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Persuasive Strategies Report

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Abstract

This deliverable provides an overview over persuasive principles and strategies, **with an insight into underlying basic human processes that are associated with persuasion.**

Especially, persuasive principles and strategies important for environmental issues are highlighted. Next, an insight is given into underlying basic human processes that are associated with persuasion.

Following, possible design solutions and taxonomies for persuasive systems and technologies are presented. with selected systems and technologies from several fields (environment, mobility, domestic context) with a focus on visualization of persuasive strategies and principles.

In the last sections, common criticism on persuasion is presented as well as possible measurements for its effects.

As a conclusion, concerns/design implications for the prototype will be derived from the results of the deliverable.

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1. Introduction

1.1 Background

Human activity has a severe impact on the nature and the environment and affects the ecosystem of the whole world. Behavior that threats this ecosystem is a danger of the human life and the human civilization (Midden et al., 2008a).

CO_2 is one of the primary gases responsible for the global climate change. CO_2 accounts for 80% of the contribution to global warming (NRC, 2010). It has been shown that choices of individuals can lead to a significant reduction of CO_2 emissions by the reduction of energy consumption. This choice of individuals requires persuading these individuals to change their behavior and to maintain this behavior over time (Dillahunt et al., 2008a).

The approach of using technology as a mean to help reducing CO_2 emissions and thus protect the environment has often neglected the human factors and focused on the technological side without consideration of human attitudes and behavior (Midden et al., 2008). Several studies have shown that this procedure (purely technological approach) often leads to disappointing results concerning the behavior of the user (Midden, Kaiser and McCalley, 2007; cited in Midden et al., 2008a). Approaches and campaigns that tried to raise awareness for environmental problems go back to the 1970s and started with novel media and mass-media like television ads and video clips.

These approaches and campaigns did not show much success (Midden et al., 2008a). One of the greatest contributors of CO_2 emissions is personal transportation. Therefore, it is useful to concentrate on the usage of technology in the mobility and travel context to reduce CO_2 emissions. This should be done not only from a technological point of view, but also from a human point of view. One way to change human behavior is called **persuasion**.

"*No leader can succeed without mastering the art of persuasion. But there's hard science in that skill, too, and a large body of psychological research suggests that there are six basic laws of winning friends and influencing people.*" (Cialdini, 2001).

Many existing research approaches in the last decade have focused on the integration of persuasive strategies within travelling applications (trip advisors, navigation systems etc.). A selection of these approaches will be presented in this deliverable.

1.2 Scope of this Deliverable

This Deliverable 5.1 provides an overview about the field of persuasive technologies with a focus on studies on persuasive strategies and persuasive technologies. Strategies will be presented and their possible implementation for the mobility context will be discussed.

First, a collection and review of existing persuasive strategies is presented. Especially we evaluate experimental studies that deal with persuasive strategies and analyze them in a meta-analytical way. Additionally investigate existing persuasive technology (in mobility, energy and domestic context) and present them. A focus will be on *eco-visualizations*: *"An [eco-visualization] is any kind of interactive device targeted at revealing energy use in order to promote sustainable behaviours or foster positive attitudes towards sustainable practices."* (Pierce et al., 2008).

2. A road to Persuasion

2.1 Persuasive Strategies and Principles in General

First, we will give an overview over the most prominent persuasive strategies and principles in the current state of the art-research (section 2.1.1), then we will explain basic persuasive strategies and principles in detail (section 2.1.2 to 0).

2.1.1 Short overview: The most important Persuasive Strategies and Principles

Table 1 shows an overview over the most important persuasive strategies and principles found in the literature, together with a short description of each principle. Additionally, a taxonomy of persuasive strategies and principles that classifies each principle along four dimensions. **Dialogue**, which is when the persuasion is applied during the process of human-computer-interaction. **Social**, which means the inclusion of other people into the process of persuasion. **System credibility**, which is the considerations of persuasive strategies and principles in the system design and engineering. **Primary task**, which is the direct relation

between the user's intention of using persuasive systems and technologies and the inclusion of persuasive strategies and principles.

Table 1: A summary of persuasive strategies and principles

Reference	Strategy & Principle	Description	Dimension (Torning & Oinas-Kukkonen, 2009)
Torning & Oinas-Kukkonen, 2009; Cialdini, 2001	*Liking*	To show similarities and to offer praise.	Dialogue
Fogg, 2003; Cialdini, 2001	*Reciprocity*	To give what the people would like to receive.	-
Cialdini, 2001	*Social Proof*	To use peers in every situation when it is available.	Social
Cialdini, 2001	*Consistency*	To make commitments active, public and voluntary.	-
Cialdini, 2001; Torning & Oinas-Kukkonen, 2009	*Authority; Expertise*	To expose and show expertise in an obvious way.	System credibility
Cialdini, 2001	*Scarcity*	To highlight unique benefits and exclusive information.	-
Torning & Oinas-Kukkonen, 2009; Fogg, 2003	*Reduction*	To reduce complex behavior to simple tasks.	Primary task
Torning & Oinas-Kukkonen, 2009; Fogg, 2003	*Tunnelling*	To guide users through a process or experience.	Primary task

Torning & Oinas-Kukkonen, 2009; Fogg, 2003	*Tailoring*	To provide information that is tailored to the individual needs, interests, personality, usage context, or other factors relevant to the individual.	Primary task
Torning & Oinas-Kukkonen, 2009; Fogg, 2003	*Suggestion*	To suggest a behavior at the most opportune moment.	Dialogue
Torning & Oinas-Kukkonen, 2009; Fogg, 2003	*Self-Monitoring*	To eliminate the tedium of tracking performance or status to help people to achieve predetermined goals or outcomes.	Primary task
Fogg, 2003	*Surveillance*	To observe behavior to increase the likelihood of achieving a desired outcome.	-
Fogg, 2003	*Conditioning*	To reinforce and shape complex behavior in a positive way or to transform existing behavior into habits.	-
Fogg, 2003	*Cause and Effect*	To enable people to observe immediately the link between cause and effect.	-
Fogg, 2003; Torning &	*(Virtual) Rehearsal*	To provide a	Primary task

Oinas-Kukkonen, 2009		motivating simulated environment to practice the targeted behavior.	
Fogg, 2003; Torning & Oinas-Kukkonen, 2009	*(Virtual) Rewards*	To (virtually) reward target behaviors influences people to perform the target behavior more frequently and effectively.	Dialogue
Fogg, 2003; Torning & Oinas-Kukkonen, 2009	*Simulations (in Real-World Contexts)*	To use (portable) simulation technologies (design for use during every day routines).	Primary task
Fogg, 2003	*Physical attractiveness*	To design computing technologies that are visually attractive.	-
Fogg, 2003; Torning & Oinas-Kukkonen, 2009	*Similarity*	To design computing technologies that are similar to the people.	-
Fogg, 2003; Torning & Oinas-Kukkonen, 2009	*Praise*	To offer praise via words, imagines, symbols or sound.	Dialogue
Torning & Oinas-Kukkonen, 2009	*Social comparison/ Competition; Social learning*	To make the users compare/compete with peers; To demonstrate desired behavior, to describe the desired behavior in	Social

		detail (instruction), to model behavior by letting a real or fictional character (for example media) demonstrate the desired behavior.	
Torning & Oinas-Kukkonen, 2009	*Surface credibility*	To create a user interface that is consistent, gives feedback, is efficient, flexible, had clearly marked exits, is in the users' language, is task oriented, is controllable, recovers and "forgives", minimizes memory load, is transparent and aesthetic.	System credibility
Torning & Oinas-Kukkonen, 2009	*Normative influence*	To make cultural and social standards and rules visible.	Social
Torning & Oinas-Kukkonen, 2009	*Reminders*	To remind the user of the desired behavior.	Dialogue
Torning & Oinas-Kukkonen, 2009	*Recognition*	Trying to access the users' memory by showing him things he can recognize.	System credibility
Torning & Oinas-Kukkonen, 2009	*Trustworthiness*	To provide a reliable and secure system	System credibility

		that can be trusted.	
Torning & Oinas-Kukkonen, 2009	*Cooperation*	To give the user the feeling that the system cooperates with him.	Social
Torning & Oinas-Kukkonen, 2009	*Personalization*	To personalize the system.	Primary task
Torning & Oinas-Kukkonen, 2009	*Social role*	To make the user adapt a certain social role. The behavior changes by means of the expectations the user and others have of that role.	Dialogue
Torning & Oinas-Kukkonen, 2009	*Real-world feel*	To give the user the feeling he would not interact with a virtual system.	System credibility
Torning & Oinas-Kukkonen, 2009	*3rd party endorsements*	To inform the user about confirmations and credits of others.	System credibility
Torning & Oinas-Kukkonen, 2009	*Verifiability*	To let the user see the meaningfulness of the systems statements (by providing empirical or tautological evidence).	System credibility

2.1.2 Fogg's seven Principles of Persuasion

Fogg (2003) suggests to use "[c]omputers to [c]hange [w]hat [w]e [t]hink and [d]o" and provides seven strategies to reach this goal: ***Reduction, Tailoring, Tunneling, Suggestion, Self-monitoring, Surveillance and Conditioning.***

Reduction aims at compressing complex behavior to simple tasks. ***Tailoring*** is a persuasive principle that suggests to provide information that is tailored to the individual needs, interests, personality, usage context and other factors that are relevant to the individual.

