Integrating Ethics into Design for Sustainable Behaviour

Abstract

Consumer behaviour contributes significantly to society's impact on the environment. Through products, designers can shift user behaviour towards more sustainable patterns of consumption, bridging the intention - behaviour gap between values and everyday actions. Design for Sustainable Behaviour (DfSB) aims to reduce the negative environmental and social impacts of products by moderating users' interaction with them. DfSB strategies have been categorised on an 'axis of influence', which correlates increased product control with a corresponding reduction in user interaction and choice. The process of designing for sustainable behaviour has been modelled within existing literature, yet these models fail to account for, and fully integrate, inherent ethical considerations. This paper presents a design process model with corresponding ethical assessment tools that may better equip designers to influence consumption patterns without compromising users' autonomy and privacy, thus bridging a gap in current knowledge.

Keywords – Behaviour, Design, Ethics, Sustainability, Technology

Introduction

Developed economies account for 20% of the world's population, and are responsible for 80% of the life cycle impacts of consumption (WBCSD, 2008). Increased levels of consumption in industrialised countries is one of the main factors contributing to continual environmental degradation (Green and Vergragt, 2002, Seyfang, 2009). Over consumption does not contribute to our overall wellbeing (Seyfang, 2009, Green and Vergragt, 2002) and the throughput of virgin material required to manufacture new products has upstream and downstream environmental and social impacts across the product lifecycle, from extraction through to recovery or disposal at end-of-life (Bhamra and Lofthouse, 2007).

Though significant progress has been made in addressing impacts arising from manufacture and disposal, driven partially by increased legislation, the use phase has received less attention. Studies of certain consumer products, such as refrigerators, demonstrate that significant environmental impacts can occur as a direct result of user interaction (Elias et al., 2009, Tang and Bhamra, 2012). This may not be true of all product categories, however, as the impacts of user interaction typically vary according to product type. Nonetheless, through increased focus on user behaviour, designers can

leverage more sustainable use patterns by shaping the way in which consumption occurs and bridging the intention - behaviour gap (Sustainable Consumption Roundtable, 2006) between values and everyday user actions.

Design for Sustainable Behaviour

Design for Sustainable Behaviour (DfSB) aims to reduce the negative environmental and social impacts of products by moderating users' interaction with them (Wever, 2012). There is, however, no single design approach or strategy for changing the behaviour of an individual towards more sustainable patterns of use (Lilley et al., 2006, Bhamra et al., 2008). This is evident in the plethora of DfSB approaches, summarised in *Figure 1*, that have emerged in recent years fuelled by increasing interest in this growing field.

[Insert Figure 1 here]

Although existing work draws on similar theoretical contributions, the orientation, emphasis and intention of the resulting models and frameworks differ. Whilst some research has focused on developing a choice-control axis (Lilley, 2007, Lilley, 2009, Tang and Bhamra, 2012, Zachrisson and Boks, 2012) or the distribution of control between the user and the product (Pettersen and Boks, 2008, Lidman et al., 2011b). Others have sought to integrate behavioural or practice theory and DfSB strategies (Elias, 2011, Tang and Bhamra, 2011, Lockton and Harrison, 2012, Zachrisson and Boks, 2012). Investigation of cultural and contextual contributing factors has also gained prominence (Elizondo and Lofthouse, 2010, Kuijer and De Jong, 2012, Spencer and Lilley, 2012).

It is evident from the broad range and remit of prior art that the theoretical foundations of DfSB have been greatly advanced in recent years; however, there are some notable gaps in current thinking. It is currently not possible, for example, to accurately analyse or predict the effectiveness of behavioural interventions. This is because, aside from limited exceptions, *"few of these design strategies have been empirically evaluated"* (Lidman et al., 2011b) in longitudinal studies. Where data does exist, the studies tend to be intensive, focussing on a relatively small sample over a limited timescale (typically up to three months duration). Therefore, the findings cannot be considered representative of a wider population, nor can any meaningful conclusions be drawn regarding the long-term efficacy of such behavioural interventions. Furthermore, the lack of a unified framework by which to categorise, apply and assess these different strategies has resulted in difficulties in comparing and assessing their effectiveness. Whilst there is clear need to develop a coherent framework for DfSB that combines existing theory, it is not possible to provide the necessary in-depth critique of relevant behaviour models and theories within this paper[1], nor is it advisable to develop such a model from a singular disciplinary or research perspective. Neither endeavour, thus, falls within the remit of this paper.

Irrespective of the debate over strategies, DfSB is already moving towards systematic implementation within the design process, with several authors (Selvefors et al., 2011, Tang and Bhamra, 2011, Zachrisson et al., 2011) tentatively producing new models that

[1] For this, it is suggested that the reader consult Zachrisson and Boks (2012)

account for DfSB at each stage of the design process. Each prescriptive model follows a similar linear trajectory, moving from an exploration and identification of the problem or target behaviour towards identifying and implementing an appropriate intervention strategy.

Design for Sustainable Behaviour: Design Process

Selvefors et al. (2011), Tang and Bhamra (2009a, 2009b, 2011) and more recently Zachrisson et al. (2011) and Lidman et al. (Lidman et al., 2011a, Lidman and Renström, 2011) have all created differing design processes in order to generate products that change the users behaviour toward more sustainable consumption (see *Figures 2*, *3* and *4*). These process models are representations of design strategy; defining the management of the design and development of a product or system in a standardised manner (Dubberly, 2004, McClelland and Suri, 2005).

Tang and Bhamra (2009a, 2009b, 2011) explored how DfSB could be used towards reducing the domestic energy impact of refrigerators in a UK case study, using their design process model (*Figure 2*).

[Insert Figure 2 here]

Working with IKEA of Sweden, Selvefors et al. (2011) took a case study approach looking at the actions and habits that surround the use and charging of small, mobile electronic devices, identifying and implementing six steps within their design process (*Figure 3*).

[Insert Figure 3 here]

The guidelines developed by Zachrisson et al. (2011) were tested through a qualitative case study in collaboration with Philips Research, looking at Norwegian and Dutch oral health care behaviours (*Figure 4*).

