User diversity in design for behavior change

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Abstract
Recently, using design to change user behavior for the purpose of sustainability has gained considerable interest. One of the essential aspects of design for behavior change is to choose the right design intervention strategy for the right behaviors and for the right individuals. In this respect, consideration of different user characteristics when designing for behavior change is critical to ensure positive behavior change. This paper argues that user diversity can be addressed by grouping users with similar characteristics into different user types. It provides a framework and a methodology to create these user types based on psychological variables including global environmental attitude, attitude towards behavior, subjective norms, perceived behavioral control, intention and finally personality traits. It discusses how the framework and the methodology could be integrated into design process, and illustrates the process by using hypothetical user types. The aim of this illustration is to clarify the predicted outcome of the methodology. As a result, four main user types are proposed: irresponsible users, undecided users, worried users and lastly enthusiastic users. Design intervention strategies are matched with these user types and the paper concludes with a brief discussion on the implications of the framework and methodology for design for pro-environmental behavior change.

Keywords
Design for behavior change, user types, pro-environmental behavior

As a prevalent research area in industrial design, the goal of design for sustainability is to develop solutions which meet the needs of present generations without endangering the needs of future generations, and to minimize our negative impact on economy, environment and society. Conventional approaches to design for sustainability mostly deal with reducing this impact by implementing product-focused strategies. These strategies mostly focus on technological and material properties of products such as use of recycled or recyclable materials during manufacture, increasing resource efficiency and achieving product longevity. However, the way people use a product is also influential on its negative impact on the environment as well as product related features. For instance, researchers found that the majority of the impact of products can be attributed to user behavior (McCalley & Midden, 2002; Wood & Newborough, 2003). Thus, promoting sustainable consumption practices is critical for moving towards sustainability along with designing sustainable products (Stegall, 2006). This can be achieved by designing for pro-environmental behavior change.
**Design for pro-environmental behavior change**

Pro-environmental behaviors are the behaviors that a person performs consciously in order to minimize his or her negative impact on the environment such as minimizing resource and energy consumption, recycling, using sustainable modes of transportation, being a member of an environmental institution and so forth (Kollmuss & Agyeman, 2002). Designing for pro-environmental behavior change refers to designing products or services which encourages these behaviors. Having an active role in the product development process (especially at the early stages), designers have the opportunity and relevant skills to develop such products for enhancing positive behavior change. What makes design prevailing for behavior change is that it can be used to communicate “persuasive arguments” to users, in this case designer’s intentions (Buchanan, 1985, p.8). In other words, designers have the opportunity to inscribe their (persuasive) intentions into products (Crilly, 2011), which appears to be one of the essential aspect of design for behavior change.

So far, many studies contribute to the accumulation of knowledge on how design can be used to change user behavior for the purpose of sustainability. For instance, Lilley (2009) illustrated that design can be used to influence user behavior. Her study focuses on social impacts of mobile phone use i.e., social side of sustainable design, and discusses the acceptability and effectiveness of different design intervention strategies for changing user behavior. A more recent study investigated the implementation of behavior change strategies and socio-psychological theories into sustainable design process with a case study on household fridge use (Tang & Bhamra, 2012). In addition to that, there are other studies which include development of prototypes aiming to decrease the amount of resource consumption occurred during the use phase. For instance, Power -aware cord (Gustafsson & Gyllenswärd, 2005) and Greeny Energy Meter (Wever, Van Kuijk, & Boks, 2008) are designed to motivate users to reduce their energy consumption by making the level of consumed energy visible to users. Other examples can be found in (Froehlich Dillahunt, Klasnja, Mankoff, Consolvo, Harrison, & Landay, 2009) and (Consolvo, McDonald, & Landay, 2009). These studies and many others illustrated the potential of design for positive behavior change. Nevertheless, choosing appropriate design intervention strategies still appears to be a major challenge when designing products motivating behavior change (Zachrisson & Boks, 2012).