Tunneling describes the principle to guide the user through a process or an experience in the interactive system. ***Suggestion*** is when a behavior is suggested to a user just in the most opportune moment. ***Self-monitoring*** helps people to achieve predetermined outcomes or goals by eliminating the tedium of tracking performance or status. ***Surveillance*** describes the phenomenon that the observation of a certain behavior automatically increases the likelihood of achieving the desired outcome. ***Conditioning*** is the reinforcement and shaping of complex behavior in a positive way and/or to transform existing behavior into habits.

2.1.3 Cialdini's six Principles of Persuasion

Cialdini (2001) presents six principles of persuasion and shows that "persuasion […] is governed by basic principles that can be taught, learned, and applied.": *Liking, Reciprocity, Social Proof, Consistency, Authority and Scarcity.*

With the principle ***liking*** ("People like those who like them") Cialdini describes the phenomenon of the *Tupperware party*: People mainly buy the Tupperware because they like the hostess, not so much because they like the product. So the key to persuasion is liking. Research has identified two core factors of liking: *similarity* and *praise*. The principle ***Reciprocity*** ("People repay in kind") refers to the fact that humans tend to treat other people like they get treated themselves. ***Social Proof*** ("People follow the lead of similar others") means that people tend to rely in many situations on the behavior of other people concerning their cognition, their affect and behavior. People need social evidence on how to think, feel and act. As a consequence, persuasion is extremely effective when it comes from peers. ***Consistency*** ("People align with their clear commitments") means that people need to be committed to what you want them to do. People feel obligated to commitments when these commitments fulfill three features: The commitments have to be *active, public* and *voluntary*. ***Authority*** ("People defer to experts") refers to the fact that the opinion and

advices of experts have a great effect on people's opinion. It is common knowledge that when the media presents an experts' view on a certain topic, the probability that this view is believed by the audience is high. ***Scarcity*** ("People want more of what they can have less of") is a strategy of persuasion that uses the fact that items and opportunities are seen to be more desirable the more rare they are.

2.2 Persuasive Strategies and Principles in the context of pro-environmental behavior

Next, we present a collection of concrete design strategies for persuasive systems and technologies. As the focus of this deliverable is on environmental behavior in the mobility context, we provide a short presentation about special persuasive strategies and principles that are integrated in tools (technologies and systems), that aim at changing users' attitudes and behavior in a pro-environmental way.

Fogg (2003; cited in Zapico, Guath & Turpeinen, 2010) proclaims that the "use of computers as simulation tools is one of the key features in computer-enabled change of user behavior and attitudes" and therefore introduces ***simulation*** as another technique of persuasion especially suitable for the context. When it comes to tools, two principles should be implemented in the design to induce a persuasive effect: First, the ***principle of virtual rehearsal*** addresses the fact, that the tool should enable "experimentation without consequences", that means the user can freely "play" with the tool to "test" different behaviors. Second, the ***principle of cause and effect*** should ensure that the intervention of the tool should be designed in a way that shows the link between the behavior and the effect.

The developers of *EcoChallenge* (see section 4.1.5 for a detailed presentation and review on this application) derive following persuasive strategies and principles from their persuasive system that should cause the intended persuasive effect on the user:

First, the application offers **challenges** that should incentive the user to show an intended behavior in a **self-competitive** context. Second, the user has the possibility to **compare** his behavior to friends and to **challenge the friends in direct competitions**. Next, the application is designed in a way that is **diversified and exciting**, which guarantees that the user will not

get bored. The longer the user uses the persuasive system the longer the persuasive strategies can influence the user. A principle that is connected to **diversification and excitement** is the **availability**: The application is **free** and thanks to its development on smart phones available in a **mobility context**.

In our literature review we derived two new persuasive principles: ***representation*** and ***creating awareness*** are highly important persuasive strategies that are applied in a number of persuasive systems and technologies (see section 3.).

Representation aims at the graphical design of certain aspects and facts (for example in application-interfaces). These representations have to be comprehensible and aim at the peripheral ***creation of awareness*** for certain aspects and facts (see section 4 for examples). According to section 2.4, persuasion aims at changing human attitudes and behavior. These two persuasion strategies try to show the targeted attitudes and behavior directly to the user.

2.3 Excursions: Mass Interpersonal Persuasion (MIP) and Persuasion

2.3.1 Fogg's Mass Interpersonal Persuasion (MIP)

Additionally, Fogg (2008) introduces the phenomenon of *Mass Interpersonal Persuasion (MIP),* a phenomenon that started together with the possibility for third parties to create and distribute interactive applications (for example applications that persuade people to disclose personal music preferences) on the social media platform *Facebook*[1].

Fogg states **six components** of MIP. These are the following:

The first is ***persuasive experience***, which is an experience that changes attitudes and/or behaviors. The second is an ***automated structure***, which is when digital information and communication technology structures the persuasion. Third the ***social distribution***, that is a persuasion that is "shared from one friend to another". The fourth one is ***rapid cycle***, which is when the persuasion can be quickly distributed from one to another. The fifth one is a ***huge social graph***, which refers to the fact that the persuasion can potentially reach "millions of people connected through social ties or structured interactions. The sixth one is

[1] http://www.facebook.com

the ***measured impact***, which is when the persuasive effect (change of attitude and behavior) can be observed (Fogg, 2008).

2.3.2 Persuasion and Diversity

Another approach to persuasion is the view from different cultures, namely individualistic and collectivistic cultures (Kimura & Nakajima, 2011). People in individualistic societies are egocentric and emphasize individual needs and goals. In contrast, people in collectivistic societies are integrated from birth onwards into cohesive groups. Collectivistic societies think more in terms of "we" instead of "I".

Persuasive strategies that can be applied in collectivistic societies are: ***Organizing groups, anonymity, mutual surveillance, development of mutual aid*** and a ***combine use of positive and negative feedback. Organizing groups*** refers to a strategy in persuasive applications that makes a member feel that the targeted behavior (or attitude change) is social desirable and acceptable in the group. ***Anonymity*** on persuasive applications promotes persuasion, because otherwise it might be possible that a user gets recognized by other users and the targeted behavior (or attitude change) is not yet a social desirable and acceptable behavior (in the group). ***Mutual surveillance*** refers to three characteristics of persuasion:

Monitoring carried out by others, that is when someone else is watching the completion of a task, the person who is watched performs better (Zajong, 1965; cited in Kimura & Nakajima, 2011) and the person will even perform better if the task contains social desirable and acceptable behavior. To *watch others* decreases the persons' feeling of being isolated and therefore increases the possibility of doing these activities that other people do. To *compare to others* evokes a pressure in a person to contribute more than others (in a group). ***Development of mutual aid*** refers to the willingness of people to contribute to the group (in collectivist cultures) and also the readiness of people to contribute for other people when they cannot contribute enough in a persuasive application. ***Combine use of positive and negative feedback*** refers to the recommendation that positive punishment conditioning should be avoided due to ethical reasons and that negative punishment should be avoided in order not to decrease the interest of the subject and not to make the subject feel bad.

2.3.3 Using strategies and principles of *Social Marketing* for Persuasive Technologies

Social marketing is a discipline that is derived from corporate marketing and aims at influencing consumers' behavior. Khan and Canny suggest that one could extract principles from social marketing and use them for designing persuasive technologies and systems (Khan & Canny, 2008). The first principle is called **benefits and costs.** Each behavior/action of an individual has costs and (hopefully) some benefits. A person enrolled in social marketing has to present the benefits in a favorable way.

The second principle is called **other person,** which is similar to Cialdini's principles related to social actions (see section 2.1.1). People are significantly influenced by what other people are doing, even if they would self-report that they were not influenced by what other people are doing.

The third one is **self-assurance (or self-efficacy)**, that means people can easily be enacted to show certain behavior when they are supported by mechanisms, like support groups (one example named by the authors is the support group "Alcoholics Anonymous").

