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The expert-layperson divide in design for sustainable behaviour: Related risks and the value of involvement

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Abstract

Individual behaviour is central to society's impact on the environment. Research suggests that to allow for sustainable development, consumption patterns must be changed. Means for change include policy, education, community-based social marketing and technology, with appeals calling for voluntary action frequently being applied, with limited success.

Research into design-led behavioural change has distinguished several strategies, differing with regards to the level of control and responsibility users are left with. A central dilemma is the trade-off between the long-term common good and individual autonomy, quality of life and democratic rights. Additionally, the difficulty of predicting actual use involves the danger that undesirable consequences may happen, while the complexity of sustainability issues makes much of the political debate and technology development inaccessible to consumers. Ways of dealing with these challenges may be found in the user-centred, user-involved and participatory tools and processes of design disciplines like interaction design and participatory design. The article addresses ethical issues arising when developing technologies intended to influence behaviour, and discusses how and to what extent adaptation and application of user-centred and participatory techniques can contribute to limiting such threats.

Keywords: Design for sustainability, behavioural change, ethics, participation.

1 Introduction

Consumer behaviour is central to society's impact on the environment, and fundamental shifts are needed in the ways societies produce and consume [1]. Drivers and mechanisms fuelling and sustaining individuals' willingness to consume range from the macro-economic setup of society and socio-technical systems to some extent locking us into certain consumption patterns, to socio-psychological factors such as attitudes, values, intentions, needs, habits and routines at the level of individual human beings [2][3]. Intervention strategies for behavioural change include policy, educational programmes, community-based social marketing and technology [3]. Information has proven not to be enough to change behaviour [3][4][5], while holding pro-environmental attitudes not necessarily translates to pro-environmental action [3]. For many durable consumer products, the environmental impact is largest in the user phase [6], and individuals' use patterns determine how sustainable they really are [4]. Research into technological influence on behaviour has identified opportunities for products and systems triggering sustainable use [4]. However, the complexity of factors influencing behaviour makes it difficult to predetermine use and predict effects. Verbeek [7] argues that three types

of agency are involved in all human actions and interpretations informing decisions on how to act: That of (1) the human being, (2) the artefact mediating the human's actions and decisions, and (3) the designer shaping the artefact's mediating role. One might add the agency of experts informing designers and politicians and managers providing constraints and requirements shaping design projects. Thus, while calls for voluntary behavioural change have limited effect, more intrusive, technology-based efforts can involve ethical dilemmas, threaten democracy and individual freedom and have unexpected, undesirable consequences.

Simultaneously, user-centred design disciplines such as interaction design and participatory design are equipped with tools and methods for democratic input to development, and for tests or assessments of concepts during development. User-centred design aims for fit between users' needs and expectations and result, and places emphasis on making products usable and understandable [8]. This raises questions about the possibilities for reducing risks by democratising design for behavioural change through lay involvement, drawing on user-centred design disciplines, as well as to what extent lay involvement is desirable in the development process and what degree of user control is appropriate in the user phase.

Based on theoretical perspectives on design influencing behaviour, technocracy and attempts to establish ethical frameworks for technologies developed to steer or change behaviour, the following issues are discussed: Which ethical issues arise when aiming for technology-driven behavioural change? How and to what extent can drawing on user-centred, user-involved or participatory techniques and processes help improving solutions and reducing risks related to design for sustainable behaviour?