[Insert Figure 4 here]

The initial steps of all the afore mentioned design processes begin with defining the intervention context; identifying the behaviours relevant to target and the physical and cognitive factors that affect and perpetrate that activity. In defining this context, the cornerstone against which to design behavioural interventions is established. The process employed by Selvefors et al. (2011) suggests that the initial focus of the project is determined by product analysis, a comparison of the product against a theoretical behaviour model to determine how the designer expects the user to act and the energy consuming consequences. Only in the second step, in which user habits are analysed, are qualitative interviews and observational techniques applied. One would expect, however, that an issue with narrowing the focus prior to interviewing and observing the user may be that certain energy consuming actions and habits are effectively ruled out before they may have even been analysed. In the third step of Selvefors et al.'s (2011) model the energy consuming aspects of the identified behaviours are considered, leading to step

four, the selection of the behavioural action to target based on its resource impact and the greatest potential for change, echoing elements of Elias et al.'s (2008a, 2008b) quantitative priority method.

Tang and Bhamra (2009a, 2009b, 2011) in defining the context of use, also use several user-centred research techniques, namely questionnaires, and in a similar vein to Selvefors et al., semi-structured interviews and observational studies. Again, a specific product or interaction is selected prior to behavioural analysis. Zachrisson et al. (2011) explore a myriad of UCD research techniques within their collaborative project, such as interviews, overt and covert (hidden camera) observational studies, the use of cultural probes and the analysis of blogs (Boks, 2011, Zachrisson et al., 2011) within their initial phases; study the practice, identify target behaviours, and identify factors affecting the behaviour. The use of UCD techniques within these research projects has been fundamental to forming an understanding of the user's action and cognitive activities and associated impact, therefore illustrating the necessity of such UCD techniques at the front end of the design process.

With the scope of research reduced and target behaviour defined, and more critically, understood, the next phase is to determine the intervention strategy to apply and to design product interventions accordingly. Selvefors et al.'s (2011) fifth and sixth steps, identifying suitable intervention approaches and developing product concepts, involve the use of UCD creative development techniques anchored around the designers understanding of behavioural strategies and their creative problem solving abilities, shunning the use of guides that relate a specified intervention to a specified behaviour. With the needs, context, actions and hidden factors identified, Tang and Bhamra (2009a, 2009b, 2011) generated insights which were framed as briefs and several paper-based design solutions were produced using their Design Behaviour Intervention Model for guidance.

Zachrisson et al. (2011) used their guidelines in order to select the design strategy appropriate for changing the target behaviour, bookending the design process to provide guidance and focus before commencing design. In addition, through this process they focused the evaluation in order to identify the appropriateness and potential of designs generated in relation to identified behavioural antecedents. Zachrisson et al. (2011) also proposed the use of external models and methods, namely Fogg's Behaviour Grid and Behavioural Model (Fogg, 2009, Fogg and Hreha, 2010), as well as Lockton's Design with Intent cards and method (Lockton et al., 2010) to aide in the defining or constraining of behaviours to target and the selection of strategies. However the use of external models and methods without an in-depth knowledge and understanding of the behaviour that the designer intends to change can be problematic. This is because the models and methods themselves do not provide any support to understanding the antecedent, cognitive structure to the behaviour (Wilson et al., 2010). Designer awareness and knowledge of the 'problem' throughout the design process is critical to the successful execution of the design process (and resulting intervention).

Although the evaluation phase proposed by Zachrisson et al. (2011) does not discuss input from stakeholders, the use of a guide may offer direction towards the areas of antecedent or habitual change that the designer may use to focus such investigation with relevant individuals. An activity which is missing in other process models. Interestingly, the evaluation of the concepts produced by Selvefors et al. (2011) is considered to be

outside of the remit of their Design for Sustainable Consumption Behaviour-approach, noting only that the most relevant concepts were evaluated *"in relation to the company's product portfolio, the company objectives, and to the competition on the market"* (Selvefors et al., 2011, P.6). No indication of how the concepts would influence the behaviour of identified users or the behavioural acts that they perform is given or methods suggested. Tang and Bhamra (2009a, 2009b, 2011) used focus groups in order to validate their concepts, which although produced useful insights cannot be shown as categorical evidence that the concepts are effective; in other words, that the designed interventions changed behaviour over time in context. Lidman et al. (2011a) turn towards a longer period of contextual study and evaluation, a key advantage of which is that the behavioural change itself becomes more apparent, is rigorously documented, with a longitudinal baseline recorded prior and post intervention for quantitative and qualitative comparison. An interesting finding of this study and that of Wever (2010) was that after the interventions were removed, several individuals returned to prior, problematic techniques of dosage or waste disposal, indicating that the change in behaviour was contingent on the continuing presence of the intervention itself. This suggests that the length of installation may affect habit formation, and furthermore, the evaluation should extend to include post intervention residual effects.

In summary, it is clear that there is a consensus model of DfSB design process forming that follows a structure of:

- forming an understanding of behaviour in context;
- the informed selection of a behavioural target;
- the selection of a corresponding behavioural intervention strategy;
- the designing of appropriate behavioural interventions;
- finally, the evaluating of the behavioural intervention against the initial understanding of behaviour in context.

This tentative structure, however, is yet to be standardised across DfSB research and is critically lacking in three key areas;

1. Consideration of the evaluation phase of the design process, the assessment criteria and how the information can be iteratively fed back into the design process in most of these design process models and case studies is, for the most part, absent.
2. There is little or no integration of ethical considerations into these process models and the provision of suitable tools to aid in prompting ethical reflection is lacking.
3. The criteria for selecting a strategy in response to identified behaviour is currently underdeveloped and in need of further consideration.

The aim of this paper is to propose a new design process model complete with corresponding ethical assessment tools that may better equip designers to influence consumption patterns without compromising users' autonomy and privacy. Through this endeavour, the authors seek to bridge a gap in current provision by addressing the second identified limitation of existing models. We also anticipate a contribution, if incremental, to clearer criteria to drive strategy selection, the third limitation. The boundaries and limits of this paper do not, however, enable a detailed approach to be taken with respect

to addressing the lack of evaluation criteria. This will be further explored in the discussion.