The fourth one is **segmentation and identity**, which means the targeted group of people should not be treated as one coherent group but instead should be segmented by certain criteria (for example people that are environmentally aware and people that are not environmentally aware).

2.4 Changing human attitudes and behavior through Persuasion: Findings from basic research

Human behavior and the corresponding behavior change can be investigated from many points of view in the social sciences (e.g. physiology, social psychology, personality psychology and a lot of other disciplines). Central concepts of explaining and possibly changing human behavior are behavioral dispositions (such as social attitude and personality traits). Behavioral dispositions are supposed to explain and predict human behavior (see Ajzen, 1988; Campbell, 1963; Sherman & Fazio, 1983; cited in Ajzen, 1991). But unfortunately prior research has shown that general dispositions are poor predictors of behavior in specific situations. This can be shown by low empirical correlations between these two variables. One possibility to solve this problem is to aggregate the specific behaviors across occasions, situations and actions, because one single behavior-sample does

not solely reflect one general disposition for behavior, but also the influence of other factors. The **theory of planned behavior** (as an extension of the **theory of reasoned action**) has as a central concept: The focus is on the personal intention of an individual in order to predict future behavior of this individual. The intention to behave is influenced by three factors: the **attitude** towards the behavior, the **subjective norms** of the individual and the **perceived behavioral control**. This theory is well supported by empirical findings (Ajzen, 1991). It was mainly in the field of social psychology that research was done on persuasion and empirical generalization to change attitudes. An important topic that was addressed by several authors was (like the field of research on behavioral dispositions) the consistency between attitudes and behaviors.

Petty and Cacioppo (1981; cited in Petty & Cacioppo, 1986) proposed a model to explain and predict behavior: the **Elaboration Likelihood Model**. This model tries to explain the underlying processes of persuasive communications. It explains communication-induced attitude by two distinct routes to persuasion: the **central route** and the **peripheral route**.

The first route (central route) is the careful and thoughtful consideration of the information that is given to an individual. The second route (peripheral route) is just a simple cue in the persuasive context that induces a change without the precise processing of the information.

Furthermore, they addresse some variables that affect the amount and direction of the change of the attitude. These variables can be clustered into three groups: Variables that serve as **persuasive arguments**, variables that serve as **peripheral cues** and variables that affect the **extent or direction of elaboration** (Petty & Cacioppo, 1984; Petty & Cacioppo, 1986).

A classical experiment by Razran (1940; cited in Hogg & Vaughan, 2007) showed that classical conditioning has an influence on attitude and behavior: People had to *rate* political slogans (like for example “America to Americans”) while they were stimulated with either positive or negative stimuli. The rating of the slogans changed the way the stimuli was directed (e.g. slogans were rated more positive in conditions with positive stimuli than in conditions with negative stimuli).

Another classical study in social psychology is by Zanna, Kiesler & Pilkonis (1979; cited in Hogg & Vaughan, 2007): Participants had to read out loud a list of words. 50% of the words were (randomly) chosen as “special” words. When participants read out those “special”

words they were administered an electrical shock. Afterwards they rated all the words on favorability. The "special" words were rated significantly worse than the "normal" words.

Ekman (1958; cited in Hogg & Vaughan, 2007) showed possible non-verbal positive reinforces within the theory of **operant conditioning**: nods of the head and smiling.

A different approach in social-cognitive learning theory is Bandura's (1965; cited in Hogg & Vaughan, 2007) **observational learning**: Participants adopt behavior by simply watching other people behaving in a certain way.

Hovland & Weiss (1951; cited in Hogg & Vaughan, 2007) show that changes of attitudes depend on the **credibility**, the **power over correctional impulses** and **similarity** of the "sender" ("senders" can be people as well as media etc.).

The so-called **Sleeper-Effect** is a change of **attitude** with a **time-delay**. The Sleeper-Effect is an effect of communication processes that says that **negative attitude-changes** caused by an **incredible sender** are "lost" over time (the change "falls asleep") (Krober-Riel, 2009). The "sender" and the "information" are decoupled over time.

Snyder (1982; cited in Hogg & Vaughan, 2007) introduced the concept of **self-monitoring**: People with **high self-monitoring** tend to behave in accordance with the requirements of the situation ("*pragmatists*"), people with **low self-monitoring** ignore the requirements of the situation ("*idealists*").

3. Persuasive Systems and Technologies

3.1 Introduction into Persuasive Systems and Technologies

According to the *7th International Conference on Persuasive Technology 2012*, "Persuasive Technology is a stimulating interdisciplinary research field that focuses on how interactive technologies and services can be designed to influence people's attitudes and support positive behavior change". It is "influenced by areas such as **classic rhetoric**, **social psychology** and **ubiquitous computing**. Researchers in this field are typically designing applications for domains such as **health, business, safety, and education**."[2] According to

[2] http://www.ida.liu.se/conferences/persuasive2012/index.php

Torning and Oinas-Kukkonen (2009), "Persuasive systems deliberately attempt to infuse a cognitive and/or an emotional change in the mental state of a user to transform the user's current cognitive state into another planned state." Persuasive technology has been applied for the improvement of **health behaviour**, **promoting physical exercise,** as well as for **sustainable mobility**. The main question of persuasive technology is how behaviour and attitudes can be changed by use of technology.

According to Torning and Oinas-Kukkonen (2009), there are six key-fields of research for persuasive systems: **human-computer interaction**, **computer-mediated communication**, **information systems**, **affective computing**, **psychology** and **rhetoric**.

Midden et al. (2008a) describe the linkage between technology and behavior that is sustainable by distinguishing four possible roles of technology:

1) Technology can be a **coordinator and intermediary**, it should help the user to achieve a goal (*here*: reducing negative ecological impact by human behavior).

2) Technology can serve as an **amplifier**; it can amplify the potential of the user to achieve his goal.

3) Technology is a **determinant**, it changes and activates human behavior by means of "affordances, constraints and cues provided by the technological environment".

4) Technology **promotes** behavior by influencing the choices of the users.

3.2 Designing Persuasive Systems and Technologies

3.2.1 Designing Architectures of Persuasive Systems and Technologies

An important step of designing persuasive systems and technologies is the consideration of the design architecture:

Loke et al. (2007) propose a technical solution for designing persuasive systems and technologies on an architectural level:

One key aspect of this architecture is **fine-grained metering and monitoring** of the devices. They should be able to monitor consumption (of energy, water etc.) on different levels. It should be possible for example to monitor the water consumption of one single outlet as well as the water consumption on a whole floor or even on the overall household-level.

A second aspect is **data processing and situation understanding,** which means the monitored data has to be translated into a visualization form that is appropriate and comprehensible. Similarly, there have to be persuasive messages or actions that are transported by the displaying of the data.

A third aspect is **action strategizing**, which means the system should be able to cover a range of different actions, from the simple notification of the user to "various forms of reinforcement messages, just-in-time prompts, social validation (e.g., where possible show the best water users in the home), adaptations (according to usage history or current needs), negotiation (e.g., to keep a previously specified budget, the user can use more water this time but have less to use next time), recommendations of water saving devices, to taking action on behalf of the user (e.g., stopping water flow at certain times (…)).".

Also, the system should have a **monitoring cycle**, that can **revise feedback and strategy**, which means the system adapts to the user and changes persuasive strategies depending on the behavior of the user.

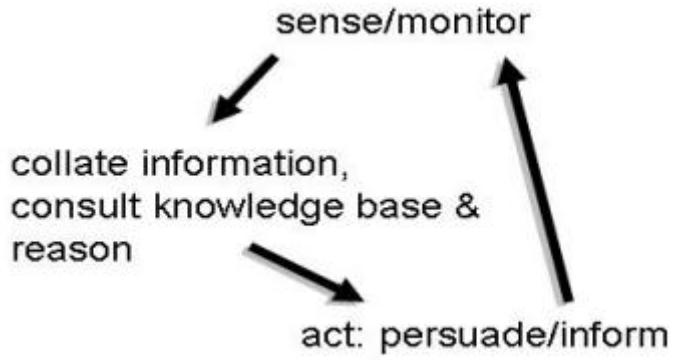
Figure 1 gives an overview over the system behavior. It senses/monitors the behavior of the user, e.g. the consumption of resources (for example: water, energy), it records and analyzes this data and it can also access a knowledge base. Then, the system uses persuasive strategies and principles to:

1) **Inform** the user about his consumption patterns and resource usage behavior

2) To **collate** the information, **consult the knowledge base** and **reason** about it.

3) **Persuade** him to act in a more sustainable way.