2 Design for behavioural change and the underlying problem

Much has been written about the interaction between people and technology. Using a term from the philosophy of technology, 'technological mediation', Verbeek [7] describes how users must interpret and appropriate technologies in order to use them. Technological mediation has a hermeneutic, experience-oriented and a pragmatic, praxis-oriented dimension: The former is related to the shaping of human perception and interpretation; the latter to mediation of actions and practices [7]. Behaviour-steering technology provides material answers on how to act [9]. Verbeek [7] identifies three forms of behaviour-steering mediation: Persuasion – e.g. through feedback, seduction – making certain actions more attractive, and force – leaving the user with no choice but to do as indicated by the technology. Lilley *et al.* [4] present a different division, distinguishing between eco-feedback, scripts or behavioural steering and intelligent products or systems. Both authors can be said to categorise strategies according to the distribution of control between technology and user, with technology in charge in the 'force' and 'intelligent products or system' groups, and the user in the 'persuasion' and 'eco-feedback' categories. Relevant for Verbeek's [7] 'persuasion' and Lilley *et al.*'s [4] 'eco-feedback' is 'persuasive technology', defined by Fogg [10] as any interactive computing system designed to change people's attitudes, behaviours or both. The term 'scripts' denotes the preferred interpretations or frameworks for action 'inscribed' or 'encoded' into objects by their designers [11], by Latour [12] described as the moral and ethical dimensions of mechanisms. Not just force, but also values, duties and ethics can be delegated to technology. Scripts may obstruct unsustainable use or facilitate sustainable use to extents where actions are performed almost without thinking. Their properties include force, scale or level of complexity, direction and distribution of tasks, responsibility and power [13]. A related concept is 'affordances', combinations of physical product properties providing users with clues on how to act, without intervention from cognition or evaluation [8]. Other authors propose strategies for strengthening the emotional tie between product or system and user and optimising psychological product lifetime through attention to shapes and surfaces, signs and scripts, sales and service [14], and – based on the assumption that consumption can

reach a level of saturation, using happiness as an indicator for development – by shifting to development of products and systems that satisfy fundamental human needs [15].

Behaviour-steering technology has been criticised for its potentially technocratic foundation. A technocracy is a society or organisation managed by scientists, engineers and other experts [16], based on scientific principles and technological means [17]. In technocratic problem-solving, technical solutions replace political decisions. It is seen as problematic because it is not democratic and based on the idea that technological solutions can solve social problems [17]. Gibbons [18] describes what he calls the new social contract between science and society, a consequence of how boundaries between university and academic science and basic and applied research are disappearing, and science and society are invading each others domains. The contract is based on a transition from 'reliable' to 'socially robust' knowledge; knowledge produced in a transparent, participatory way [18]. The social robustness refers to a contextualisation process: Knowledge must be valid also outside laboratories, and the validity is achieved by involving a broader group of experts, including lay 'experts' [18]. Problems are no longer simply formulated and negotiated in institutional settings, but also in the public space [18]. When society participates in the generation of knowledge, it is less likely to be contested than the purely 'reliable' one [18]. With science and technology seen as socially shaped in processes of confrontations between humans and nature involving choices of values and interests, there is no longer a perceived fundamental contradiction between political and technological solutions [17]. Hence, democratic development processes may contribute to reducing the threat of technocracy in behaviour-steering technology.

Current approaches and practices in ecodesign or design for sustainability range from the technocratic to the democratic. Parts of the foundation for ecodesign is truly technocratic and based on processes where experts have been decision-makers and lay engagement, if taking place, has focused on non-technical issues such as ethics [19]. The other extreme is lay-people exercising strong influence in traditionally expert-dominated territory.

3 Ethical questions arising

Despite good intentions, technology designed to optimise human behaviour according to sustainability criteria may be ethically questionable. Ethics is referred to as the philosophical study of normative behaviour, of right and wrong conduct [20]. Among relevant dilemmas is the trade-off between what is good for our long term interests or overarching goals and what is right in the moment. Consequentialist or utilitarian ethics evaluate behaviours based on the right- or wrongness of results; deontological or duty ethics focus on the moral value of the act and intentions behind it, evaluated according to values like human autonomy and only secondarily according to outcomes [20][21]. Act-based utilitarianism evaluates actions studying their consequences according to criterion such as human happiness or well-being [22], rule-based utilitarianism evaluates consequences of following general rules restricting behaviour while welfare utilitarianism is concerned with the satisfaction of people's long-term interests [20]. Utilitarianism has been criticised for not adequately ensuring justice when maximising good over bad; critics of duty ethics uphold that legalistic, narrow application of norms has no reference to real-life consequences, and that different duties may conflict [20]. What is 'right' conduct may thus be a question for debate: Utilitarians in favour of immediate action to protect our long-term welfare from the global effects of unsustainable behaviour could accept limitations to individual freedom, while for duty ethicists seeing restrictions to human autonomy as invariably unacceptable, such intervention would remain taboo. Next, some ethical issues arising in relation to behavioural steering and persuasion are addressed.