There are two guides available for designers which help them to respond to this challenge. First, Lockton, Harrison, and Stanton (2010) provide an idea generation toolkit, *Design with Intent Toolkit*[^1], which provides an inventory of intentional design strategies adapted from diverse disciplines such as architecture, computer science and ergonomics. The toolkit includes six different groups of strategies: architectural, error-proofing, persuasive, visual, cognitive and security, and it guides designers choosing the appropriate design intervention strategy according to the intended user behavior. For instance, using affordances and constraints to encourage desired behaviors and discourage undesired ones. Second, Fogg and Hreha (2010) have developed a guide for designers of persuasive technology, called as *Behavior Wizard*[^2]. They propose fifteen types of behavior change classified according to the designers’ intentions (increase, decrease, stop behavior or maintain a change), and the duration of the behavior (one time change or a change in a period of time). For instance, green span refers to performing a new behavior with a period of time, whereas purple dot refers to increasing behavior one time (Fogg & Hreha, 2010). Depending on the type of behavior change, they provide examples for the techniques that can be used to achieve the desired behavior.

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[^1]: Current version of the toolkit can be found at http://www.danlockton.com/dwi/Main_Page
[^2]: Current version can be found at http://www.behaviorwizard.org/wp/
It is obvious that these guides are valuable tools for designers, however, their major emphasis is on intended user behavior and designers’ intentions. Thus, the aim of this paper is to propose a new framework focusing on users and user diversity which would add a different perspective to the discussion on guiding designers during idea generation. It begins with an introduction of this framework, where essential elements of the framework are explained referring to the literature on design for behavior change, persuasive technology and psychology. This is followed by a discussion on the implementation of the framework for the design process. The discussion is based on how theory of planned behavior can be applied to create user types and how they can be used to address user diversity during the design process. Finally, the paper concludes with a brief discussion on the implications of this framework and the methodology for design for pro-environmental behavior change.

The framework for choosing the right design intervention strategy

According to the framework, four issues should be considered when designing for pro-environmental behavior change. First, designers need to be familiar with the determinants of human behavior. Second, they need to set a specific design goal based on their intention. This goal should include desired behavior and target users. Third, they need to know the characteristics of their target users and define (or create) user types based on these characteristics. Fourth, they need to know the extensive collection of design intervention strategies in order to decide which one(s) is most suitable for their goal and target users. (Figure 1).

Fig 1. The framework for choosing the right design intervention strategy
Determinants of pro-environmental behavior

When designing for pro-environmental behavior change, designers need to have an understanding of the psychological theories which examine the variables influencing pro-environmental behavior. Studies in environmental and behavioral psychology show that pro-environmental behavior is a complex phenomenon affected by many interrelated factors including attitudes, intentions, values, knowledge, norms, demographics and so on (Bamberg & Möser, 2007; Diamantopoulos, Schlegelmilch, Sinkovics, & Böhlen, 2003; Hines, Hungerford, & Tomera, 1987; Kollmuss & Agyeman, 2002; Stern, 2000). Therefore, designers need to be aware of this multi-dimensional nature of human behavior to be able to make informed decisions about which behavioral determinants should be targeted.

Designers’ intentions

Referring back to persuasive nature of the design activity, it is the designer’s intention that determines how a persuasive product should be and how it should be experienced. In other words, based on their persuasive intentions, designers can shape user experience (Crilly, 2011), which also influences the effectiveness of design intervention strategies (Tromp, Hekkert, & Verbeek, 2011). That is to say, designers’ (persuasive) intentions play a prominent role in the success of a persuasive product and also in selecting the appropriate design intervention strategy. Hence, the initial step in designing for behavior change should be setting a specific design goal in accordance with designers’ intentions, since a well-defined goal appears to be crucial as it influences the entire process. Here, the design goal refers to selecting desired behavior, target user and the type of behavior change that designers intend to motivate through design, for instance, encouraging recycling and discouraging the use of disposable products among university students, or supporting students who are already involved in recycling.