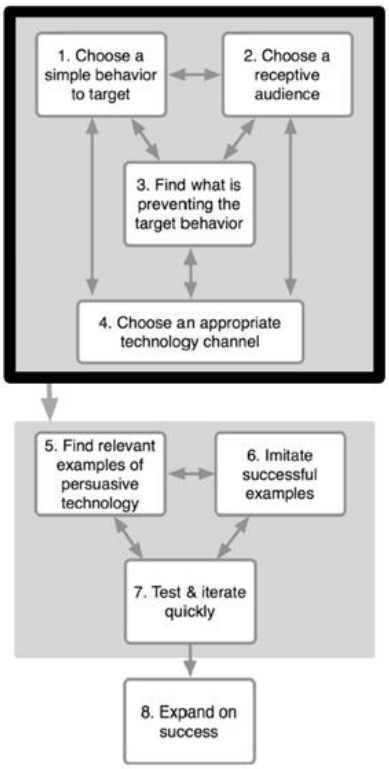
Figure 1: Overview of system behaviour



3.2.2 General Approaches of Designing Persuasive Systems and Technologies

Fogg (2009) proposes a process for designing persuasive systems in eight steps. **Figure 2** summarizes this process. In step one to four activities are prepared and defined. In step five to seven the developments and learning from other (successful) systems happens. In step eight the consequences and next steps from the design are summarized.

Figure 2: Design process for the creation of persuasive technology



Torning and Oinas-Kukkonen (2009) as well as Oinas-Kukkonen and Harjumaa (2009) investigate a broad collection of research from years 2006 to 2008 and propose the ***Persuasive Systems Design Model (PSD Model)***. This model provides a framework and conceptualization of technology-mediated persuasion. The PSD Model describes the context of the persuasion and divides the context of the persuasion into: ***Intent* of persuasion**, ***event* of persuasion** and ***strategy* of persuasion**. The intent comprises the ***persuader*** and the **type of *change***. The event comprises the ***use context,*** the ***user context*** and the ***technology context***. The strategy comprises the ***message*** and the ***route* of persuasion**.

The result of a review of 51 scientific papers (Torning & Oinas-Kukkonen, 2009) showed frequencies of the most used design principles in the *Persuasive conferences*[3]. These are presented in **Figure 3.**

Figure 3: Frequencies of the most used design principles

Persuasion technique	Support dimension	Frequency
Tailoring	Primary task	11
Social comparison	Social	11
Tunneling	Primary task	10
Reduction	Primary task	10
Suggestion	Dialogue	9
Surface credibility	System credibility	8
Normative influence	Social	7
Self-monitoring	Primary task	6
Social learning	Social	6
Praise	Dialogue	5
Liking	Dialogue	5
Simulation	Primary task	4
Reminders	Dialogue	4
Authority	System credibility	4
Recognition	Social	4
Rewards	Dialogue	3
Similarity	Dialogue	3
Trustworthiness	System credibility	3
Cooperation	Social	3
Personalization	Primary task	2
Rehearsal	Primary task	2
Social role	Dialogue	2
Expertise	System credibility	2
Real-world feel	System credibility	2
3rd party endorsements	System credibility	2
Social facilitation	Social	1
Verifiability	System credibility	0
Competition	Social	0

3.2.3 Participatory Design of Ambient Persuasive Technology

Participatory Design refers to a process where the **end-user is involved in a design process of a product right from the beginning**. By letting end-users participate on this process one can gain insight into the special needs of the users, their "knowledge, perspectives, and creativity, as well as an enthusiastic group of supporters of the new approaches." (Davis,

[3] URL: http://www.ida.liu.se/conferences/persuasive2012/index.php

2008). We also believe in a stronger effect (change of attitudes and behavior) of persuasive systems and technologies when the user is allowed to contribute to it.

Davis (2008) proposes an approach to promote sustainable and pro-environmental behavior on a University campus. She starts the participatory design process with a so called *Future Workshop*, which should contain the following agenda-points: Identification of problems with existing systems and technologies, a "[f]antasy phase to envision and ideal world in which those problems were solved" and a phase which aims at the implementation of new ideas in the existing systems and technologies.

In this concrete workshop a number of target behaviors (that aim at sustainability) have been identified and ideas for inducing this behavior with the help of systems and technologies have been generated.

3.3 A taxonomy of Persuasive Systems and Technologies

In the following, a comprehensive **taxonomy with nine dimensions** (derived from the **PSD Model**) for describing and classifying research on persuasive systems is presented (Torning & Oinas-Kukkonen, 2009):

1. *Persuader*
    a. Who is speaking via the design? Who embedded an argument in the artifact?
    b. Why are they speaking? What is their intention or purpose?
    c. What do they hope to benefit from successful persuasion?
    d. What is their background and culture, etc.?

2. *Change type*
    a. What is the goal? Behavior and/or attitude change?
    b. What transformation should the software system produce?
    c. What other approaches have failed?
    d. Did the software system finally produce the desired transformation?

3. *Use context*
    a. Who are the users as a group, e.g. socially challenged girls 10-12 or 55 years and older?
    b. What problem-domain dependent features in the form of well-known problems are to be addressed by the design? Physical, cultural/normative, or competitive?
    c. Who (or what) else is competing for attention in this space?

4. *User context*
    a. What is specific for the users with regard to what they are to be persuaded of?
    b. Why is there a need for persuasion? What constrains their decision?

5. *Technology context*
    a. Single hardware platform or multiple?
    b. Networked or stand-alone software?
    c. Single or multiuser software, or shared collaborative?

6. *Message*
    a. What is the form? Why was it chosen? What is the genre, e.g. game, social community, tracking tool, ambient system, etc.?
    b. What type of content is the system providing?
    c. What kind of appeal is mostly employed? Logos, Ethos, Pathos or Mix?
    d. What kinds of arguments are being provided?

7. *Route*
    a. What is the approach? Direct (one dominant argument) or indirect (several arguments)?

8. *Experimental papers*
    a. Did the system measure a degree of persuasiveness between conditions or did the system actively make an attitude change?
    b. Number of subjects
    c. Method employed
    d. Analysis of results
    e. Level of transformation

9. *Ethical considerations and implications*

This taxonomy can be used by researchers, developers and designers to describe existing persuasive technologies and systems or for the planning of such systems and technologies.

4. Persuasive Systems and Technologies in different contexts and their evaluation

In the following section we present a selection of persuasive systems and technologies in different context and – when available – evaluations of these persuasive systems and technologies.

4.1 Persuasive Systems and Technologies in the context of environmental protection (reduction of CO_2 emissions)

4.1.1 EcoIsland

Kimura and Nakajima (2011) argue that it is difficult to change attitudes and behavior that is important for public interest, for example the protection of the environment. They introduce a persuasive system that is called *EcoIsland*. *EcoIsland* aims at persuading people to protect the global sea levels from rising and is created for application in Japan (especially because Japan faces the threat of rising see levels). This protection can be due to the reduction of greenhouse gases (like CO_2). *EcoIsland* should be applied on a display in a prominent room in a household (like living room for example). Interaction with this display happens with

devices like mobile phones or PC web browsers. First, the household members agree on an amount of greenhouse gas. The emission of this amount should be reduced. *EcoIsland* counts how much greenhouse gas is caused by the activities of the people that live in this household and shows the trade-off between the "Current CO_2 Emission" and the "Targeted CO_2 Emission". The reporting of the activities of the family members happens with the interaction devices. The users get feedback about their actions by the prompt reaction of the sea level. It rises or decreases according to the CO_2 emissions caused by different actions. **Figure 4** shows the main window of *EcoIsland*.