3.1 Democracy and individual freedom

Technological behaviour-steering or persuasion may be perceived as threats to individual freedom and rights; as anti-democratic forces where designers rather than democratically

elected representatives steer behaviour [7]. Behaviour-steering technology may restrict freedom in two ways [17]: By interfering with users' activities, or by restricting users' autonomy, shaping and conditioning plans and goals. The first category includes speed bumps making drivers slow down; the second could include cars choosing when to drive and at what speed, based on government policies [17]. With behaviour-steering technologies, the aim is to make individuals behave in accordance with the intentions of someone else, and, in the case of feedback and persuasion, to convince users into adopting their goals and values. The amount, type and format of information provided can be used to manipulate individuals into action or inaction or adopting certain beliefs and attitudes. Misuse of behavioural steering is imaginable, as well as application of problematic methods of persuasion.

To debate and determine under what circumstances and to what extent restrictions of human freedom can be justified, the benefit of the common good must be traded off against the cost to individual liberty and other negative impacts [17]; whether what is 'good' for long term welfare is more important than what is 'right' in the moment. Even when resistance towards it exists, behaviour-steering technology can be democratically justified. Examples include how several countries have prohibited smoking in public space through their democratic political system. Berdichevsky and Neuenschwander [22] propose eight 'Principles of Persuasive Technology Design', a framework for analysing persuasion according to motivations, methods and intended and unintended outcomes [22]. According to Verbeek [7], it does not sufficiently address designers' responsibility for unintended outcomes.

3.2 Technological solutions to social problems

Trying to solve social problems with technology, unanticipated and unintended consequences can occur in spite of a democratic technology development process. Khaled *et al.* [23] address the difference between individualist and collectivist cultures: Most persuasive applications are developed for national markets in the USA, often rated as the most individualist country. Persuasive strategies may rely on individual responsibility, which is generally less developed in members of collectivist societies. Making such products available elsewhere, the persuasive strategies may not translate as effectively as they are related to cultural norms [23].

The danger of misfits between developers' expectations and actual consequences is not just the risk of persuasive strategies not working. Rebound effects are unintended outcomes or offsets in effects of measures taken to protect the environment, caused by behavioural or other systemic response [24]. Greening *et al.* [25] distinguish between (1) direct rebound effects, (2) secondary fuel use effects, (3) market-clearing price and quantity adjustments or economy-wide effects and (4) transformational effects. Direct rebound effects limited to the individual household level are decomposed into substitution effects and income effects. Slob and Verbeek [26] list three groups: (1) Increased use or how introduction of more energy-efficient technologies may give increased energy consumption includes how people offset the effects of efficiency improvements in washing machines by washing smaller quantities of laundry more often [26]. (2) Bypassing or not using technology is seen when people invent ways of escaping automatic control systems for heating or lighting to be in charge themselves [26]. (3) Unintended use is for example how people open windows to ventilate in energy-efficient houses with self-regulating systems for ventilation and temperature control [26].

Innovation levels determine the potential efficiency improvement factor of pro-environmental efforts. Improvements of a factor 4-20 are thought necessary to make production and consumption sustainable [27]. In radical design – radical in terms of structure, function or design criteria, standards and codes of 'normal' design are often not applicable [28]. Hence, designers can neither turn to regulations nor previous practice when transforming criteria into solutions or trading off between criteria [28]. Complex products introducing new technology generate alternative interpretations [29]. Radical design thus implies larger degrees of

uncertainty regarding social effects [28]. For new technology and higher innovation levels, there is more uncertainty and the challenge of predicting effects and assessing ethical issues greater, making questions about responsibility for intended and unintended outcomes relevant.