The Ethics of Design for Sustainable Behaviour

A review of recent literature in this field revealed the growing importance of ethical considerations within DfSB (Pettersen and Boks, 2008). Although the intention of Design for Sustainable Behaviour is to lessen negative or increase positive impacts of use, through shaping users perceptions, learning and interaction experiences (Brey, 2006), in doing so it has the potential to raise ethical problems. Exploration of the ethical dimensions of influencing behaviour through design is, at present, still fairly limited and there is a distinct lack of a structure or criteria by which to 'ethically rank' or compare interventions or to assess the ethical repercussions of their use, either in or outside of their intended context. To enable designers to recognise and effectively deal with emergent ethical issues resulting from intended or unintended use, they need to be able to identify, analyse and evaluate the impacts of user-interactions with their interventions on the user, society and the environment. It is, therefore, important to consider the morality of the decisions made by the designer, to fully understand the ethical issues surrounding this field of inquiry and to identify existing relevant theory in order to construct useful, well-informed, comprehensive tools for designers. To encourage designerly reflection on ethics within DfSB it is necessary to begin by identifying and discussing ethical issues which may warrant consideration.

The choice-control dichotomy of acceptability versus effectiveness has emerged as a key debate within DfSB discourse representing an interesting ethical dilemma for designers. It is often argued that the success of information campaigns is limited as resultant behavioural changes often fall foul of the *"fall-back"* effect, whereby consumers revert to previous behaviours when the campaign ends (Wood and Newborough, 2003) therefore any changes are relatively short-lived. Furthermore, their effectiveness in successfully converting intention to action has proven limited. *"The effects of information seem to depend largely on its specificity. Mass media campaigns tend to result in an increase in attitudes or knowledge (e.g. Staats et al., 1996), but there is no clear evidence that this results in reductions of energy use"* (Abrahamse et al., 2005). To minimise unpredictability and ensure compliance with energy saving goals, for example, it is possible to design highly autonomous systems which eradicate the need for human intervention completely or use constraints to prescribe actions (Cole et al., 2008). Notwithstanding current technological limitations, persuasive technologies, operating ubiquitously and autonomously, have the potential to be incredibly effective, offering a more reliable and replicable method for ensuring more sustainable behaviour. However, persuasive strategies, though arguably more effective than informative ones, often restrict choice and while it is technically possible to restrict irresponsible behaviour, it is socially problematic (DeVries, 2006). The delegation of moral responsibility and role of the designer in motivating and effecting change for the mutual benefit of society and the environment is a fundamental, contentious and hotly debated issue. Persuasive technologies *"might be seen as a threat to human autonomy, a source of moral laziness or an anti-democratic force in society which lets designers rather than representatives of the people steer our behaviour"* (Verbeek, 2006a). In reality, to address the complex,

interrelated issues related to consumer behaviour and to leverage more sustainable behaviour, a mix of educational, marketing and technological interventions are needed (WBCSD, 2008). This research argues that designers are well placed to contribute significantly towards reducing impacts by actively shaping consumption practices, bridging the intention - behaviour gap between values and everyday user actions. It is, however, vitally important that a balance is reached between controlling and encouraging sustainable behaviour. By removing decision making from the user and preventing 'unsustainable' actions, we separate cause and effect. Without feedback on cause and effect, users may be less likely to learn from, and adapt, their behaviour accordingly. *"Acceptance is fundamental for long-term effects"* (Lidman et. al, 2011, p. 108) yet customers' acceptance of an intervention is rarely assured. Persuasive or autonomous technologies, though effective, may be perceived as restrictive and this may reduce acceptance. Lidman et. al's recent evaluation of prototypes designed to reduce laundry liquid dosing, for example, found a connection between low acceptance and a feeling of overt control expressed as; *"a certain disapproval of being steered by the prototype"* (ibid, p. 108). This correlates with the perception of designers interviewed by Lilley (2009) who felt uneasy at the prospect of reversing the traditional subservience of products to users. When taking the example of providing opportunities for user control over their environmental heating and cooling technologies, reducing control may be counterproductive as user interaction can increase tolerance of indoor conditions (Cole et. al, 2008). Removing choice, however, may, in some instances, be considered justifiable and tolerable if doing so for the 'greater good' (for example, only marketing A-rated washing machines) and it is plausible to consider that users may respond positively to the automation of certain actions if they bring benefit in terms of convenience and time reduction.

In order to achieve the long term aim of sustainable behaviour, individual freedoms may be restricted through the manipulation and interfering with of activities by technological agency, or the restriction of an individual's autonomy, such as through policy legislation (Pettersen and Boks, 2008a). *"Usually, BSTs [behavior-steering technologies] are used to promote some socially, desirable end, such as sustainability, safety, efficiency, or equity……the importance of promoting positive ends [however] must be weighed against the cost to individual liberty"* (Brey, 2006, p. 358). Persuasive technologies should endeavour to avoid infringing on the liberties and privacy of the user and those affected by use. A BST may, however, still be justified even in the face of resistance, if *"the cost of not using the BST can be shown to be greater than the cost to individual liberty when it is used"* particularly if a less coercive alternative has failed to effect change (Brey, 2006, p. 360).

Fogg (2003) suggests that the ethical dimensions of persuasive technologies may be assessed by the outcomes of a user's interaction with the product. If the designers intended outcome is benevolent towards the user, there tends not to be any ethical issues, however, if the intended outcome is unethical, then the designer must take ethical responsibility. Furthermore, if an unintended outcome could have been foreseen, the ethical responsibility to correct this oversight lies with the designer (Fogg, 2003). Whereas user-agentive strategies enable a clear division of responsibility for impacts to be represented, impacts resulting from unintended behaviour between the designer or programmer and a fully autonomous system, however, are less easily quantified; *"it is more difficult to discern where the human responsibility lies for its functioning or*

malfunctioning" (The Royal Academy of Engineering, 2009). In these cases, ethical responsibility is not clear-cut but open to debate.

By carefully anticipating and considering the ways by which a product may be unintentionally appropriated, overused or used inappropriately by (un)intended users, the designer can be considered to be acting ethically (Fogg, 2003). One of the difficulties of assessing the ethical implications resulting from product use, however, is that it can be difficult for designers to accurately predict user behaviour and evaluate the influence of technologies on behaviour in ethical terms (Verbeek, 2006a). A technology can have many potential uses, which can be dependent on the use context, the user's intentions, habits and practices and the social norms which govern behaviour in the specific context in which the user is located. Albrechtslund (2007) refers to this phenomenon as 'multistability'.