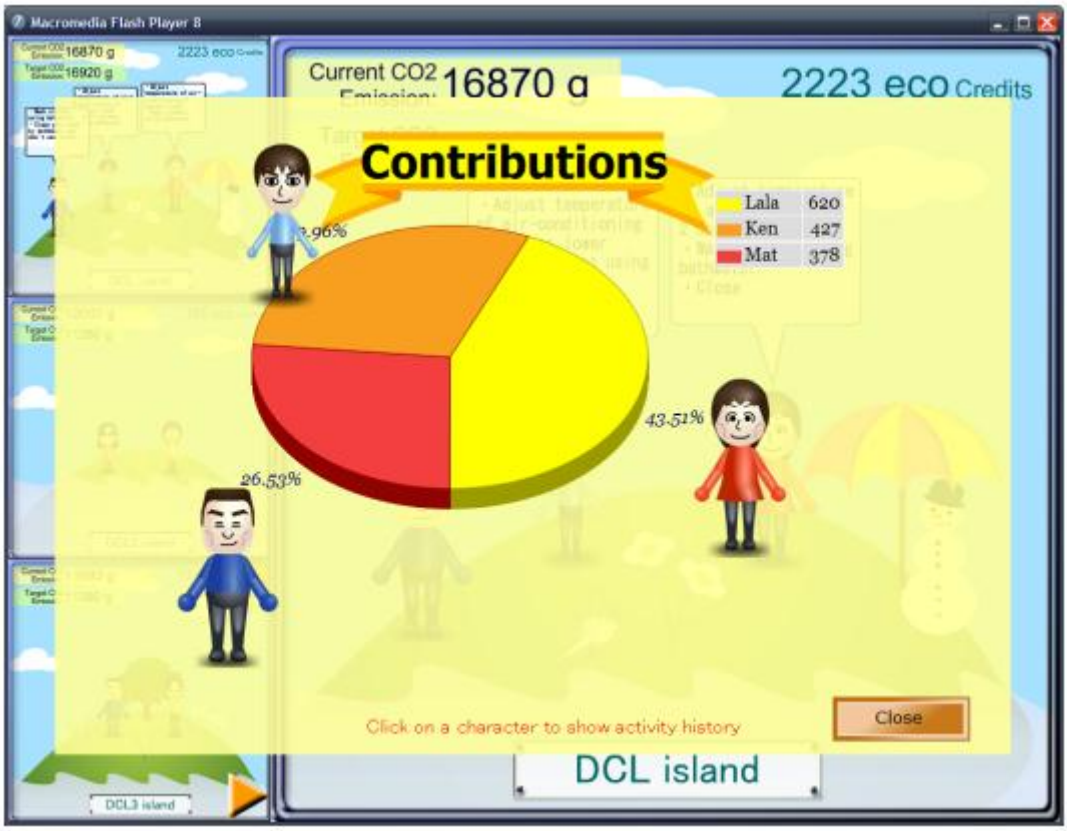
Figure 4: The main window of *EcoIsland*

Additionally, this persuasive system offers the possibility for trading with emission rights on a marketplace. The marketplace consists of nearby islands (see an example of nearby islands in **Figure 4**). **Figure 5** shows the process of trading in *EcoIsland*.

Figure 5: The process of trading in *EcoIsland*

The currency for trading is called *EcoPoints/Credits* and can also be used for buying virtual items for the decoration of the island. To address the users on a **personal and individual level** (not only on an aggregated level like on the household level) *EcoIsland* can show the "Activity history" of single users and also the contribution to the emissions in comparison to the other household members that participate in *EcoIsland*. **Figure 6** shows the single contributions of the household members.

Figure 6: Single contributions of the household members

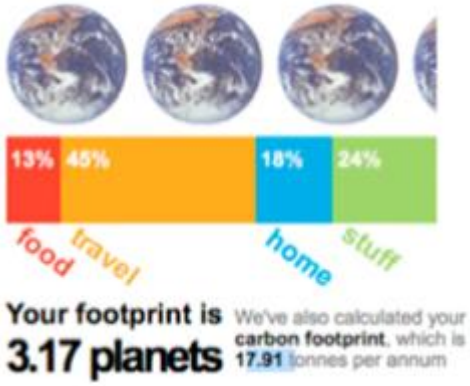


EcoIsland was **evaluated by six test-families in a four week period**. After the evaluation period the attitudes towards environmental issues were evaluated with a questionnaire. One result was that **85%** of the participants (17 out of 20) rated themselves **more conscious of the environment than before**. Participants reported that the sea levels of the islands of other families motivated them.

4.1.2 WWF carbon calculator

There are many carbon calculators available on the internet[4]. As an example the *WWF carbon calculator* (WWF, 2010; cited in Zapico et al., 2010) is presented here. This calculator presents the "relation to how many planets would be needed if everyone lived like the user". It compares the users' *lifestyle* to a normative baseline. Figure 7 shows a possible comparison.

Figure 7: An example result of the WWF carbon calculator



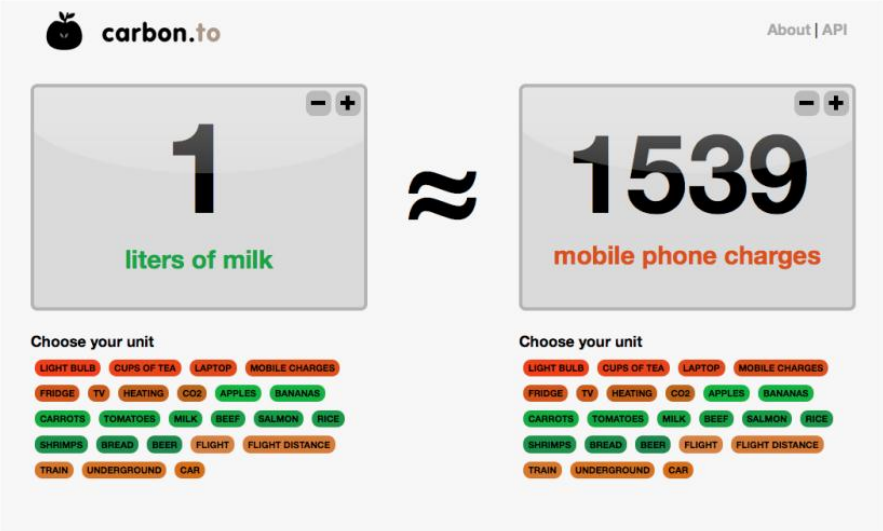
4.1.3 Carbon.to – Carbon so you can understand it

Carbon.to[5] is a web service that provides an intervention for the better understanding of CO_2 emission as a concept. This service offers a design solution that "allows users to improve their understanding of carbon emissions in a playful way" (Zapico, 2010). *Carbon.to* offers the possibility to choose a unit from the everyday life like: *liters of milk, mobile charges, apples, flight kilometers, hours to use a laptop*. The service then calculates the **carbon footprint** (CO_2 *emission that is due to this product/action*) of this product/action and offers the possibility to compare it to other units. The second unit can also be freely chosen by the user. See **Figure 8** for an example calculation where the carbon footprint of 1 liter of milk is compared to the equivalent mobile phone charges (here: 1539 mobile phone charges).

[4] Small selection of URLs: http://www.carbonfootprint.com/calculator.aspx; http://www.carbonfootprint.com/calculator.aspx; http://www.nature.org/greenliving/carboncalculator/index.htm; http://www.carboncalculator.co.uk/; http://www.epa.gov/climatechange/emissions/ind_calculator.html