3.3 The distribution of responsibility

Delegating decisions to products and systems means blurring and complicating the distribution of responsibility for actions and their consequences [17]. Things shape how people experience the world and organise their lives – how humans relate to each other and to artefacts and whether it happens consciously and intentionally or not, and designers are responsible for making it happen in a desirable way [21]. Artefacts cannot make deliberate decisions about their influences on human action: Such influence cannot be characterised in terms of morality, and artefacts cannot be held responsible for their behaviours [21]. Things do nevertheless play a mediating role when mediation of moral considerations is delegated to them – when public benches split into separate seats stop people from lying down, or arise implicitly – when genetic tests reveal diseases a person is hereditarily predisposed for, thus contributing to a moral evaluation [21]. Products play a mediating role in people's moral considerations, and the design process can involve moral choices regarding the mediating role. The challenge is to anticipate and adapt it. Failing to recognise the moral aspects of things leads to technocracy [21]. However, as artefacts are what they are only thanks to their contexts and their mediating role arises in people's relations with them, it is difficult, but not impossible, to predict. This is related to what is called the multi-stability or interpretive flexibility of things [21]. With conventions, some stability arises, but, as mentioned, for higher levels of innovation and new product categories, the predictability is lower.

This chapter has addressed ethical dilemmas and the difficulty of predicting processes of contextualisation. The next looks at how participatory development processes can contribute to development of socially robust, ethically justifiable design for sustainable behaviour.

4. The potential of lay involvement and user-centred design

4.1 Democratic input to development

Verbeek [9] stresses the importance of finding democratic ways to 'moralise' technology. Taking moralisation and development of behaviour-steering technology 'into the agora' [18], may increase the probability that technologies will be socially robust and not contested later on. What potential lies in user-centred and user-involved design's methods and processes?

The main advocate for democratic input to design is the participatory design movement. It represents a strong-democratic approach to decision-making in technology development, seeking to actively engage laypeople in the design of products and systems [19]. Participatory design stresses empowerment of laypeople, the importance of the local and organisational democratisation reforms [19]. Empowerment enables stakeholders to share responsibilities and privileges traditionally belonging to professionals. Local rooting means adapting techniques to particular people, institutions, cultures and economics. Projects are shaped by their organisational context, and depend on truly being embedded in it to be sustained [19]. Hence, organisational reforms towards greater democratisation are important goals. Participatory design is applied in different fields – from politics and community development to information technology, and levels of participation vary. Arnstein [30] sorts them into three groups: (1) 'Nonparticipation' in terms of 'manipulation' and 'therapy', (2) 'degrees of tokenism' with the steps 'informing', 'consultation' and 'placation' and (3) 'degrees of citizen power' split into 'partnership', 'delegated power' and 'citizen control' [30]. A similar system from science and technology ranks participation from a 'low degree' of citizen involvement to direct involvement in research practices, challenging rules of scientific methods [31]. Different levels are appropriate at different times to meet the expectations of different stakeholders, and may vary both within a development process and according to scientific

culture [31]. In natural sciences and engineering, participation has traditionally been low and limited to the final stages; in medicine and biomedicine people are often involved earlier and to a higher extent [31]. Participatory assessments of new technology often happen at final stages of development. Chilvers [32] warns against the 'technocracy of participation': Participation is no guarantee for democratic and transparent assessment. Making lay stakeholders participate does not automatically mean they have the means for bringing up their concerns [31]. Hierarchical power relations [31] and value differences among stakeholders are challenges to participatory decision-making. Participation is exposed to the same problems, deficiencies and critiques as science, and not immune to disempowerment and exclusion [32]. Participatory approaches do however offer opportunities for emphasising diversity, for including and considering the perspectives, needs and often opposing interests of all stakeholders, also groups either marginalised by design or excluded from public debates and technology development – like women, immigrants, elderly, disabled, sick or young.