The designer plays an important role in determining the mediating effect of technologies and products, but not the only role. Users interpret signals given through the product and appropriate technology to better suit their needs; and the technology itself can *"evoke certain kinds of behavior"* (Verbeek, 2006b) in ways which are not always intended or anticipated by the designer (Albrechtslund, 2007). It is generally acknowledged that *"many, if not all, persuasive technologies have unintended effects"* (Verbeek, 2006a). The unpredictable nature of user behaviour, coupled with the interactive and responsive nature of some behaviour changing devices, may even result in rebound effects such as; increased consumption; the bypassing of technology or its ignorance; and unintended use (Pettersen and Boks, 2008a). Users reluctance to submit to prescribed actions may result in unforeseen 'work-arounds' or rebound effects being enacted, which may result in greater environmental or social detriment. Users may engage in 'game-playing' to escalate instead of decrease impacts if the product fails to effectively counsel against inappropriate behaviours or may even deactivate features deemed irritating or overtly moralistic.

According to Pettersen and Boks (2008a) a designer can only predict what the outcomes of an intervention are, as the user may interpret and interact with a product in unforeseen ways. Albrechtslund (2007) argues, however, *"foresight is limited to anticipation rather than prediction"*. Berdichevsky and Neuenschwander's (1999) flow chart (see *Figure 5*) attempts to clarify the levels of ethical responsibility which can be associated with both predictable and unpredictable intended and unintended consequences resulting from the use of persuasive technologies, to provide further clarity and aid ethical decision-making.

[Insert Figure 5 here]

For example, if the outcome is unintended, reasonably predictable and unethical, the designer is responsible and at fault, whereas if the same outcome is not reasonably predictable and unethical the designer cannot be held responsible.

Issues associated with trust, privacy and security also need to be discussed. Consumers, for the most part, implicitly place their trust in electronic products. They expect products to *"tell the truth"* and find it difficult to discern between true and false information. Berdichevsky and Neuenschwander (1999) recognise that persuasive technologies must not misinform in order to achieve their intended outcome, for example, false information should not be used to encourage more sustainable behaviour. Well intentioned

interventions may inadvertently diminish users trust in the device if data is manipulated to achieve a persuasive end e.g. exaggerating water usage data to encourage reduced consumption. In terms of privacy and security it is important to recognise that products using an informative approach to influence users' decision making process often use Bluetooth, GPS and motion sensors to gather behavioural data to inform their interactions with users. Although a great deal of information about consumer behaviour is already available via census data, store loyalty cards and CCTV, consumers appear reluctant to provide personal data freely. The collection, storage, sharing and use of data, therefore, must be carefully managed and safeguarded (Berdichevsky and Neuenschwander, 1999). Persuasive technologies must not use personal information to exert leverage to ensure the designers intention is fulfilled, for example by passing information to a third party such as a parent, employer or spouse who may act on it to punish or reward behaviour (Berdichevsky and Neuenschwander, 1999).

Revised process model

A designers understanding of the ethical issues inherent in design practice develops with experience and correlates with an increased understanding of the context of design industry and the role of design within the wider system. Their ability to identify and address ethical issues in design practice is dependent on their experience, level of control, responsibilities and influence (Birkett et al., 2008, Birkett et al., 2009). However, as Albrechtslund (2007) highlights, the question of ethics in design is *"not optional"*, as all technology has ethical connotations whether intentionally prescribed by the designer or not. This suggests that novice designers may have a short fall in requisite skills in order to adequately deal with the ethical dimensions inherent within design practice. This model, therefore, is aimed towards those that may not have yet developed such mature skills or knowledge base, such as student designers or those with a limited knowledge of, or experience in applying, DfSB strategies.

To address the limitations of previous models it is necessary to represent the *process* of designing for sustainable behaviour complete with design stages and points of ethical reflection. Using user centred design (Gould and Lewis, 1985) (Preece et al., 2002), as its foundation, and building on prior art, a new process model (*Figure 6*) is proposed.

[Insert Figure 6 here]

This five-stage model aims to enable; the identification of behavioural determinants, categorisation and prioritisation of target behaviours, formulation of design intent, strategy selection and point of entry, intervention development and cyclical testing and refinement. Crucially, it also provides staged opportunities for ethical reflection as well as tools that may be used to conduct ethical evaluations at strategic points. The five stages, as described below, are; 1. identify behaviour, 2. categorise behaviour, 3. formulate intent, 4. select strategy and point of entry (on the axis of influence) and 5. develop and evaluate.

Identify Behaviour

From the starting point of the initial design brief, behavioural determinants such as needs, habits, attitudes, behaviours, policy, incentives ('carrots') and penalties ('sticks') and the way in which goods and services are delivered, enabled and supported by infrastructure, (Jackson, 2004, Mont and Plepys, 2008, Seyfang, 2009) should be identified through dual processing of user-centred research insights and an analysis of political, environmental, economic, social and technological (PEEST) factors. This analysis not only enables the selection of target behaviours but also, crucially, provides a baseline of behaviour against which the success of the intervention in changing behaviour may be measured. Without understanding these influencing factors, it will be difficult to comprehensively argue that changes in behaviour can be attributed solely to the designed intervention. At this stage, an ethical review of the methods and modes of data collection involving human subjects should be undertaken.

Categorise Behaviour

Once identified, behaviours can be categorised and evaluated using the Ethical Assessment Matrix A (see *Table 1*), a tool which enables target behaviours to be prioritised on the basis of their impact on society and the environment (Low, Medium or High), the longevity of the effects produced as a result of the behaviour enacted (Short term / Long term) and the permanency of these effects (Reversible / Irreversible). Behaviours which score highly in terms of impact and are considered long term and irreversible should ideally form the primary behaviours targeted.