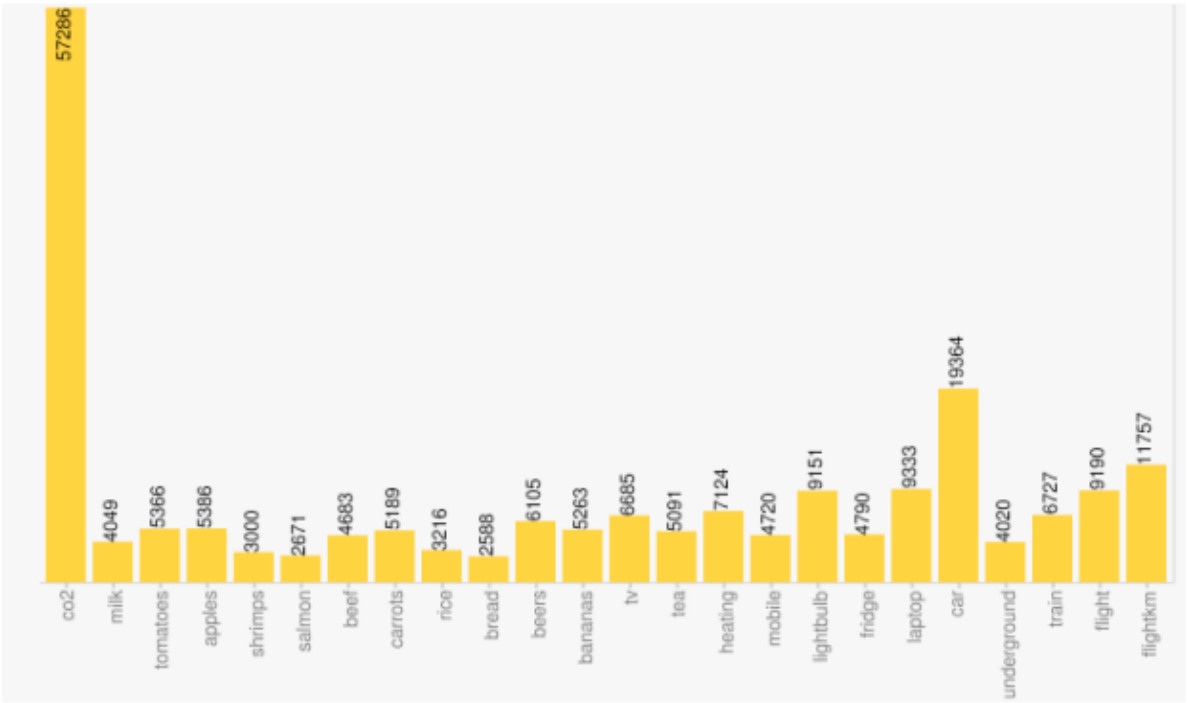
[5] http://carbon.to

Figure 8: An example calculation of Carbon.to



The authors and developers of *Carbon.to* evaluated its effect in a user study in the year 2009. Social media platforms were used to recruit participants (Twitter, Facebook, Blogs). The service was released on these platforms and attracted 7500 people in the first year. The data gathering was conducted with a logging system that saved each interaction (*change of numbers, change of units*) and with the qualitative feedback that was released on the social media platforms. The user logs give information about what units are compared the most, which are: CO_2, **kilometers with a car** and **kilometers with a plane**. See **Figure 9** for a detailed breakdown of the user logs for a period of six months. The results have been consistent over time, as a comparison of logs for one month and six months does not show a different ranking of most compared units.

Figure 9: User logs from the service *Carbon.to* for six months



The logs[6] also showed: First, the average **number of interactions is 40 per user**, which means that the users used the service very actively. Second, about a third of interactions were comparisons of the unit CO_2 and something else. Third, **units of food were not that popular**.

From the high numbers of CO_2 comparisons you can draw the conclusion that the **users' desire for understanding the concept of** CO_2 **emissions** was high, as they tried to "get a feeling" for CO_2 emission of several products and activities through the comparisons. From the qualitative data the authors derived following conclusions: **Eating beef, salmon and flying has a higher ecological impact than expected by the users** ("*Wow, super sick").*

[6] Note: Be aware that this statistics might be biased, as CO2 is the default-setting when entering the website.

4.1.4 Virtualwater.eu – The Water Footprint of Products

Virtualwater.eu[7] is based on a similar concept like the service *Carbon.to* (see section 4.1.3), it tries to increase and focus people's **awareness on valuable resources** that are important for the survival of the whole humanity like water, fresh and intact environment and climate system (endangered by too much CO_2 emission). The *Virtual Water Project* aims at the determination of **water footprint of products** (similar to the concept of CO_2 footprints of products) and a feedback to people on these footprints in order to show how much freshwater has to be used to produce certain products. The intended effect is a **change of consumption patterns**, which means increased usage of products with smaller water footprint than products with a higher water footprint. *"The water footprint of a person, company or nation is defined as the total volume of freshwater that is used to produce the commodities, goods and services consumed by the person, company or nation."*[8] The feedback is available as an application for the iOS-System and as a poster. See **Figure 10** for design pattern examples that can be adapted as visualization styles for the design of persuasive systems and technologies.

[7] URL: http://virtualwater.eu/

[8] URL: http://virtualwater.eu

Figure 10: The Virtual Water-application on iPhone (left) and the Virtual Water-poster (right)

What is the main focus of *The Virtual Water Project* is to make the concept of *Water Footprint* perceptible to the user. This is done by "a set of info graphics and visualization of research data". The most important research in this field is done by Chapgain and Hoekstra (2004). A user evaluation of the impact of the system is pending.

4.1.5 EcoChallenge

EcoChallenge contains elements from the presented persuasive systems and technologies *EcoIsland* (see section 4.1.1), *WWF carbon calculator* (see section 4.1.2), *Carbon.to* (see section 4.1.3) and *Virtualwater.eu* (see section 4.1.4). It is an application for *iOS* and aims at a **sustainable lifestyle**. The application wants to persuade users to set **sustainability as a main aim in life**. The application offers concrete **challenges** that the user can fulfill and check (like for example: "Cook a meal for your friends and use only ingredients that grow/are produced local"). As an **incentive** the application gives an overview over all **fulfilled challenges** (see **Figure 11**).

Figure 11: Overview over fulfilled challenges in *EcoChallenge*

To help people to fulfill the challenges, people can get extra information that might be helpful to reach the aim of the challenge. For example, when the challenge is *"Don't eat meat for one week"* (in order to promote an environmental friendly nutrition) the user can get information about delicious meals (with recipes) as an alternative to eating meat. This providing of **alternative behavior possibilities** should persuade the user to rather behave in this way than the others. As an incentive to accept and fulfill many challenges, the user receives a "**button**" (fitted to the special challenge) for every challenge he has fulfilled and is also ranking by means of fulfilled challenges with his friends. See **Figure 12** for the interface with the success metrics.

Figure 12: Interface showing "prices" and rankings (challenges)

Additionally, it offers **information on certain topics** (every week a new topic is presented), like how easy one can enjoy local products (like yoghurt). See **Figure 13** for an example Interface concerning weekly topics for the promotion of pro-environmental behavior.

Figure 13: Interface example of information on weekly topics concerning pro-environmental behaviour

Related to the mobility context (see section 4.2 for a review of persuasive systems and technologies that directly address the mobility context) the application offers **information about CO_2 emissions in the context of transportation of certain products and a comparison between local and foreign products**. The visualization through graphical bars and additional information of how much CO_2 emission could be avoided through the usage of local products (see **Figure 14**) should persuade users rather to use local than foreign products. An inspection of this implicit hypothesis is pending.

Figure 14: The graphical representation of the comparison between local and foreign products concerning CO2 emissions

Info graphics and additional verbal information explain the detailed product chain of the ingredients of the products and visualize the places and distances of single ingredients (see **Figure 15**).

Figure 15: Visualization of product chains

What comes next is the **addressing of the user on an individual level**. The user not only gets information about a general number of products, but also informative statistics about single products he uses. He can choose certain products and is then informed by the application about the distance of the journey of single products (see **Figure 16**).

Figure 16: Individual user statistics

For addressing aspects of **social comparison**, the user has the possibility of comparing his individual statistics to the individual statistics of friends. It is common knowledge that it is the nature of humans to compare to each other and to participate in informal competitions. We hypothesize that this social comparison incentives people to beat their friends concerning distance statistics. An inspection of this specific hypothesis is pending. Thematically addressing the CO_2 emission topic, certain **information topics are** enriched with info graphics that connects different **aspects of nutrition with information about** CO_2 **emissions.** See **Figure 17** for a comparison between three lifestyles of nutrition concerning CO_2 emissions.

Figure 17: A graphical and numerical comparison between three nutrition lifestyles (eating meat, vegetarian, vegan) concerning CO2 emission

As it is easy to see, a nutrition that is based on **meat** causes more CO_2 emission than a **vegetarian nutrition**. Less CO_2 emission than vegetarian nutrition is caused by a **vegan nutrition**. As it is obvious, this kind of persuasive strategy **makes hard facts clearly and unambiguously comprehensible**. The user is forced to face data. A change of attitude and behavior is intended in a direction that fits to this state of data. As with the individual statistics of the products it is possible to calculate individual statistics on how much meat a user eats (in gram), for example. Another option is then a comparison to the consumption of meat of the users' friends. See[9] for a detailed view on all interfaces and interactions of this feature. More related to **energy consumption patterns** is information (under the headline "clean light") about CO_2 footprints of light bulbs (see **Figure 18**), again represented in a purely graphical (relations of the blue circle represent amount of CO_2 emission caused by this light bulb) and also numerical (here: 182g of CO_2 vs. 34 g of CO_2 in 8000 hours of lightning) way.