Lack of transparency is ethically problematic when forcing actions and choices upon people, but also when persuasive technologies shape experiences and interpretations intended to inform and trigger specific behaviours. Openness regarding the assumptions and uncertainties determining results is particularly important for feedback on behaviour. A technology may be developed in a democratic way, but the foundation for the persuasion or behaviour-steering can be truly technocratic. Howard [19] lists industrial ecology as example of ecodesign's technocratic foundation where lay involvement in decision-making is a great challenge. Industrial ecology experts' calculations, interpretations and priorities are rooted in engineering and natural sciences and aim for reduced cradle-to-grave environmental impact through material and process assessments [19]. When their calculations are used in carbon calculators, results depend on system boundaries, methodology and correctness of data [33]. As no standardised framework exists for calculation of 'ecological footprints' and different systems emphasise different actions and intervention areas, information on the environmental consequences of a lifestyle differs largely between applications [33]. Lack of transparency can thus threaten the credibility of environmental sciences or give users wrong ideas about the impact of their lifestyle and their possibilities for reducing it. Frustration or inability to follow advice may reduce receptivity for similar requests or information, people may rationalise their inaction or develop aversions [33]. Howard [19] argues that involvement of lay 'consultants' may give industrial ecology a slightly more participatory orientation, but not enough to alter its technocratic character. Openness about preconditions and boundaries for calculations used in persuasive and behaviour-steering designs should however be a minimum requirement, and how to communicate them openly could be an issue for such lay consultants to address.

4.2 Empowerment by enhancing understanding

Philosopher Achterhuis argues that artefacts should be moralised and decisions delegated to devices to relieve people from the burden of continuously having to reflect upon their actions [21]. Intelligent products and systems can optimise their behaviour according to sustainability criteria without users even noticing it, like TV sets with light sensors adjust brightness settings according to the surroundings' light conditions. However, relieving human cognition may prevent consumers from recognising and learning about sustainability issues, making persuasive technologies a source of moral laziness [7]. Thøgersen and Ölander [34] have identified spillover of environment-friendly behaviour between behavioural categories. Based on research on habitual decision-making, they state that the probability that an environmentally benign behaviour in one area will make a person reflect on behaviours in other domains is lower the more habitually the other behaviours are performed [34].

Designers increasingly employ ethnographic methods to further understand and get closer to delivering what future users want and need [35]. Redström [29] criticises the optimisation of

fit between use and users for systematically eliminating the opportunities for alternative interpretations, over-determining use and obstructing creativity and improvisation. Verbeek [21] calls for a shift towards transparent products actively engaging users in their functioning, like toilets with two flush modes require a conscious choice. This may conflict with usability goals aiming to enable specific users to use products to achieve specific goals with effectiveness, efficiency and satisfaction. Designers may also apply their skills in translation of abstract ideas or complex information to comprehensible physical shapes and graphical interfaces; facilitate the hermeneutic dimension or how reality is perceived and interpreted [7]. Information visualisation aims to augment people's understanding [36], and used strategically it can bridge the perceived gap between individual actions and global sustainability challenges. This includes opportunities for providing appropriate foundations and contexts for interpretation of results fed back to users – avoiding that people see their possibilities for contributing as insignificant and worthless [37], and for communicating underlying calculation principles and system boundaries, as discussed in the previous section.

4.3 Preventing undesirable outcomes

To make it likely that a technology will work and rebound effects will not occur, designers should establish a connection between the contexts of design and use [9]. That is the aim of user-centred approaches, characterised by (1) early focus on users and tasks, (2) empirical measurement and (3) iterative cycles of design, test, measurement and redesign [38]. Future users are involved to improve developers' insight into their needs and goals, to manage expectations and establish feelings of ownership [38].

Redström [29] argues that making potential users and domain experts 'designers' does not wipe out uncertainties or the difficulty of predicting the future, but sees user-involvement as an opportunity to pass questions about use on to future users. Verbeek [7] states that it should be part of designers' moral responsibility to carry out a mediation analysis or reflect explicitly on all possible mediation roles of persuasive or behaviour-steering technologies: Designers should use their imagination to create a link to the technology inserted in a future use context. Alternatively, they can apply the method of 'constructive technology assessment', involving stakeholders in the design of technologies [9]. The method is based on collective meetings with all relevant stakeholders, aiming for consensus about the technology and its properties [9]. Participants are also invited to anticipate the technology's possible mediating roles in a use context. Results from the systematic assessment are fed back into the process and used to modify the design [9]. This kind of procedure may complement user-centred and user-involved processes, as it emphasises assessment of all aspects of technological mediation and involves all stakeholders, not just future users. Careful assessment, openness and transparency is necessary to ensure that persuasive and technology-steering technologies work right, are reliable and that legitimate violations of freedom are distinguished from illegitimate ones.

