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DESIGNING PERSUASIVE SYSTEMS FOR SUSTAINABILITY– A COGNITIVE DISSONANCE MODEL[1]

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Abstract

One of the major challenges in changing human behavior is dealing with the large gap between our action and its consequences. Persuasion for sustainable action is a complex and long procedure since changing the behavior for the benefits of collective society rather than the individual is a challenge. Although several design principles have been derived for the ease of persuasive system design, no specific principles have addressed the goal of persuasion to be sustainable. In this paper we have proposed design principles for persuasive system design for sustainability. We also have proposed a cognitive dissonance model to show how these principles can work from a psychological incentive. Success of sustainability through persuasive system design (PSD) can be triggered by following the model in design procedure that focuses on reducing individual dissonance towards changing a specific target behavior for society.

Keywords: Persuasive technology, Design principles, Cognitive dissonance model, Sustainable HCI.

1   Introduction

Sustainability in the field of human-computer interaction (HCI) research has been a popular topic of interest in recent years, in which designing systems to change user behavior towards a sustainable action is one of the primary goals. Notions like "green design", "green technologies", and "green engineering" are therefore not relatively new. While green design considers changing people's habits and thus reducing our ecological impacts, a powerful strategy of using persuasive design towards achieving green design is yet to be practiced thoroughly (Fogg, 2003). Several persuasive system design principles exist, although no design principles aiming for designing persuasive systems for sustainability are evident today, not even in the form of any theoretical framework. Since persuasion for sustainability is an issue that in many different ways is directly associated with users and their behavior, a user-centered reflection through the design principles for sustainability research is essential. Also sustainable HCI research seems to be occupied within the scope of sustainable interaction design only, although regarding user and system interaction a lot more could be done within the context of sustainability. Since many sustainability researches focused only on the supply side by neglecting the user side research, it is thus essential to understand users' characteristics, their needs, and skills. In a nutshell, a user-centered approach for improved design for sustainability solution is necessary (Wever et al., 2008). In this paper, five design principles intended for persuasive system design targeting sustainability are suggested, focusing on the user understanding. With appropriate design principles in hand, it is, however, also important to realize how the principles will work in practice, to encourage the users' behavior in the direction of sustainability. The cognitive dissonance theory by Festinger (1957) refers to how we use our inner drive for altering our attitude towards making a decision. Reducing the gap between two conflicting behaviors is usually done by alteration of our attitude. Also, Cooper and Fazio (1984) found that responsibility for an aversive event is one of the major factors in producing cognitive dissonance (Cooper and Carlsmith, 2001). We used these arguments as the basis of proposing a cognitive dissonance model to demonstrate how our proposed design principles can be used to reduce gaps between the users' conflicting attitudes,

allowing them to make decisions on altering their attitude, and reducing undesirable consequences towards sustainable behaviors. The underlying research question considered in this paper is: 'What are the design principles for designing persuasive systems aiming for sustainability and how do they fit in a cognitive model to be used in practice?' The design principles were derived by means of a combinatorial approach. Three theoretical foundations were used as our basis of design principles derivation. Five unique design principles were established from these three theoretical frameworks and were presented in Section 3. We then argued how these design principles could work towards achieving sustainability in controlling the users' dissonance by proposing a cognitive dissonance model for sustainability, presented in Section 4. Finally, limitations and future research possibilities were discussed.