Characteristics of target users

Another consideration is to know about the characteristics of different target users. This is important because users with different characteristics may respond to same design intervention strategy in a different way, i.e. it may lead to behavior change for a user but not for another. The reason is that the effect of behavioral determinants on human behavior can be varied across behaviors and individuals (Gardner & Stern, 1996; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995; Stern, 2000). Therefore, it is crucial to know which behaviors and which behavioral determinants should be addressed when designing behavioral interventions (Abrahamse, Steg, Vlek, & Rothengatter, 2005). Furthermore, there is evidence that intervention strategies are more likely to be successful when they are used with persuasive systems adapted to different needs of target users (Broms, Bång, & Hjelm, 2009; Kaptein, Lacroix, & Saini, 2010; Kirman, Linehan, Lawson, Foster, & Doughty, 2010; Petkov, Köbler, Foth, & Krcmar, 2011). This implies that an in-depth exploration of the target users is also required, since the persuasive systems should be designed in accordance with the audience that designers are trying to persuade (Oinas-Kukkonen & Harjumaa, 2009). Consequently, designers need to have a clear understanding of the target population when designing for pro-environmental behavior change.

User types

Regarding the significance of user characteristics for behavior change, sometimes it may not be practical to choose intervention strategies for each individual user in the target population. Therefore, dividing the target population into distinct groups (user types) in terms of their compliance with intervention strategies would provide a more practical way to decide the most appropriate strategy. An attempt to create such user types can be found in Kaptein et al. (2010). They create user profiles by categorizing the users according to their susceptibility to persuasive arguments. These profiles are created by...
adaptive computer systems based on user data, so that the systems adapt themselves to different users. Another example can be found in Ottman’s (2011) work on green marketing. She suggests five psychographic segments varying in terms of their involvement and interest in environmental sustainability, i.e. five shades of green (LOHAS, Naturalites, Drifters, conventional and unconcerned). She argues that environmentally friendly products should be developed according to the different needs of these segments. Although they seem to address user diversity, both user profiles proposed by Kaptein et al. (2010), and green segments proposed by Ottman (2011) are not intended to guide designers during idea generation.

A more design focused approach can be found in Lockton, Harrison, and Stanton (2012). Since they observed that designers need to model the users when generating ideas with Design with Intent Toolkit, they propose three different user types based on the level of user involvement in decision making process when using a product: pinball user, shortcut user, and thoughtful user. Despite their focus on design and designers, user types suggested by them do not particularly focus on pro-environmental behaviors, and their classification is based on designers’ assumptions, experiences and predictions, in other words, not relying on sound user research. Therefore, there is still a need to develop a methodology to create user types which can be utilized by designers when designing for pro-environmental behavior change.

**Intervention strategies**

Last but not least important, designers need to know different intervention strategies used to influence user behavior. Many scholars attempted to categorize these strategies. However, the main problem is that their categorizations of knowledge and terminologies differ according to the discipline, e.g. product design, interaction design, software design (Fogg, 2003; Lidman, Renström, & Karlsson, 2011; Lilley, 2009; Oinas-Kukkonen & Harjumaa, 2009; Selvefors, Pedersen, & Rahe, 2011; Tang & Bhamra, 2008; Wever et al., 2008, Tromp et al., 2011). Thus, a common terminology of design intervention strategies applicable to different design disciplines would facilitate the communication and discussion among design teams and contributes to idea generation. In this respect, the scheme proposed by Geller (2002) can be used to categorize the strategies at macro level. His categorization is based on the state that the target user is found in relation to performance of the behavior. According to this categorization, instructional interventions aim to inform people about the behavior and its consequences. Motivational interventions aim to make the behavior desirable for people by targeting their motivations. Supportive interventions aim to make the behavior automatic (habitual) by helping them along the way. Both instructional and motivational strategies aim to start a new behavior and address users who do not perform the desired behavior, whereas supportive interventions aim to maintain behavior change and address users who are already performing the behavior (Table 1).
## Implementing the framework during the design process

The framework can be integrated into design process with five stages: defining the goal, understanding the psychology of users, creating user types, detailing user types, selecting the intervention strategy and finally idea generation (Figure 2).