5 Conclusion

The rationale behind design for sustainable behaviour lies in the grave global effects of unsustainable consumption, calling for immediate, fundamental shifts in consumption patterns and resource distribution. However, individual freedom is a taboo area for political intervention. It constitutes a major barrier to sustainability efforts depending on politicians taking the lead and industry acting proactively, both being under scrutiny of the main public. Investigating how to eradicate such barriers and influence individual behaviour positively without compromising freedom and rights may be a task for designers and design researchers.

The article has addressed the gap between experts, stakeholders and future users in design of technology for behavioural change: The danger of technocracy, ethical violations and solutions not working as intended, how stakeholder involvement, openness and transparency can be ways of overcoming or reducing the threats and how developers should strive for such

practices both regarding scientific foundations for development, the design process itself and the final technology to be implemented in a use context. User-centred, user-involved or participatory design processes can be ways of reducing the gap between designers' intentions and actual use contexts, and provide arenas for moral assessment of persuasive and behaviour-steering designs. Systematic assessment involving all relevant stakeholders throughout the development is likely to contribute to social robustness and ethically justifiable technological means for approaching sustainability goals. Involvement of stakeholders is however no guarantee that persuasive or behaviour-steering solutions will work as intended.

There are advantages and disadvantages to each level and way of involving laypeople in development. Their appropriateness may depend on a project's scope and resources, and the number and characteristics of its stakeholders. Generally, participation leads to greater accommodation of social needs [39], and lay co-designers may facilitate thorough debates, expectation management and acceptance. However, research suggests that high degrees of user involvement can reduce a project's success rate, flexibility, effectiveness and number of innovations [38]. Others state that whether or not to involve users is not the question, but how and at what stage [38]. Aiming for a sense of ownership, acceptance or self-propelling project execution, it makes sense to allow for substantial lay involvement where important decisions are made and the room for change is largest. However, 'real' participation can be hard to achieve. Challenges include beliefs that participation threatens existing hierarchies, and to provide stakeholders with the means for expressing their concerns. Ideally, participatory techniques and approaches should be adapted to particular people, institutions, cultures and economics. As mentioned, industrial designers are skilled at transforming abstract concepts and complex information into visual representations and physical shape. However, translating and simplifying jargon, technical schemes or political structures to fit the knowledge and experience of laypeople leaves their understanding and influence in the hands of designers and facilitators. Sanoff [39] claims the major source of participant satisfaction to be the feeling of influence in decision-making, and not the extent to which solutions meet individual needs. This may be misused to create illusions of substantial participation [39]. Regarding the technology being developed and how to test concepts, different kinds of setups and formats are appropriate at different stages, with degrees of formality and completeness varying. Whom and how many to test concepts on – fellow experts or representative selections of future users, depends on project scope, phase and what is thought needed to resemble actual use and reveal major flaws. Thus, careful analysis is needed to determine involvement levels and how to provide participants with both understandable development processes and design concepts, in order to avoid the risks and limitations of user involvement and enable concerted assessments that can reduce the threats involved in design-led behavioural change.

The strategies presented in chapter 2 differ with regards to the distribution of control between designer, technology and user; whether they aim for voluntary behavioural change or force behaviour upon people, and whether the persuasion or behaviour-steering is active or passive. A central question is for which products and systems and under what conditions the different strategies should be applied. Decision-makers – experts or laypeople – should base choices on analyses of the behaviours that are to be changed or adjusted. The full picture should be considered, including users' characteristics, tasks and cognitive load in the situation of use, contextual aspects and other limitations and opportunities for facilitation of sustainable behaviour. One extreme is application of intrusive strategies that for example through feedback on systems' status or automatic unsustainable actions 'unfreeze' behaviour, raising it to a discursive level where alternatives can be evaluated [3]; the other is intelligent products and systems optimising their performance unnoticed. Users cannot be expected to reflect actively upon every action, but cannot be provided with technological fixes for every situation either. To propose guidelines on the balance of control and freedom in such solutions, further

research is needed. Research is also needed regarding their efficiency in different cultural contexts, and how to predict actual use on higher levels of innovation.