[9] URL: http://eco-challenge.eu/ueber/

Figure 18: Comparison of the CO2 footprint of two light bulbs

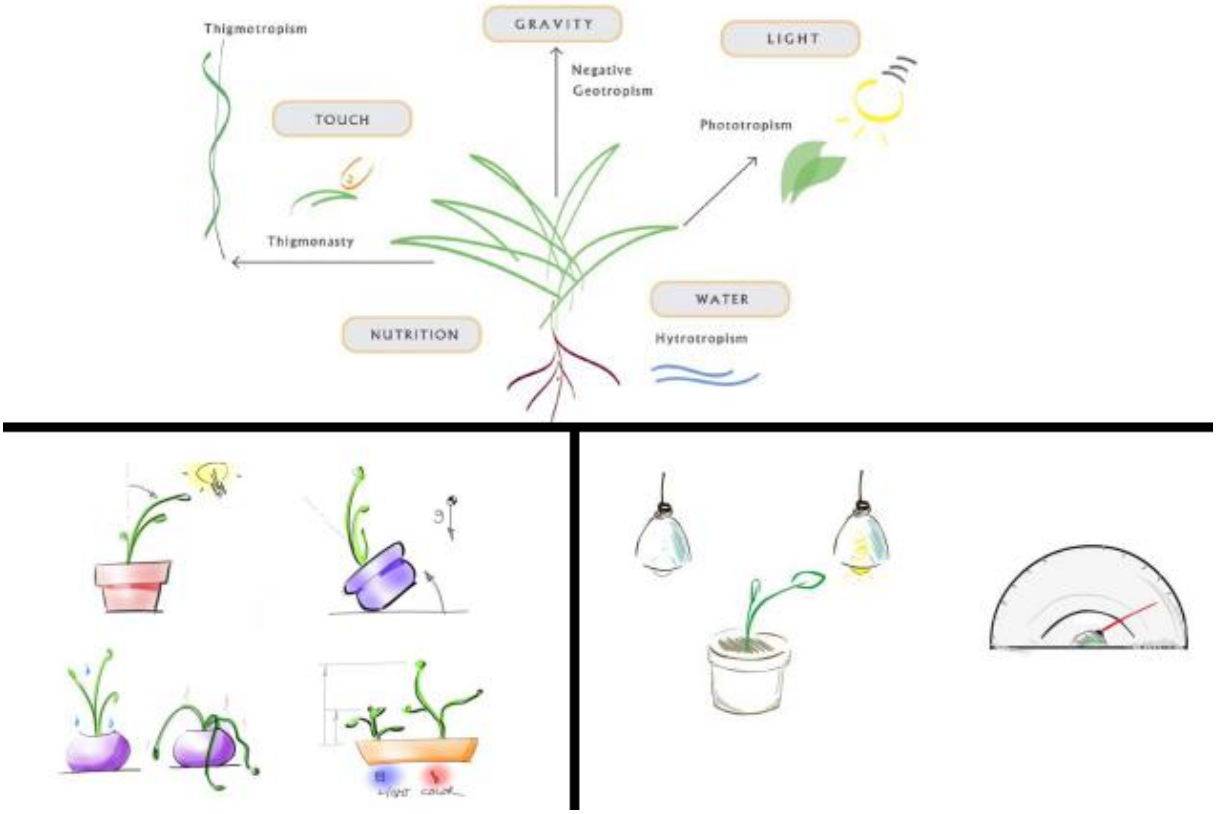
Again, individual statistics and comparisons to friends are possible.

4.1.6 The *Infotropism* display

Holstius et al. (2004) use materials from the nature as informative systems. They found that the behavior of plants can easily be understood by people, for example when houseplants generally point towards a source of light humans intuitively can interpret this behavior.

Another motivation for the authors to use plants as an informative display is the aliveness of plants that contributes to an **emotional experience**. The growth, shape and general appearance of plants can be influenced in several ways. **Figure 19** shows a **Concept sketch**: *Thigmonasty* refers to the sensitiveness of plants to touch, *negative geotrophism* refers to the orientation of the plant and *hydrotropism* refers to several water sources. *Nutrition* is also a variable that has an influence on plants. Furthermore, the *quality of light* can change shape, color and direction of light (for example: low pressure sodium light fosters thick stems, side shoots and deep green foliage).

Figure 19: Several ways of influencing plants (Upper picture: Concept sketch; Lower left picture: Concrete manipulations; Lower right picture: "Needle gauge" design for data displaying)

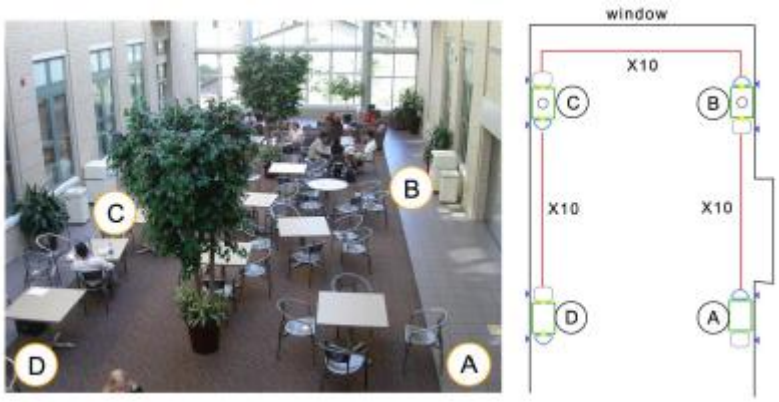


The environmental sustainable behavior that is targeted by the authors is **recycling.** The prototype consists of two tons (one "normal" ton for trash and one ton for "recycling") with sensors that regulated two light bulbs and a plan between the two tons. Additionally, the plant can either be a real plant or an artificial robot plant (see **Figure 20** for a picture of the prototype).

Figure 20: The prototype of a plant that indicates "normal" waste in relation to "recycling" waste

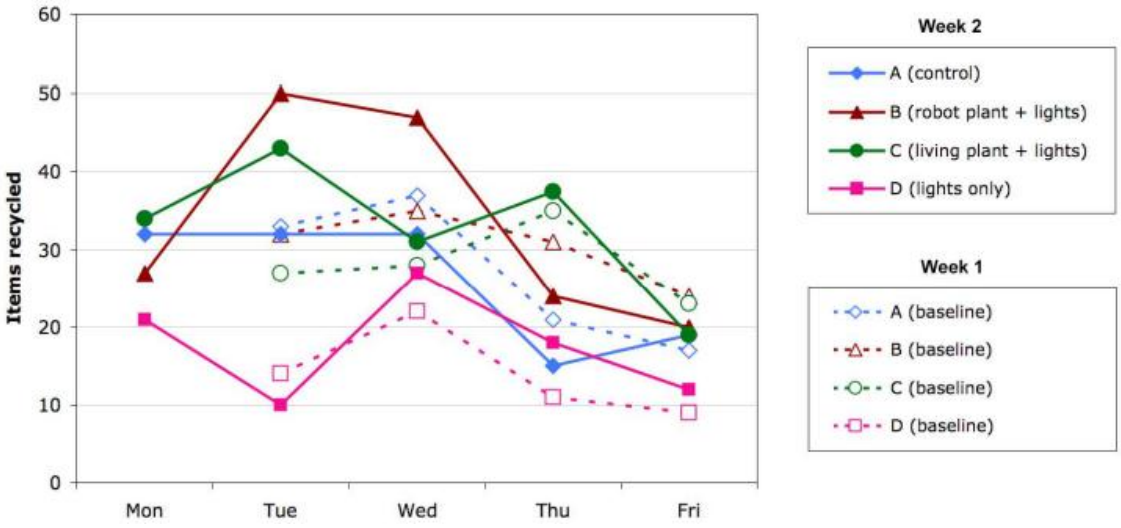
The prototype was evaluated in a two-week field study in a cafeteria. The **first week** was used as a **baseline** (only trash and recycling containers and sensors without lights and plants) arranged on four locations (A-D; see **Figure 21**), in the **second week** there were four conditions: In the **control condition** (A) there were no lights or displays (compare to **baseline**), one **experimental condition** (B) was with a robot plant and lights, another **experimental condition** (C) was with a living plant and lights and the last **experimental condition** were lights only.

Figure 21: Locations of the control and experimental conditions during the baseline (first week) and in the actual experiment (second week)



The results of the behavioral data (items being recycled) showed an increase in recycling.

No comparison of results turned to be **statistically significant**.



Only a multivariate analysis of variance of the ratio of the standardized scores of trash and recycling showed a significant effect (F[3,9]?= 3,1; p=,08) of the living plant (**experimental condition C**).

