without being a domain expert, the author could not hope to make detailed suggestions, but was able to translate some of the DwI patterns to this context, and also to make suggestions about methods of investigation (not included here). Some of the design ideas include general suggestions around the design of materials such as letters, statements and leaflets explaining householders' options: these could be improved to match better the insights uncovered through ethnographic studies of householder behaviour. This could involve simple things such as colour-coding on bills and making it easy to track from one statement to the next how the remaining balance and interest are changing, or more involved aspects of layout and text to emphasise particular choices or defaults. Specific application of the DwI v.1.0 patterns suggested a range of concepts (Tables 1 and 2), both ethical and somewhat less so.

The main insight for the development of DwI resulting from this exercise (which prompted a series of interesting conversations with ideas42, with the potential for future collaboration) was that, given familiarity with the patterns, it is relatively easy to translate and apply the ideas in traditionally 'non-design' contexts. This was also evident to some extent from the workshop with West Sussex County Council (see section 5.4.3).

Table 1: Concepts generated using DwI v.1.0 to address foreclosure mitigation

'MORE ETHICAL' CONCEPTS	'LESS ETHICAL' CONCEPTS
POSSIBILITY TREES or 'maps' simulating visually the outcome of different repayment / loan modification / delinquency schedules on householders' future payments, credit records, etc., with some kind of values assigned for different future points (a month from now, a year, five years, etc). Could be designed as part of the forms themselves, to lay out clearly which paths are possible and what the outcomes would be. This could help reduce / correct hyperbolic discounting, and FRAMING the outcomes very clearly as 'loss or gain' could make use of the principle of loss aversion.	Using DECOYS when presenting the options available to householders, to influence them to choose the 'best' one.
Use SOCIAL PROOF: show householders what others like them, in similar value houses with similar mortgages and similar incomes & outgoings, are doing—how are they managing? Which choices are they making? (good or bad). Enable householders to feel that they are able to do better than others, too: show what EXPERT CHOICEs an independent professional would make in the same situation.	PEERVEILLANCE: making repayment information public—e.g. signs outside people's houses stating which bank the mortgage is with, and how well the householders are doing at repaying. WATERMARKING: Somehow reducing people's attachment to their homes, perhaps by putting up bank logos or signs outside the more payments they miss. The less it seems like it belongs to them, the easier it will be to persuade them to move. This is a particularly unpleasant strategy.
PAVE THE COWPATHS: if the bank sees a number of householders adopting a particular strategy because it's best for them, find a way to formalise that without needing to involve deception, and present it to other householders directly as a legitimate option as part of a negotiated modification.	
TAILORING / optimised suggestions at the right moment (KAIROS) for what householders should do at any particular time—what would be most sensible from their point of view, right now? Could be linked to other accounts with the same bank, with householders' consent, to suggest optimised payments based on the income and outgoings for that month (and with a 'friendly' overdraft system). Suggested PORTIONS or frequency / spacing of repayments could adjust based on other bills / debits the bank knows the householder has that month. Could extend to quarterly or drop to weekly, etc. Or, rather than suggestions, the DEFAULT payment amounts could change based on this optimised model, with a chance to opt-out.	

Table 2: Concepts generated using DwI v.1.0 to address foreclosure mitigation

'MORE ETHICAL' CONCEPTS	'LESS ETHICAL' CONCEPTS
CONDITIONAL WARNINGS / ARE YOU SURE? questions, triggered if a householder seems to be behaving in a way which is not ideal. Maybe somehow building in an extra, confirmatory step before someone can miss a payment—not sure how this could happen.	
TUNNELLING & WIZARDS: A trustworthy, independent 'coach' or software wizard to help guide householders through their decision-making. To retain trust it would need to be seen as independent of the banks and thus be able to suggest strategic options which benefit the householder, even if they are not in the bank's interest. This may lead to more borrowers becoming strategic borrowers, though.	POISON PILL strategies, BUNDLING something unpalatable along with the mortgage which is triggered for strategic defaults but not for 'genuine' ones. Not sure how this would be detected.
WHAT YOU KNOW: 'Test questions' to establish householders' thought processes about borrowing and repayment, before allowing choices to be made. This might allow strategic borrowers to be identified somehow. Different choices could then be presented, based on the understanding revealed by the questions (which probably ought not to be framed as a test!)	
Considered use of METAPHORS and REPHRASING & RENAMING to illustrate better the processes and options available. Reduce implications of hopelessness (e.g. 'underwater') which may exacerbate ostrich effect.	
SCORES / CHALLENGES & TARGETS along the way, with REWARDS of some kind for achieving particular repayment milestones.	UNPREDICTABLE REINFORCEMENT: lottery-style rewards for those who keep up regular payments, similar to premium bonds. Missing payments would make you less likely to win future random prizes. In effect, kind of regressive though since the least able to make payments would then be less likely to win anything.
ANCHORING: Show clearly how much other similar houses are selling for in the neighbourhood (or comparable neighbourhoods) to anchor householders' expectations more realistically, so they are less likely to overvalue their homes. (See also an unethical version of this)	ANCHORING: deceptive (falsely reported) undervaluing of similar houses, to depress householders' expectations of how much their house is worth
RECIPROCATION: set the system up so householders' repayments go into a 'take a penny, leave a penny' community fund first, before the banks draw the money, allowing 'bad' and 'good' months to be smoothed out and reducing one- or two- month delinquencies. (Of course this means overpayment for some people, some months.)	