Though instructive, it is recognised that human agents (and by extension, behaviour changing technological agents) are not necessarily rated by aggregate scales but each positive and negative act independently (Gowri, 2004). Therefore, scaling moral impacts with a strength rating may lead one to believe there to be an attainable net positive impact of a design, with the strength of a single positive outcome outweighing several negative outcomes of a lower moral value. Furthermore, this may imply that all values and issues are on the same linear scale; what may be morally negative for one individual, may be positive for a different individual. Therefore, although ranking and prioritising is a useful start point, analysis of impacts and consequences should be qualitatively assessed with all moral issues discussed with all stakeholders, with rigid adhesion to rank and prioritising avoided (Gowri, 2004). It is recommended, therefore, that where possible, relevant stakeholders are involved in the evaluation process to help determine the ethical impact, the effects of multistability and make the process more democratic as opposed to technocratic (Petterson and Boks, 2008; Verbeek, 2006a, 2006b).

[Insert Table 1 here]

Formulate Intent

From this analysis, the design intent is formulated and subjected to rigorous ethical scrutiny. Probing questions examining: the designers intent; validity of the targeted behaviour; the level of control exerted by the product, service or system; whether this can be justified in relation to the perceived severity of the behaviour targeted; privacy and security issues related to data collection, transfer and storage, accuracy, reliability and

trustworthiness, and the overall impact on stakeholders who may use the product or system or be affected by its use either directly or indirectly should, therefore, be asked.

A full design specification outlining all the requirements the product, service or system must fulfil including aspects such as; appearance, ergonomics, lead times and maintenance, in conjunction with any constraints that may affect its design or delivery and crucially, the target behaviour and intended behavioural outcomes, can then be drafted. At this stage, indicative evaluation criteria may be developed in response to the intended aesthetic, functional and psychological aspects of the design.

Select Strategy and Point of Entry on Axis of Influence

Selection of an appropriate strategy is not straightforward and is dependent on a myriad of internal and external influencing factors that must be acknowledged and dealt with. The target behaviours set out in the specification may then be aligned to a suitable strategy and a 'point of entry' on the axis of influence negotiated. This negotiation must account for and balance an analysis of the users' level of compliance and response to prior interventions, the gravity of the consequences of the behaviour enacted and the context of use (Elias et al., 2008a, Wever et al., 2008, Lilley, 2009).

Develop and Evaluate

The intervention can then be developed and refined through an iterative process of testing and evaluation and measured against pre-defined criteria. At this stage, the designer should pause to project and hypothesis on the potential intended and unintended outcomes of the behavioural intervention and the potential effect on the user and those affected by its use either directly or indirectly. These are noted and assessed using Ethical Assessment Matrix B (see *Table 2*) which requires the designer to consider the ways by which their product may be used, down to prediction on the part of the designer as to how the technology will be adapted within its use context; its multistability. Using the Matrix, behaviours identified can be rated in terms of their severity, longevity, permanency of consequences and likelihood of occurrence. Having rated all behaviours identified, those behaviours which score highly in terms of impact, are considered long term, irreversible and have a high or medium probability of occurring can be highlighted for deeper consideration.

[Insert Table 2 here]

The prediction process can be constructed in one of two ways; either by the designers own imagination, or by a systemic involvement of stakeholders (Verbeek, 2006b, Pettersen and Boks, 2008). The designer can use their imagination and inherent skills to predict and design for the user and use contexts associated with a technological device. By envisaging the roles and demands that the device will play, future scenarios can be iteratively designed for. The limitation of this technique, however, is that it relies on the designer's innate imagination and empathic ability, as well as their interpretation of what they perceive to be the user and use context. As with Matrix A, to fill this gap in knowledge and to supplement and inform this forward-facing technique, designers need to actively engage with all potential stakeholders. By empowering stakeholders and directly feeding their experiences and expectations into the design process, decision making moral responsibility can be shared to provide a democracy of power and a

discursive platform to examine opposing values to ensure that the diverse requirements and interests of all are accounted for and a consensus is reached (Verbeek, 2006b, Pettersen and Boks, 2008). Potential users can get involved in the early investigatory stages of a design process to help uncover tacit knowledge and provide insights into how and in what contexts future technology may be used (McClelland and Suri, 2005). The selection of design options, refining of solutions and evaluation processes can all involve the users input to some degree, to help the designer to shape the potential ethical future of the technological device as well as broaden the potential of uncovering undesirable multistable outcomes. A device designed through user centred design methods may still lead to a device that negates the end users decision making ability, however, the device may still be considered to be democratically sound (and not technocratic), as the democratic user input and decision making is still present, but its point in the product cycle has shifted. By improving this understanding, better predictions can be made by the designer or the stakeholder as to how the technology will be interpreted and appropriated into society, although it should be acknowledged that this prediction could never be guaranteed or in consideration of every eventuality.

The product should then be prototyped and observed in use (see Rogers, Sharp and Preece, 2011 for appropriate UCD methods) to identify actual intended and unintended behavioural outcomes, emergent rebound effects and workarounds. Unintended behaviours should be scrutinized to assess their environmental, social and ethical impacts. As indicated in *Figure 6*, untenable impacts resulting from unintended behaviours should prompt a return to one of the previous four stages of the process at which decisions made resulted in the ensuing direction.

The tools presented thus far have centred on the behaviours enacted, those to be changed and the behavioural outcomes of an intervention. Yet an ethical measure of an intervention is not only calculated by the behaviour changed, but is also a measure of the design process itself. The following questions evaluate the ethics of the user's changed behaviour, as well as the ethics of the process through which the design intervention was created (*Table 3*).

[Insert Table 3 here]

For the novice designer it is recommended that this checklist be used to ensure ethical adherence in conjunction with other tools introduced within the design process presented. However, as the designer's knowledge and experience develops, this checklist may be used as more of an aide memoir to prompt ethical consideration. It is envisaged that continued use of the tools will not be necessary as these ethical questions will be asked reflexively as part of design thinking without prompting.

Discussion

The expansion of design process model previously presented in prior literature to include ethical reflection has offered new insight and furthered debate in the emerging field of DfSB. However, it is acknowledged that though some limitations of prior research have

been wholeheartedly tackled, others remain only partially resolved or entirely unconsidered.