![Figure 2. Implementing the suggested framework during the design process](image)

### Defining the Goal
- **Desired behavior**
- **Target population**
- **Type of behavior change**

### The Psychology of the User
- **Attitudes, norms, intentions, behavioral control, personality traits**

### Creating User Types
- **Undesired**
  - Negative
  - Environment
  - Area
  - Other

### Detailed User Types
- **Comfort users**
  - Pass to model by private car, earn credit, upper-middle class, have a house in country side, mobile lifestyle
- **Workaholic**
  - over 20 years old, work oriented, middle class, conservative, live in a list of numbers
- **Lazy**
  - Work-oriented, has no job, reluctant to use public transportation, always be late, uses for all the time, interested in things requires less effort, save the day

### Selecting the Design Intervention Strategy
- **Idea generation**

In the first stage, after receiving the design brief, designers determine their goal in terms of the behavior that they are trying to motivate, target users and the type of behavior change. Second stage involves collecting user data about intentions, attitudes, norms, and perceived behavioral control to understand the psychology of the target users. This is followed by creating user types that can be emerged in the data. At this stage, data collection can be done through survey questionnaires and user types can be created by using tools such as cluster or association analysis. This process would likely to result in statistically significant but not detailed user types, i.e. *macro level user types*. Thus, the next stage involves conducting further research (preferably qualitative methods such as laddering interviews) in order to have detailed user types, i.e. *micro level user types* which explain users’ beliefs, past and current behaviors, experiences in relation to the type of behavior that designers trying to encourage. The last stage before idea generation

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3 For the purpose of this paper, several strategies are chosen from the reviewed papers (Lilley, 2009; Lockton et al., 2010; Selvefors et al., 2011; Tang & Bhamra, 2008; Torning & Oinas-Kukkonen, 2009; Wever et al., 2008), and integrated into three main intervention categories proposed by Geller (2002).
involves selecting the appropriate strategy based on the detailed user types created in the previous stage. If the time is limited to conduct further research, designers can directly pass to selecting the design intervention strategy based on macro level user types. Since the main focus of the paper is user diversity in pro-environmental behavior change, the remainder of the paper focuses on user types regarding the whole implementation process. It explains how they can be created by using psychological variables and how design intervention strategies can be matched with them.

**Understanding the psychology of the users**

Ajzen’s (1991) theory of planned behavior can provide a systematic approach to understand the psychology of target users. There are three main reasons of this. First, it is a well-known theory of human behavior which has been applied across diverse behavioral domains such as pro-environmental behavior, health behaviors, addiction behaviors, purchasing behavior and so forth. Second, it allows predicting intentions by measuring attitudes, subjective norms and perceived behavioral control with considerable predictive validity (Ajzen, 2011). Third, it explicates on each determinants of behavior and provides guidelines to develop scales to measure these determinants.

The theory of planned behavior postulates that behavior is directly determined by a person’s intention and his or her actual control over behavior (Ajzen, 1991). The intention to perform behavior is further influenced by attitude towards behavior, subjective norms and perceived behavioral control (Figure 3).

![Fig 3. The theory of planned behavior (Adapted from Ajzen, 1991)](image)

According to Fishbein and Ajzen (2011), attitude is the positive or negative evaluation of the behavior to be performed; subjective norm is the perceived social pressure to perform or not to perform a behavior, and perceived behavioral control is person’s perception of their ability to perform a behavior. These factors are further influenced by individual beliefs about the behavior: behavioral beliefs, normative beliefs and control beliefs. In other words, beliefs indirectly affect a person’s intention by shaping attitudes, subjective norms and perceived behavioral control. Finally, background factors such as knowledge, global
dispositions, personality traits, demographics and experience indirectly influence the intention by acting upon these beliefs.