2   Background

Persuasive design is relatively a new research field in which persuasion is the engagement of communicating deliberately with a clear purpose and outcome in mind (Tørning and Oinas-Kukkonen, 2009). Persuasion can also be seen as any intentional communication. HCI researchers are often interested in how humans might be enabled to design computer systems that are understandable and usable, and how information could be collected for that kind of design. Therefore cognitive models are created to allow interaction (communication) between man and machines. Our perception of sustainability is based on the world commission on environment and development's definition: "that it meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Sustainability is therefore the work towards minimizing or reversing the impact of different processes on sustainability, both present and future. This has implications for generational consideration and resource allocation among the living. Research dealing with only a component of sustainability is accelerating in many research fields including HCI (Dao et al., 2011), now one of the fastest growing research areas in HCI (DiSalvo et al., 2010). The sustainability research in information technology is often labeled as "green IT" and research in sustainable HCI is also focused on issues like reducing greenhouse emission and the use of resources through the design of artifacts to change the individual's consumption and choice behavior (Dao et al., 2011; Dourish, 2010). Studying user behavior has thus always been a major issue for successful design and designing for sustainability is not an exception in this case. Depending on technology and design, different persuasive goals can be attained. Thus using persuasive technology to change people's behavior towards sustainable goals in an effective way is highly conceivable. An effective persuasive system must therefore be appropriately designed if sustainable goals are to be reached, since to pursue the desired goals a persuasive design approach is necessary. At the same time, the Fogg Behavior Model (FBM) is shown in Figure 1, which has three principal factors: motivation, ability, and triggers. A "trigger" must be presented if a target behavior is to occur (Fogg, 2009).
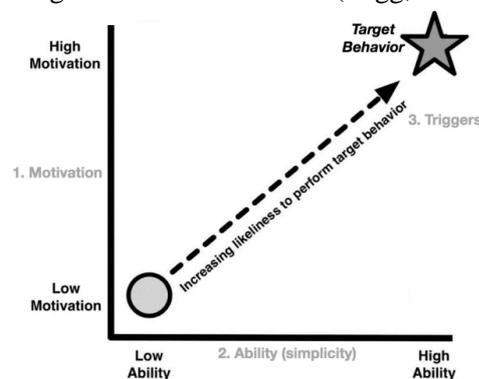

Figure 1:   Fogg's three factor behavior model: motivation, ability, and triggers (Fogg, 2009).

According to Fogg (2009) both motivation and ability must exist for a behavior to follow, and increasing the ability could be the resolution to increase behavior performance instead of only increasing the motivation. A system with low ability to motivate its users therefore would need highly motivated users to be biased towards the targeted behavior—motivation alone is not enough to gain the desired behavior if a lack of ability exists. FBM thus implies that motivation and ability are somewhat like trade-offs, but without the appropriate trigger a behavior will not be stimulated (Fogg, 2009). Interactive technologies like computers can work in three ways: as tools, as media, and as social actors. As a tool the computer must work towards making activities more efficient or easier to do and by motivating and influencing people's behavior. As media, computers can convey information from symbols (symbolic media) and provide sensory information, e.g. audio, video, and simulation (sensory media) (Fogg, 2003). It becomes increasingly important to understand, analyze, and determine how to design persuasive systems, since society at large continues to adopt them. Persuasive design principles should therefore acknowledge FBM and the functional triad. In contrast, cognitive dissonance is one of the most heavily studied phenomena in the history of psychology, which was introduced by Festinger (1957) and dominated the social psychology research from the 1950s until the 1970s. Cognitive dissonance is the discomfort created when an individual holds different elements of knowledge inconsistent with each other, and a change in attitudes is often the most assessed way of reducing psychological dissonance (Harmon-Jones and Harmon-Jones, 1997). Nevertheless, striving to accomplish cognitive consistency is important because inconsistency can motivate a change of attitude. To be able to motivate a person to change attitude and/or behavior, urge for consistency must be powerful enough and this could therefore be used in persuasive design.

3 Derivation and Description of the Design Principles

Tørning and Oinas-Kukkonen (2009) presented several design principles for supporting persuasions in a literature review framework. However, which design principle could be used to increase the possibility of persuasion towards sustainability was not addressed and the design principles were based on authors' application to the operational level of the Persuasive System Design (PSD) Model by Oinas and Harjumaa (2009). This PSD model was considered as one of the foundations for deriving design principles. Likewise, Kimura and Nakajima (2011) showed five extracted design strategies that were used to design a persuasive application for encouraging users to reduce CO_2 emissions. We also considered these design strategies since they were used to promote public interests in collective societies. Finally, design principles for sustainable system design by Mustaquim and Nyström (2013) were also considered. Table 1 shows how the characteristic matrix was generated from these three different theoretical foundations for formulating the features of our design principles.

The Persuasion Context in the PSD Model (Oinas-Kukkonen and Harjumaa, 2009)	Design Strategies to Promote Public Interest in Collectivist Society (Kimura and Nakajima, 2011)	Sustainable System Design Principles (Mustaquim and Nyström, 2013)	Properties of the Design Principles
Intent, Strategy	Mutual surveillance	Following nature as a mentor guideline	Equitability
Event, Strategy	Organization of group	Design for majority with diversity	Inclusiveness
Intent, Event	Mutual aid development	Customizable system for simplicity	Optimality
Event, Strategy	Anonymity	Reduction of adverse effect over time	Privacy
Intent, Strategy	Combined use of different feedback	Understand synergies and emergent properties	Transparency

Table 1:   Characteristic matrix of persuasive system design principles for sustainability.