Development of strategy selection in relation to behavioural theory

The process-oriented model to support the implementation of DfSB strategies in design practice (*Figure 6*) provides the means by which to understand how and why consumers act through the formalised integration of a user-centred research phase leading to the extraction of behavioural determinants. The selection of a strategy is aided by the consideration of tripartite criteria; the users' level of compliance and response to prior interventions, the gravity of the consequences of the behaviour enacted and the context of use. However, the designers understanding of user behaviour and the relationship between this and the selection of an appropriate strategy could be further strengthened through the strategic alignment of DfSB theory with that of behaviour and/or practice. Despite this admission, a deliberate, conscious decision was made at this stage in the development of the models presented, not to integrate behaviour or practice theory. Without wishing to be seen as 'sitting on the fence', this is ostensibly due to the relative newness of research investigating the potential for a fruitful connection and the current lack of a comprehensive 'fit' between these theories. It is anticipated, however, that future iterations of the process model will incorporate consideration of emergent research linking these aspects.

Consideration of cultural diversity and its impact on DfSB

Furthermore, consideration of, and empathy with, the cultural context of the target user, highlighted by Elizondo (2010) as a gap in the provision of supporting tools for DfSB, could be strengthened through the explicit introduction of methods for eliciting empathy with users.

Limitations of scaled assessment in ethical matrix tools

A further limitation stems from the relatively crude and simplistic scales used within Matrices A (*Table 1*) and B (*Table 2*) which fail to account for the diversity of ethical considerations inherent in identifying and evaluating user behaviour and its impacts. To categorise ethics in these terms is, on reflection, problematic as potential factors do not all exist on the same axis (e.g. violence vs. profanity) therefore weightings such as these may lead to the concept of a 'net' positive product, mitigating a large negative impact with several smaller positive impacts (or vice versa).

Lack of evaluation criteria

The lack of DfSB case studies makes it difficult to judge the effectiveness of the design processes proposed by authors such as Selvefors et al. (2011), Tang and Bhamra (2009a, 2009b, 2011), Zachrisson et al. (2011) and Lidman et al. (Lidman et al., 2011a, Lidman and Renström, 2011), as well as the appropriateness of both the targeted behaviour and the selected DfSB strategy. Because of the lack of case studies coupled with the short duration of many of the implemented design processes identified, which tend to focus on the early, front end of the design process model and the selection or defining or DfSB strategies, how a DfSB device should be evaluated is relatively undetermined. Consideration of the evaluation phase of the design process and development of

appropriate assessment criteria is, for the most part, absent, leaving a considerable gap in knowledge (although recent work by Wilson et al. (2013) contributes much to this debate).

Conclusions

The process model demonstrated in *Figure 6* successfully bridges a current gap in the provision of tools to support the integration of DfSB by providing three key criteria for selecting a suitable strategy and negotiating a 'point of entry' on the axis of influence. These criteria, which represent one of several integrated ethical assessment tools, will effectively support designers wishing to reduce the negative environmental and social impacts of products by moderating users' interaction with them, whilst navigating a complex range of ethical concerns. However, given the limitations discussed in the preceding sections and the on-going, rapid development of theoretical knowledge in the field it is anticipated that future iterations of this model will mature in line with DfSB theory and practice as the identified gaps in knowledge are closed.

The lack of case studies, especially those that implement the entire design process from initial investigation through to evaluation or cyclical iteration, constrains the evaluation of these design processes to predominantly theoretical discussion with few results to debate. It is acknowledged, therefore, that further testing of the model within the scope of a 'live' project is needed to gauge its suitability and applicability to a broad spectrum of designers designing in, and indeed for, a range of contexts and users. The revised models and tools are not, however, by any means, definitive and are open to debate and scrutiny. Nor are they intended to be a definitive account of the process of designing for sustainable behaviour that must be slavishly followed, as it is recognised that, in general, rigid, formalised processes are unlikely to be readily adopted by designers. It is hoped, however, that they will serve their purpose in providing a framework suitable for early career designers who have a limited pool of skills and ethical knowledge from which to draw in order to tackle DfSB design challenges.

Word Count

6,600 words, excluding tables and figures.

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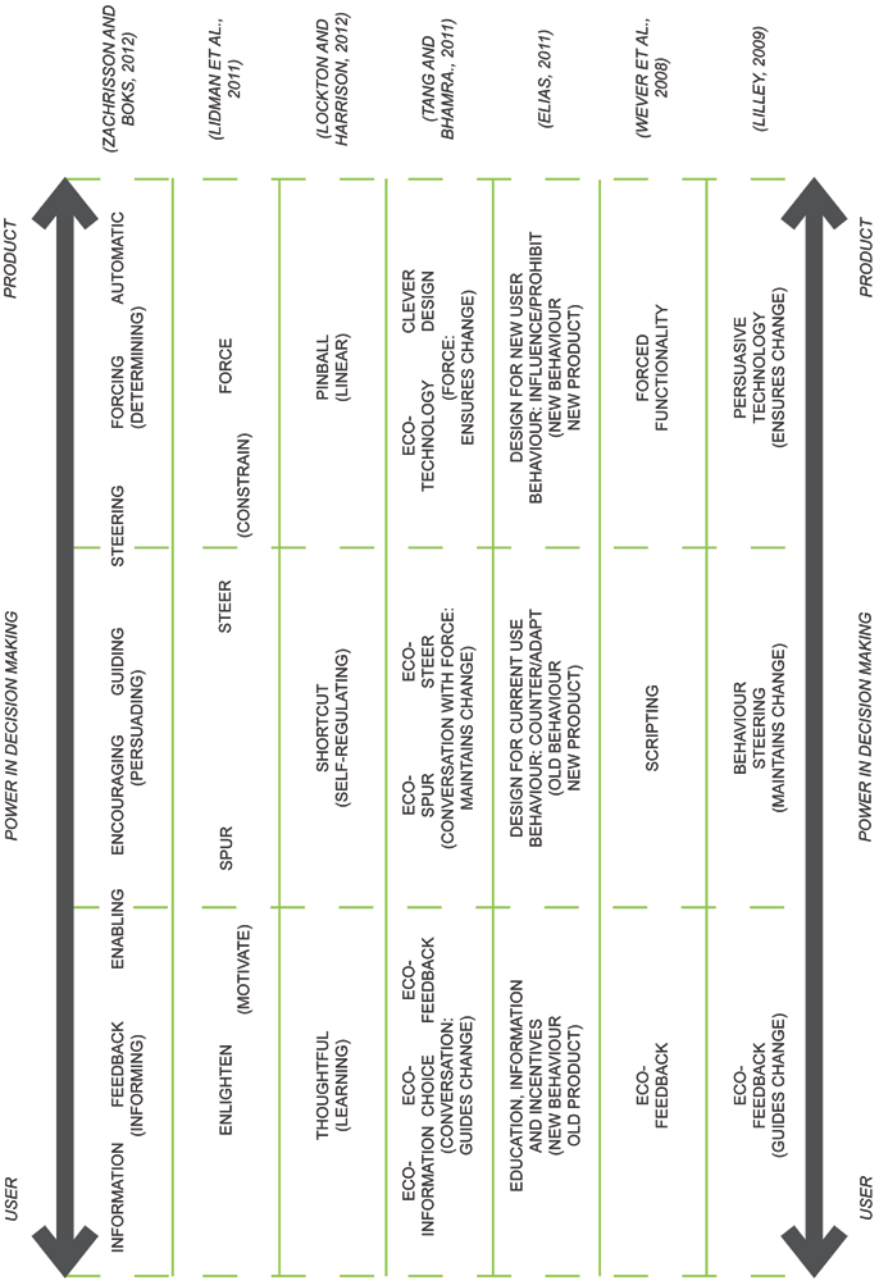