**Creating user types based on the theory of planned behavior**

The theory of planned behavior not only helps understanding the psychological state of the user but also allows creation of user types. That is to say, psychological variables such as attitudes, intentions and norms can be used to divide a target population into various heterogenous segments varying in their likelihood in performing pro-environmental behaviors and their response towards different intervention strategies. This process is illustrated by creating hypothetical user types and suggesting appropriate intervention strategies that can be used to motivate these user types. User types are generated by using six variables selected from the theory: intention, attitudes, subjective norm, behavioral control, global attitude (general environmental attitude) and personality traits.

Since intention, subjective norm, attitude and behavioral control are the core constructs of the theory, they are included in this process. The evidence shows that up to 53% of the variation in behavior can be explained by only intention, and up to 66% variation in intention can be explained by attitudes, subjective norms and perceived behavioral control (Ajzen, 2011). These findings illustrate the importance of these constructs for predicting human behavior. In addition to the core constructs, two of the background factors mentioned in the theory are selected: personality traits and global attitudes. Personality traits are selected because they are one of the most commonly used variables to analyze the profile of pro-environmental individuals (Fraj & Martinez, 2006), and they have been traditionally used in marketing studies in order to create market segments within a population (Gunter & Furnham, 1992; Wedel & Kamakura, 2000). General environmental attitude is selected as a global attitude, since it seems to be the second variable to create profiles of pro-environmental individuals besides personality traits (e.g. Markowitz, Goldberg, Ashton, & Lee, 2012). Moreover, environmental attitude scales has a potential to be applied to different pro-environmental behavioral domains, as it contains broad environmental issues and attitudes.

**User types**

It should be noted that, user types presented in this paper are hypothetical and created for illustrative purposes, in other words they do not depend on actual user data. They are constructed based on the scales developed to measure the selected variables. For instance, Fishbein and Ajzen’s (2011) sample questionnaire is used for intention, subjective norm, behavioral control and attitudes, New Ecological Paradigm (Dunlap, 2008) is used for general environmental attitude and finally Big Five Inventory (John, Naumann, & Soto, 2008) is used for personality traits. As a result, four main user types are proposed as *irresponsible users*, *undecided users*, *worried users* and lastly *enthusiastic users*. Design intervention strategies are matched with these user types (Figure 4).
Irresponsible users seem to be egocentric, have no concern for the environmental issues and do not feel responsible for environmental problems. They usually think that performing pro-environmental behaviors do not solve the environmental problems, thus, they have no intention to be engaged in environmental friendly actions. Designers need to consider all three types of intervention strategies in order to make them aware of environmental issues and make pro-environmental behaviors desirable for them by targeting their motivation. Information, eco-feedback, rewards and intelligent products which decide on the appropriate behavior on behalf of the user can be preferred to motivate this user type.

Undecided users usually feel responsible for environmental problems but they appear to be confused about whether their actions can change the situation. Even though, they are curious to know the ways of decreasing their negative impact on environment, they are reluctant to act due to lack of knowledge and lack of behavioral control. This type of users can be motivated by employing instructional and motivational type of intervention strategies such as normative feedback, rewards, and eco-feedback.

Worried users generally feel responsible for environmental problems, they are concerned about the wellbeing of future generations; however, they do not have intention to perform pro-environmental behaviors due to the fact that they are routine oriented and not open to change their routines. Furthermore, even though they think that performing pro-environmental behaviors can be a solution to environmental problems, they need a support and a motivation to act which might increase their self-confidence. Worried users can be encouraged by both supportive and motivational strategies such as behavior steering, rewards and competition.