Contexts in the PSD model were mapped (Column 1) to satisfy the argument that derived characteristics could fit into the PSD model and thereby they became viable for persuasive design. Design strategies by Kimura and Nakajima (2011) were mapped (Column 2) to show that the derived design principles can work on a public interest like sustainability. Finally, design principles from Mustaquim and Nyström (2013) were mapped (Column 3) since it was important to show how existing design principles for sustainable information technology system design could contribute towards generating new knowledge for designing a focused persuasive system. On Column 4 we showed the resulting features. Equitability was established as an intent and strategy of design that considered mutual behavior changes among the users towards a sustainable action. This was done by following nature as a mentor guideline so that the practical use of resources in design for the purpose of increasing reasonable performance of the individuals could be achieved. Moreover, the event of group organization was considered as a design strategy and event. Here inclusive design concept in terms of including most possible user groups in the design process was considered. To put it differently: the successfulness of group organization could be increased by practicing inclusiveness. A possibility to develop for mutual benefit by providing users the opportunities of the customization of design can result in an optimal design for a specific purpose that was selected as an intent and event. In addition, a design strategy of privacy is mapped with the anonymity in group, aiming for reducing different adverse effects over the course of time. Even transparency can be a design strategy for understanding different synergies and emerging properties that may be realized and determined with the combined use of different user feedback and, in particular, was mapped within the context of intent from the PSD model. Based on the features listed on Column 4, we proposed five design principles for PSD for sustainability, described in Section 3.1.

3.1 Persuasive System Design Principles for Sustainability

Principle 1: Practice equitability during the use of resources in design

A good strategy in design is resource-balancing or minimization, a lesson that was in contrast learned from nature and can be used in understanding how individuals behave in a group. Indeed, sustainability is also about minimizing and balancing impact. The reasonable performance of individuals in a group is largely important to be initiated by design when the aim is to persuade for sustainability. Since users might not appreciate or see that a particular attitude or behavior is changed only by them or within a few users, a sense of equitability should be initiated through the design, which could work as a bias for individuals working in a group by shaping and balancing their performances. In simple terms, the equitability design principle could be justified through the proper use of different design resources.

Principle 2: Diversify the design by including more users and then focus as group

At the same time sustainability is not an issue that can be achieved by focusing only on individuals. Including most possible mainstream users and considering them as a group in the design process would allow individuals to break psychological barriers towards acting on a targeted behavior. Besides, it is often difficult to act as an individual in breaking different barriers. The idea of inclusiveness is thus important in persuasive design for sustainability. Considering the inclusiveness design principle can improve the possibility of including more population into the practice of a certain task of a specific behavior. Designing for only a few selected users by excluding others from the requirement analysis phase can increase the risk of a design's becoming unsuccessful in persuasion for sustainability. Considering a diversified majority of multiple user groups is equally important in this case.

Principle 3: Provide optimum and mutual capabilities to users through the design

Persuasive design aiming for sustainability cannot be accomplished without the ability of users to contribute throughout the complete design process. Often users cannot do this because the design is

too complex and likewise it is not possible to customize it. Besides, users might need to interact with each other. Design could provide the ability of easy customization that can result in an improved, optimal user participation in contributing towards sustainability. The simplicity design principle can help initiating this. Development of different joint utilities for users could all together lead towards the increased ability for customization of design and thereby could result in an optimal design of a persuasive system for sustainability promotion or achievement.

Principle 4: Keep user's privacy concerns in mind throughout the design

Privacy is not a new concern in any design but it has a different role in designing persuasive systems to act on users' behavior (to make them act in a more sustainable fashion). Keeping the user's behavior a secret can motivate practicing of that behavior. Sensitive issues like privacy in PSD should therefore be considered, practiced, and reflected upon throughout the design process. If privacy issues are properly designed the risk of adverse effect will be reduced.

Principle 5: Maintain transparency in design for dealing with different outcomes

After a persuasive system has been designed it should be transparent to its users. Different effects, issues, and feedback from other users are important for users of a persuasive system. These issues can shape the user's behavior in the future towards using the designed system. It is therefore important to evaluate and understand synergies and rising issues in the design of the persuasive system. Persuasive system designers should therefore keep this in mind during design. This design principle can be used to generate strategy to understand user behavior and, in brief, can justify the target behavior aimed at by the design.