Figure 1: DfSB Strategies represented against the Axis of Influence (Lilley et al., 2006)

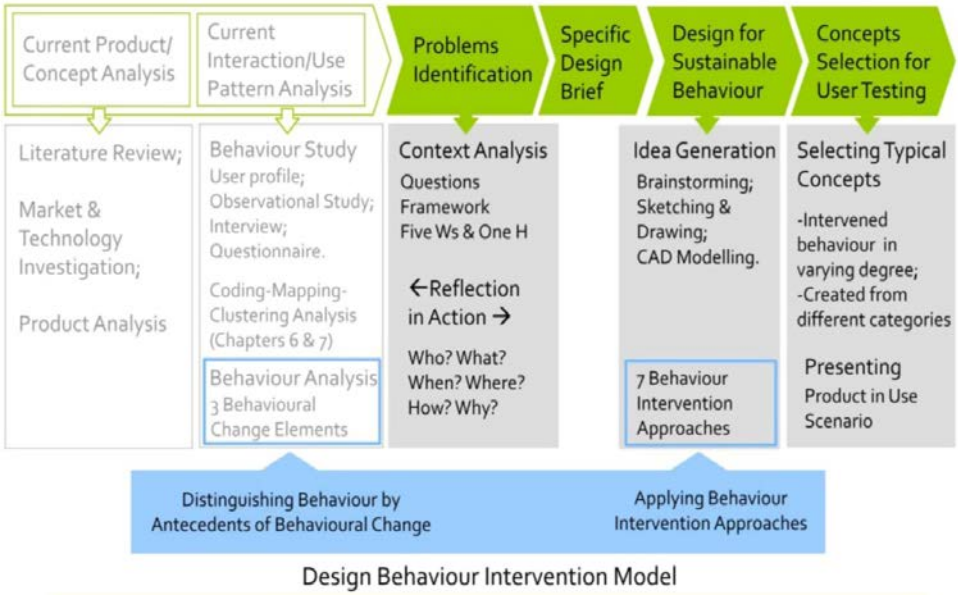

Figure 2: Design Behaviour Intervention Model Design Process (Tang and Bhamra, 2011)

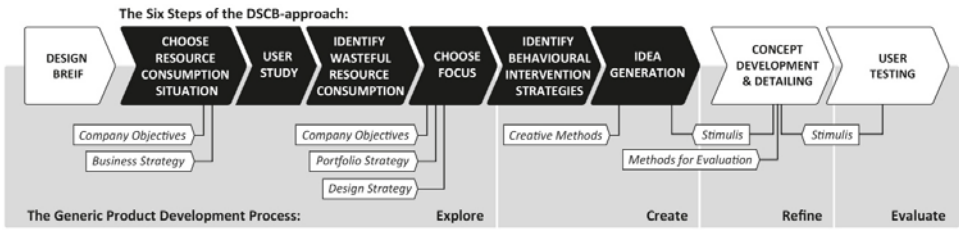

Figure 3: DSCB-approach Integrated into a Design Process (Selvefors et al., 2011)

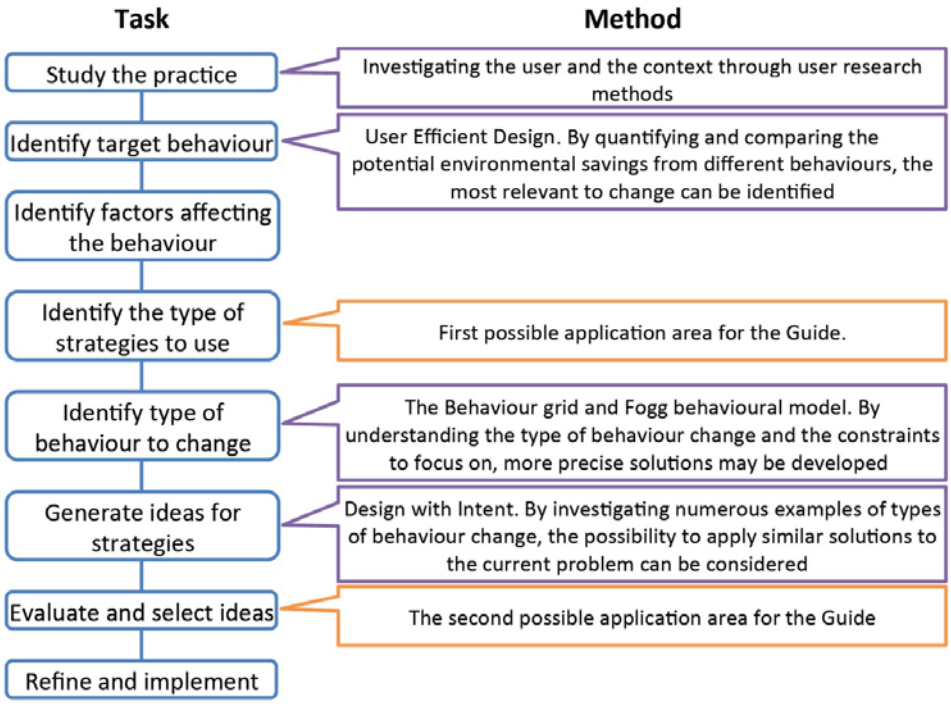

Figure 4: Zachrisson et al.'s (2011) Proposed Design Process (edited from original)