Finally, enthusiastic users are the ones who have already performed (and perhaps performing) pro-environmental behaviors. They seem to be very sensitive to environmental issues and they believe that their choices regarding the performance of pro-environmental behaviors mean a lot for the environment and for other people.
However, their performance of pro-environmental behaviors may not be repetitive due to the disappearance of a motivation or emergence of a new barrier such as time and money constraint. For this reason, supportive strategies should be preferred for enthusiastic users in order to make the desired behavior habitual and maintain behavior change.

In some situations, the target group may include more than one user type simultaneously. When designers encountered with such a challenge during the design process, it would be practical to choose the design strategies that are effective for multiple user types. For instance, if the target group includes both undecided users and irresponsible users, eco-feedback or rewards can be chosen as an intervention strategy. Another way to overcome this challenge could be using a combination of strategies which seems to be effective for multiple user groups, instead of selecting only one strategy. For instance, if the target group include undecided and enthusiastic users simultaneously, designers may use rewards (for the former) and reminders (for the latter).

**Detailing the user types**

The user types explained above can be an example of macro level user types created within a greater population by using quantitative data collection and analysis methods. However, there are some advantages and disadvantages of using quantitative methods to create user types. First, the outcome would be statistically significant if the sample size is sufficient. Second, quantitative methods provide a quick way to collect and analyze the data, which can be desirable especially when the time is limited for a project.

Despite these advantages, a disadvantage of using quantitative methods is that the resulted user types would lack detailed explanations about user behaviors, goals and thoughts which can provide inspirational information for designers. This can be surpassed by conducting further research. For instance, let's assume that the goal of a design team is to develop a personal travel assistant, which encourages users to adapt environmentally friendly travel choices to decrease their ecological footprint derived from their commuting behavior, and assume that they have created four macro level user types for the travel assistant as irresponsible, undecided, worried and enthusiastic users. In this example, the design team may come up with two additional micro level user types for irresponsible user type: comfort-mania users and reckless users. While the comfort-mania users may not want to change their travel choices for the sake of their own comfort, reckless users may not want to change their behavior since they care more about money than the wellbeing of environment. It is apparent that the way that designers could motivate these two types of users will differ since their unwillingness to choose eco-friendly travel choices are different. Therefore, having detailed information about user types would enable the designer to see little nuances between them and contributes to idea generation.

**Conclusions**

Behavior change is an old topic that researchers have dealt with for many years. However, changing behavior through design for the sake of sustainability is a relatively new research area which requires elicitation and spread of new knowledge about the ways of encouraging pro-environmental behaviors. Thus, an information source, which provides guidelines for designing for pro-environmental behavior change, would be invaluable for design community. This paper establishes an initial ground for such an information source by proposing a framework for choosing appropriate design intervention strategies to ensure positive behavior change. According to the proposed framework, designers should set a well-defined design goal, know their target users and be aware of design intervention strategies available to them. The central aspect in this framework is the consideration of user diversity when designing for behavior change. It involves being aware of how behavioral variables differ across users and how these differences influence
their compliance with different intervention strategies. Once these differences are determined and users are divided into groups (or user types), designers can easily decide the right intervention strategy to choose. Thus, the creation of user types can be a great value for designers in terms of making informed decisions about how to motivate different users. We believe that the framework and the methodology proposed in this paper has a great potential for developing an information source for designers who are engaged with designing for behavior change.

References


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A research assistant and a PhD. candidate in the Department of Industrial Design at Middle East Technical University (METU), Ankara-Turkey. He is also working as a researcher in UTEST Product Usability Unit at METU. His research focuses on how industrial design can encourage users to perform environmentally conscious behaviors such as reducing energy consumption or environmentally friendly driving. He is interested in developing a framework and a methodology to provide guidance for designers to address user diversity for pro-environmental behavior change and develop solutions that ensures positive behavior change.

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