4 Proposed Cognitive Dissonance Model

A cognitive dissonance model of persuasive design for sustainability is shown in Figure 2. We used the three principle factors from the behavior model by Fogg (2009)—motivation, ability, and triggers discussed in Section 2—to understand how they can work together with our derived design principles for shaping a target behavior like sustainability. Our proposed model was adapted from the cognitive model presented by Oliver (1980). The model is shown as a form of path diagram (Figure 2) between design principles and elements of the behavior model and is described as follows.
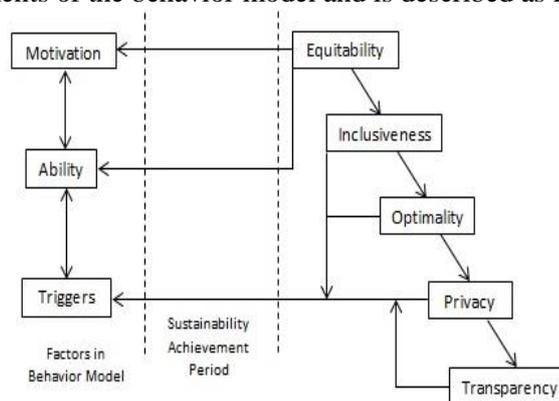

Figure 2:   Cognitive dissonance model for persuasive design for sustainability

In this model three factors from the behavior model by Fogg (2009) were considered as the elements of a bidirectional process. This means that when motivation can increase the ability for triggering a target behavior, in the same way it can work the other way around. This is because Fogg (2009) described that it is possible for these elements to function jointly at the same time to influence. An enhanced trigger aimed towards the targeted behavior could thus allow users of a persuasive system a higher ability (with less effort to use) to gain increased motivation. The five derived design principles were shown on the right side of the model (Figure 2). By practicing the equitability in design, a

possibility to add more users to the design thought process can be achieved. For example, if more users can feel that they are not the only ones in a process and there are others involved with them, then they can be motivated towards participating in the design process. Likewise mutual capabilities for users of the design could be initiated, which refers to the equitability. In the same way problems of changing attitude towards sustainability can be thought of as collective behavior and the ability to customize a system by its user could give completeness to the design in terms of its purpose of use. On the other hand, adding a higher number of possible users through the inclusiveness design property can trigger user behavior as a group that is often difficult to achieve individually. An example could be changing user behavior through the design of a mobile phone application, whereby users are persuaded to act more environmentally conscious by recycling. If users of such applications do not feel that they are a part of a large group of others who are also performing similar actions, then it can be very difficult to expect the success of such an application. In particular, the application should not be designed just for focused user groups but for all possible users through the practice of the inclusiveness principle of design. Of course users need to feel the purpose of using such an application, which should be equally distributed among the members of the society of which they individually are a part. Equitability, inclusiveness, and optimality could help in achieving that in this case. Issues like privacy follow afterwards and transparency in dealing with different factors will follow next for justifying the target behavior. The example of the mobile phone application, for instance, cannot be expected to be used by more users regardless of its purpose of use that is changing user behavior towards a sustainable action if the privacy is hampered and information is not transparent. Thus the equitability design principle will work towards increasing motivation and ability of users and inclusiveness gives the users a higher ability towards achieving the target behavior. Optimality in design, privacy, and transparency can be reflected through the design and can work as triggers that will lead towards increased motivation and thereby achieve the target behavior. The phase between the design principles and behavior model factors in which they are working with each other is the moment when sustainability achievement should take place through the use of a persuasive system. Users thus can be motivated towards a target behavior—sustainability in this case—since motivation, ability, and triggers will work on them in an improved way for shaping their behavior towards a target. This can be done by controlling their dissonance. For understanding how dissonance can be balanced, we need to consider the effects of each design principle together with the three factors of Fogg's (2009) behavior model. The dissonance will be controlled towards these three factors of the behavior model and this can be initiated by practicing the design principles in the design process. Specifically, it is possible for the users to gain more motivation, the ability to achieve a task, and therefore they must be triggered positively and any dissonance that could prevent this happening would be reduced. Indeed, equitability and inclusiveness can add constant cognition in the form of justification in the mind of the user, which also can initiate motivation to increase the individual abilities. Similarly optimality can increase the importance of consonant cognition, which can reduce dissonance in a trigger. On the other hand, privacy and transparency can reduce the importance of dissonant cognitions. This can lead to enhanced triggers by controlling the dissonance towards a target behavior. Finally the organization of these actions can define the time period when sustainability would be achieved as a target behavior as seen in Figure 2.