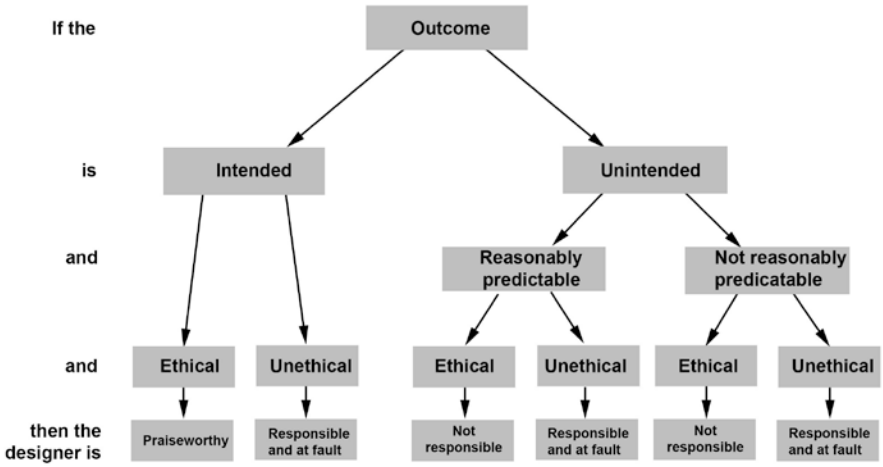

Figure 5: Flow chart (Berdichevsky and Neuenschwander, 1999, p. 55)

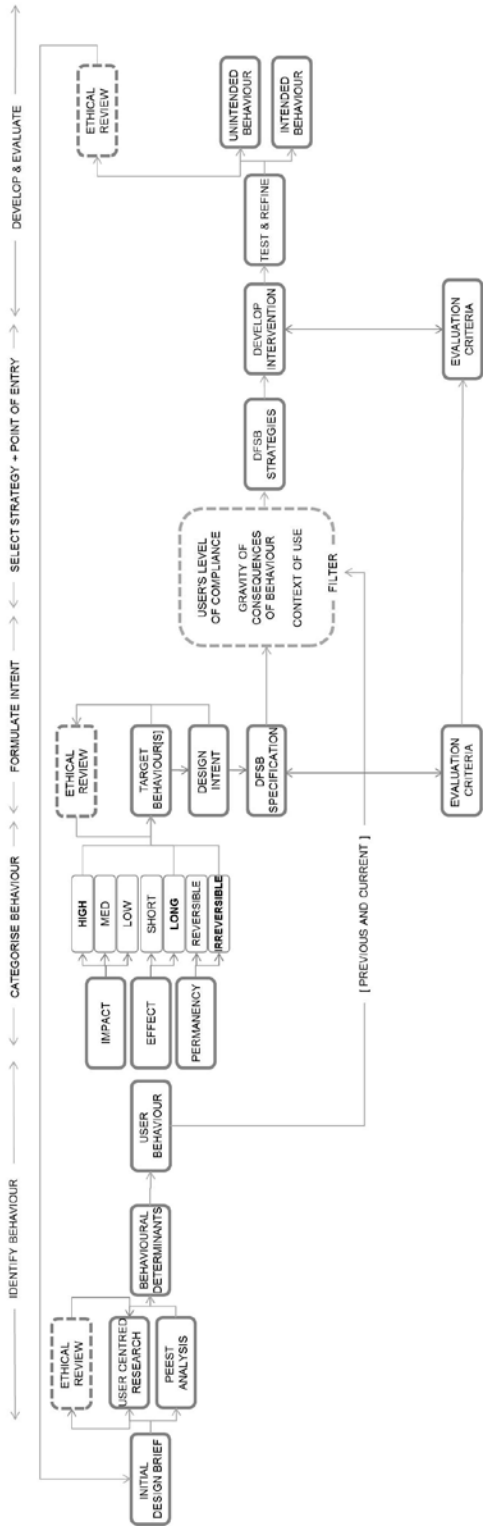

Figure 6: Design for Sustainable Behaviour: Process Diagram

Table 1: Ethical Assessment Matrix: A: Evaluation of Behaviours Identified

	IMPACT			EFFECT		PERMANENCY	
Behaviour identified through user observation studies	*L*	*M*	*H*	*Short Term*	*Long Term*	*Reversible*	*Irreversible*

Table 2: Ethical Assessment Matrix: B: Evaluation of Behaviours Identified

		SEVERITY			LONGEVITY		PERMANENCY		OCCURANCE		
How could the product/ system be used?	*What would be the impact/ consequences of this behaviour on stakeholders?*	*L*	*M*	*H*	*Short*	*Long*	*Reversible*	*Irreversible*	*L*	*M*	*H*

Table 3: Ethics – Evaluation Questions

Was the designer's original intent for designing a behaviour intervention ethical?
Was the designer's original motivation for designing a behaviour intervention ethical?
Are the intervention methods employed by the designer, in order to change the user's behaviour, ethical?
Has the designer/user/purchaser taken moral responsibility for the design intervention?
To what extent is the user in control of the design intervention?
Is the level of user control over the design intervention acceptably weighted against the intent and motivation of the designer?
Have the democratic decision making rights of all stakeholders been accounted for in the design process?
Have the values and morals of all stakeholders been accounted for in the design process?
Have the values of the stakeholder been evaluated against a robust ethical framework?
Are the intended outcomes of the design intervention ethical?
Have unintended interactions between the user and the design intervention been predicted and are ethical?
Have unintended use contexts involving the user and the design intervention been predicted and are ethical?