References

[1] United Nations (2002): "Report of the World Summit on Sustainable Development", Johannesburg, South Africa, United Nations publication, New York.

[2] Røpke, I. (1999): "The dynamics of willingness to consume", *Ecological Economics*, Vol. 28, No. 3, March 1999, 399-420(22).

[3] Jackson, T. (2005): "Motivating Sustainable Consumption: A review of evidence on consumer behaviour and behavioural change", A report to the Sustainable Development Research Network, University of Surrey, Guildford.

[4] Lilley, D.; Lofthouse, V.; Bhamra, T. (2005): "Towards instinctive sustainable product use", 2nd Int. conference: Sustainability Creating the Culture, Nov. 2-4, Aberdeen. Available from: http://hdl.handle.net/2134/1013 (accessed 23.06.2008).

[5] Chess, C.; Johnson, B. B. (2007): "Information is not enough", Moser, S. C.; Dilling, L. (Eds.): "Creating a Climate for Change: Communicating Climate Change and Facilitating Social Change", Cambridge University Press, pp. 223.

[6] Brezet, H.; van Hemel, C. (1997): "Ecodesign: A Promising Approach to Sustainable Production and Consumption", Paris, UNEP.

[7] Verbeek, P.-P. (2006b): "Persuasive Technology and Moral Responsibility: Toward an ethical framework for persuasive technologies", Persuasive06. Available from: http://www.gw.utwente.nl/wijsb/medewerkers/verbeek (accessed 23.06.2008).

[8] Norman, D. A. (1988): "The Design of Everyday Things", Doubleday/Currency.

[9] Verbeek, P.-P. (2006a): "Materializing Morality: Design Ethics and Technological Mediation", *Science Technology Human Values* 2006; 31; 361.

[10] Fogg, B. J. (2003): "Persuasive Technology: Using Computers to Change What We Think and Do", Morgan Kaufmann Publishers, San Francisco.

[11] Akrich, M. (1992): "The De-Scription of Technical Objects", Bijker, W. E. and Law, J. (Eds.) (1992): "Shaping Technology/Building Society: Studies in Sociotechnical Change", Cambridge, Ma: MIT Press, 205-224.

[12] Latour, B. (1992): "Where Are the Missing Masses? The Sociology of a Few Mundane Artifacts", Bijker and Law (Eds.) (1992): "Shaping Technology/Building Society: Studies in Sociotechnical Change", Cambridge, Ma: MIT Press, 225-258.

[13] Jelsma, J. (2006): "Designing 'Moralized' Products: Theory and Practice", Verbeek, P.-P.; Slob, A. (Eds.): "User Behaviour and Technology Development", Springer, 221-231.

[14] Muis, H. (2006): "Eternally Yours: Some Theory and Practice on Cultural Sustainable Product Development", Verbeek, P.-P.; Slob, A. (Eds.): "User Behaviour and Technology Development", Springer, 277-293.

[15] Hofstetter, P.; Madjar, M.; Ozawa, T. (2006): "Happiness and Sustainable Consumption: Psychological and physical rebound effects at work in a tool for sustainable design", *International Journal of LCA*, Special Issue 1 (2006), 105-115.

[16] Elzinga, A.; Jamison, A. (1995): "Changing Policy Agendas in Science and Technology", Jasanoff, S.; Markle, G. E.; Petersen, J. C.; Pinch, T. (Eds.): "Handbook of Science and Technology Studies", Sage, Thousand Oaks, California, 572–597.

[17] Brey, P. (2006): "Ethical Aspects of Behaviour-Steering Technology", Verbeek, P.-P.; Slob, A. (Eds.): "User Behaviour and Technology Development", Springer, 357-364.

[18] Gibbons, M. (1999): "Science's new social contract with society", *Nature*, Vol. 402, Supp, 2 December 1999, 11-17.

[19] Howard, J. (2004): "Toward Participatory Ecological Design of Technological Systems", *Design Issues*, Vol. 20, No. 3, Summer 2004, 40-53.