5 Discussions and Future Work

The proposed cognitive model is an abstract representation of a complex phenomenon like persuasion, several design principles, and focused behavior change (aimed at sustainability). How our design principles can control cognitive dissonance and thereby persuade users towards a target behavior was addressed by the proposed cognitive model. It is worth mentioning here that the five design principles presented in this paper significantly differ from the design principles presented in one of our foundation frameworks by Mustaquim and Nyström (2013) inasmuch as these five design principles are precisely meant for designing a persuasive system for sustainability, whereas the foundation

framework's design principles were generalized for designing an information technology system for sustainability. While sustainable HCI strongly deals with interaction design for promoting sustainability, previous design principles that were used as the foundation framework for this paper really generalized sustainability issues and did not consider a user-centered approach. Mustaquim and Nyström (2013) contributed IT system design principles for sustainability in a broader way and in simpler terms applying them to PSD for sustainability could be vulnerable. The strengths of this paper's design principles are that they could contribute in reducing the framing effects in design. When there is no clear basis of choice, humans usually make decisions based on how easy it is to justify them to themselves or to others, and proper framing makes this easy to do (Anderson, 2009; Shafir, 1993). It is important to make the issue of sustainability an 'easy to justify issue' (Anderson, 2009) for the users of a persuasive system aiming to deal with sustainability. The design principles described in this paper can improve and help in framing of sustainability issues to the users and thus support the argument by Shafir (1993). On the other hand, Cooper and Fazio (1984) looked at their model on dissonance in a new way and argued that dissonance arises when people see that their behavior is liable to create undesirable consequences (Cooper and Carlsmith, 2001). Eventually if there are no consequences then dissonance will not occur because of a varying behavior. The proposed design principles in this paper could be used to design systems that can help reducing aversive consequences when dealing with sustainability issues and thereby increasing the possibility of controlling dissonance by generating varying behavior. This supports the idea established by Cooper and Fazio (1984). Off course one of the important issues in persuasion is the ethics of different ways to promote persuasions. We believe that design principles presented in this paper will not initiate propaganda in design by manipulating users; instead it will contribute in giving knowledge for the targeted behavior. Nevertheless, empirical verification for establishing these arguments is needed, which will be the next major step of this research, since we in this paper wanted to show in a theoretical model how proposed design principles can achieve sustainability by controlling dissonance. Validations of these design principles or the model was not the scope. The established design principles are unique for PSD, since we did not find them to be addressed in the literature discussing persuasive design and its principles. By evaluating the design principles the proposed cognitive model can eventually be verified. On the contrary, other external variables like the level of abstraction in cognition or effect can initiate conflicts towards the success of this model and finding alternative routes to reduce dissonance may therefore be an important issue for improving this model.

6   Conclusions

In the face of rapid research and development, one remaining significant problem in PSD is the understanding of design strategies and principles for a system aiming towards a focused target behavior. This understanding is still in its early stage. The issue of sustainability with this respect is especially a critical one, because it is reflected through the collective behavior of groups in a society. Using a sustainable system does not guarantee that its users will change their behavior towards sustainability and the design can play a crucial role in shaping the user influence. While several approaches exist to persuade a more sustainable attitude through the design, the appropriate design strategies with emphasis on the user are missing. In this paper five design principles of PSD for sustainability have been proposed and derived from existing theoretical frameworks to establish a cognitive model to explain how dissonance can be reduced for making decisions about sustainability as the focused target behavior. The basis of the proposed cognitive model was three principle factors from a behavior model. Design principles focusing on PSD for sustainability are not the same as other available design principles for persuasive design. Achieving sustainability through PSD strongly involves user-centered research of sustainability and the proposed design principles are highly relevant for that. The proposed design principles and cognitive model can be used to improve the overall usability of a designed system to contribute towards adding new knowledge in the research of sustainable HCI, where the idea of PSD plays an essential role.

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