[20] Peach, L. (1995): “An Introduction to Ethical Theory”, Penslar, R. L. (Ed.): “Research Ethics: Cases and Materials”, Indiana University Press, Bloomington, 13-26.
[21] Verbeek, P.-P. (2005): “What Things Do: Philosophical Reflections on Technology, Agency and Design”, The Pennsylvania State University Press.
[22] Berdichevsky, D.; Neuenschwander, E. (1999: “Toward an Ethics of Persuasive Technology”, Communications of the ACM, Vol. 42 (5), 51-58.
[23] Khaled, R.; Barr, P.; Noble, J.; Fischer, R.; Biddle, R. (2006): “Our Place or Mine? Exploration into Collectivism-Focused Persuasive Technology Design”, IJsselsteijn, W. *et al.* (Eds.): PERSUASIVE 2006, LNCS 3962, 72-83.
[24] Hertwich, E. (2005): “Consumption and the Rebound Effect: An Industrial Ecology Perspective”, *Journal of Industrial Ecology*, Vol. 9, No. 1-2, 85-98.
[25] Greening, A. L.; Greene, D. L.; Difiglio, C. (2000): “Energy efficiency and consumption – the rebound effect – a survey”, *Energy Policy* 28 (2000), 389-401
[26] Slob, A.; Verbeek, P.-P. (2006): “Technology and User Behavior: An Introduction”, Verbeek, P.-P.; Slob, A. (Eds.): “User Behaviour and Technology Development”, Springer, 3-12.
[27] Knot, M.; Luiten, H. (2006): “User involvement in the development of sustainable product-service systems: The Case of the Personal Mobility System “Mitka””, Verbeek, P.-P.; Slob, A. (Eds.): “User Behaviour and Technology Development”, Springer, 263-276.
[28] Poel, I. van de; Gorp, A. C. van (2006): “The Need for Ethical Reflection in Engineering Design: The Relevance of Type of Design and Design Hierarchy”, *Science, Technology, & Human Values*, Vol. 31, No. 3, May 2006, 333-360.
[29] Redström, J. (2006): “Towards user design? On the shift from object to user as the subject of design”, *Design Studies*, 27 (2006), 123-139.
[30] Arnstein, S. (1969): “A ladder of citizen participation”, *Journal of the American Planning Association*, 35:4, 216-224.
[31] Lengwiler, M. (2008): “Participatory Approaches in Science and Technology: Historical Origins and Current Practices in Critical Perspective”, *Science Technology Human Values* 2008; 33; 186.
[32] Chilvers, J. (2008): “Deliberating Competence: Theoretical and Practitioner Perspectives on Effective Participatory Appraisal Practice”, *Science Technology Human Values* 2008; 33; 155.
[33] Hertwich, E.; Larsen, H. N.; Pettersen, I. N.; Solli, C. (2008): “Climate calculators and expert systems: Design and calculation”, Proceedings: Sustainable Consumption and Production: Framework for action, 10-11 March 2008, Brussels, Belgium, 163-180.
[34] Thøgersen, J.; Ölander, F. (2003): “Spillover of environment-friendly consumer behaviour”, *Journal of Environmental Psychology* 23 (2003), 225-236.
[35] Shove, E.; Watson, M.; Hand, M.; Ingram, J. (2007): “The Design of Everyday Life”, Berg, Oxford.
[36] Heer, J.; Card, S. K.; Landay, J. A. (2005): “prefuse: A Toolkit for Interactive Information Visualization”, CHI 2005, Papers: Interactive Information Visualization, April 2-7, Portland, Oregon, USA, 421-430.
[37] Bottrill, C. (2007): “Internet-based tools for behaviour change”, Proceedings, European Council for Energy Efficient Economics (ECEEE) Summer Study, France.
[38] Preece, J.; Rogers, Y.; Sharp, H. (2002): “Interaction design: beyond human-computer interaction”, John Wiley & Sons, Inc.
[39] Sanoff, H. (1985): “The application of participatory methods in design and evaluation”, *Design Studies*, Vol. 6, No. 4, October 1985, 178-180.