4.1.7 The Virtual Polar Bear

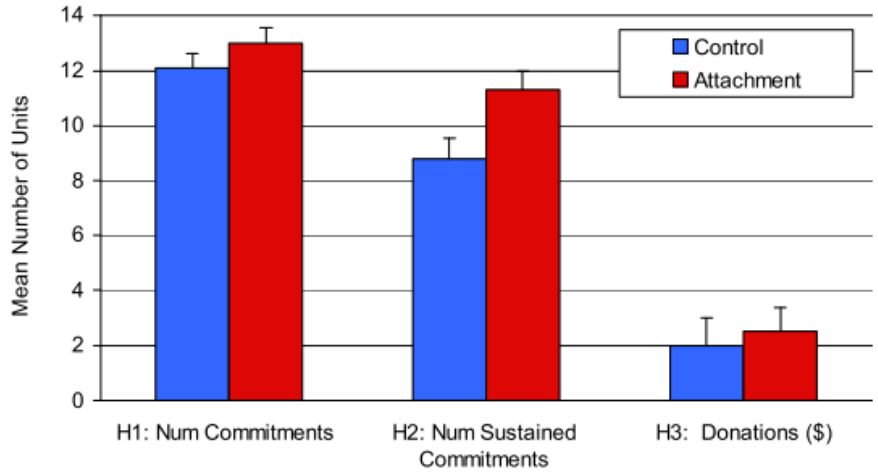
Dillahunt et al. (2008) propose that a **polar bear** symbolizes climate change (polar bear as an endangered animal because of the thinning of the ice caps as a consequence from global warming). The authors expect people to have an emotional attachment to polar bears when

they are confronted with their fate. The consequence is a hypothesized action of people to preserve polar bears and to reduce energy consumption. The authors conducted a between-subjects study with two groups to evaluate a **Virtual Polar Bear-application** (that can be used on smartphones for example). One group was introduced to the bear, the other group was the control group. To create commitment and emotional attachment, the authors used a story that describes the impact of global warming on the life of polar bears. The study group (the "attached" group) got the story, the control group did not get the story. Also, the participants of the "attached" group had to name the bear on the display (see **Figure 22** for a picture of the Virtual Polar bear). All participants completed an initial survey and two different scales before and after the main intervention (interacting with the polar bear). The Flash-based virtual polar bear on an ice floe grew as they committed to environmentally responsible actions and decreased as they did not chose to commit to actions.

Figure 22: The Virtual Polar bear with a lot of ice (top) and with little ice (bottom).

The participants were asked if they would commit to several actions, for example: Turn off the water while brushing (…) teeth; Turn off lights if you are leaving a room for more than 10 minutes; Wash only full loads of clothes; Wash only full loads of dishes etc. Also, they were asked if they had also fulfilled the actions they committed to. Additionally, they were asked if they would donate money to a zoo. The authors hypothesized that the group that is emotionally attached to the polar bear would have significant higher means concerning *commitment to actions, fulfilled actions* as well as *willingness for donations* than the group that is not emotionally attached to the polar bear.

Figure 23: Results of evaluation of the Virtual Polar bear



In this sample (n= 20; n1= 10; n2= 10) the "attached" group had significant higher means (F[1,11]= 6,527, p=.0309) than the control group.

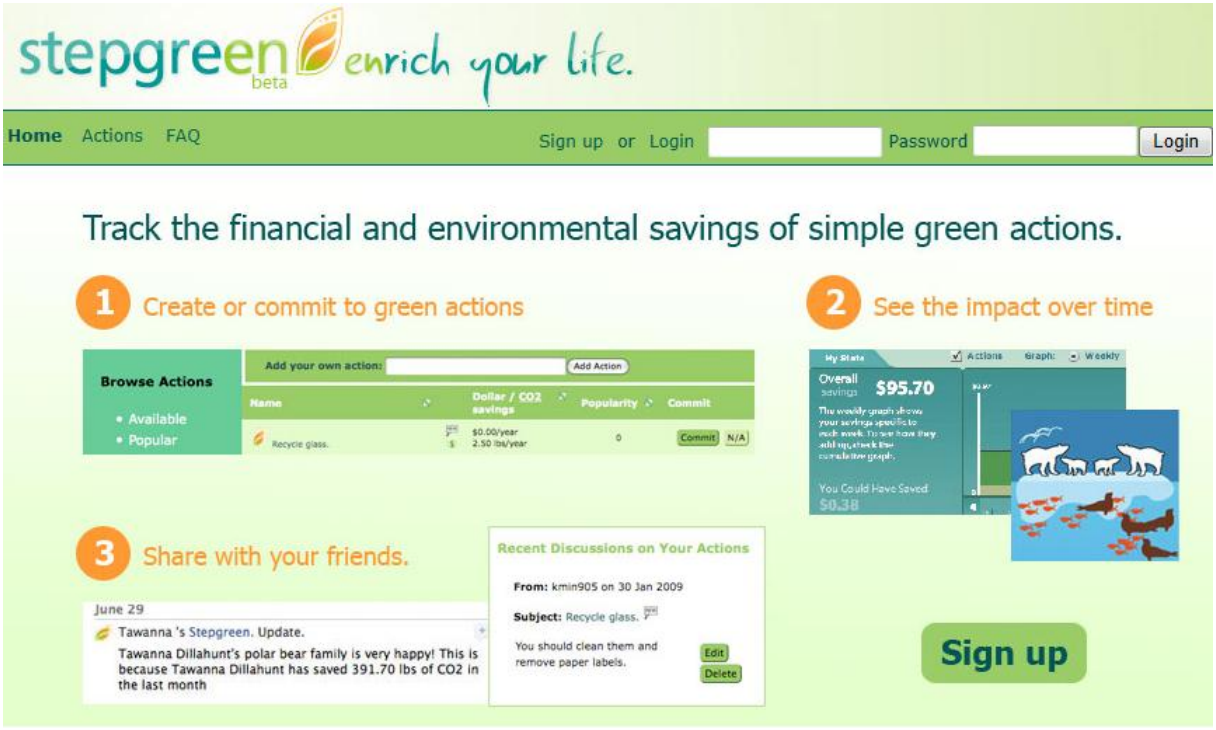
4.1.8 The *StepGreen* website

The *StepGreen*[10] website is a project by the HCI Institute at Carnegie Mellon and allows users to "commit to green actions", see the impact of their green actions over time and share their results with their friends. See **Figure 24** for the startpage of *StepGreen*.

On this website to the user can "track the financial and environmental savings of simple green actions" over time. That is to "commit" to green actions (such as "recycle glass" and to see the impact of this green action over time.

[10] URL: http://www.stepgreen.org/

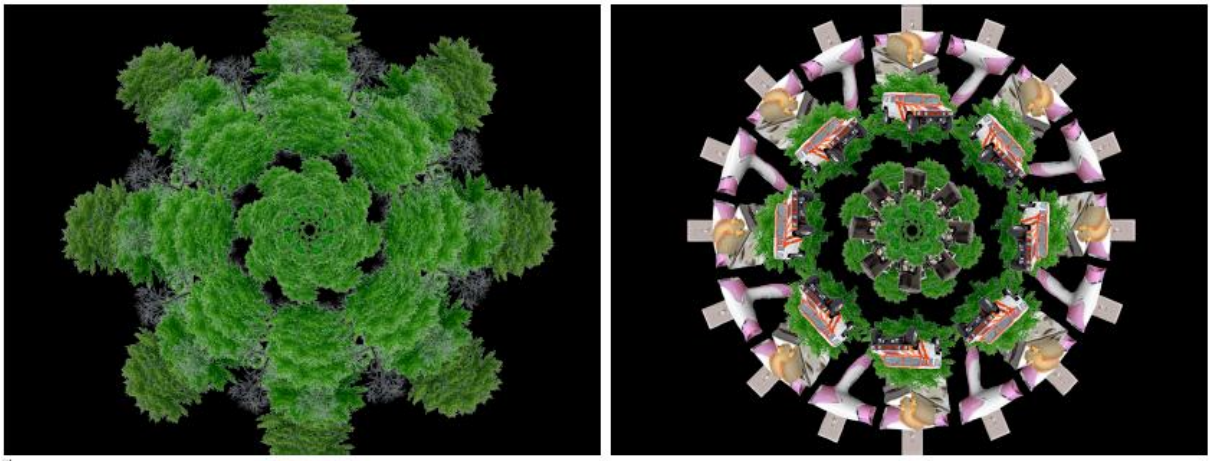
Figure 24: Startpage of *StepGreen*



4.1.9 7000 oaks and counting (touch-screen kiosk)

Tiffany Holmes has an approach of visualizing real time energy consumption in a creative way to foster environmental sustainable behaviour ("*Eco-visualization"*). This approach aims at a better understanding of the concept of carbon footprints. *7000 oaks and counting* is a public artwork that is implemented at a "lobby-sited kiosk and website that display an animation of dynamic energy loads at the National Center for Supercomputing Applications (NCSA) in Urbana, IL". The animated graphics represent carbon loads in the building by a series of corresponding tree images. The more trees are displayed, the less carbon dioxide is emitted, the more electronic appliances (and less trees in return) are displayed the more energy is used. See **Figure 25** for a comparison between the visualization of energy consumption in the early morning (left) and at midday (right) (Holmes, 2007).

Figure 25: Left: Eco-Visualization in the early morning with no energy consumption; Right: Midday with more energy consumption



4.1.10 Stump

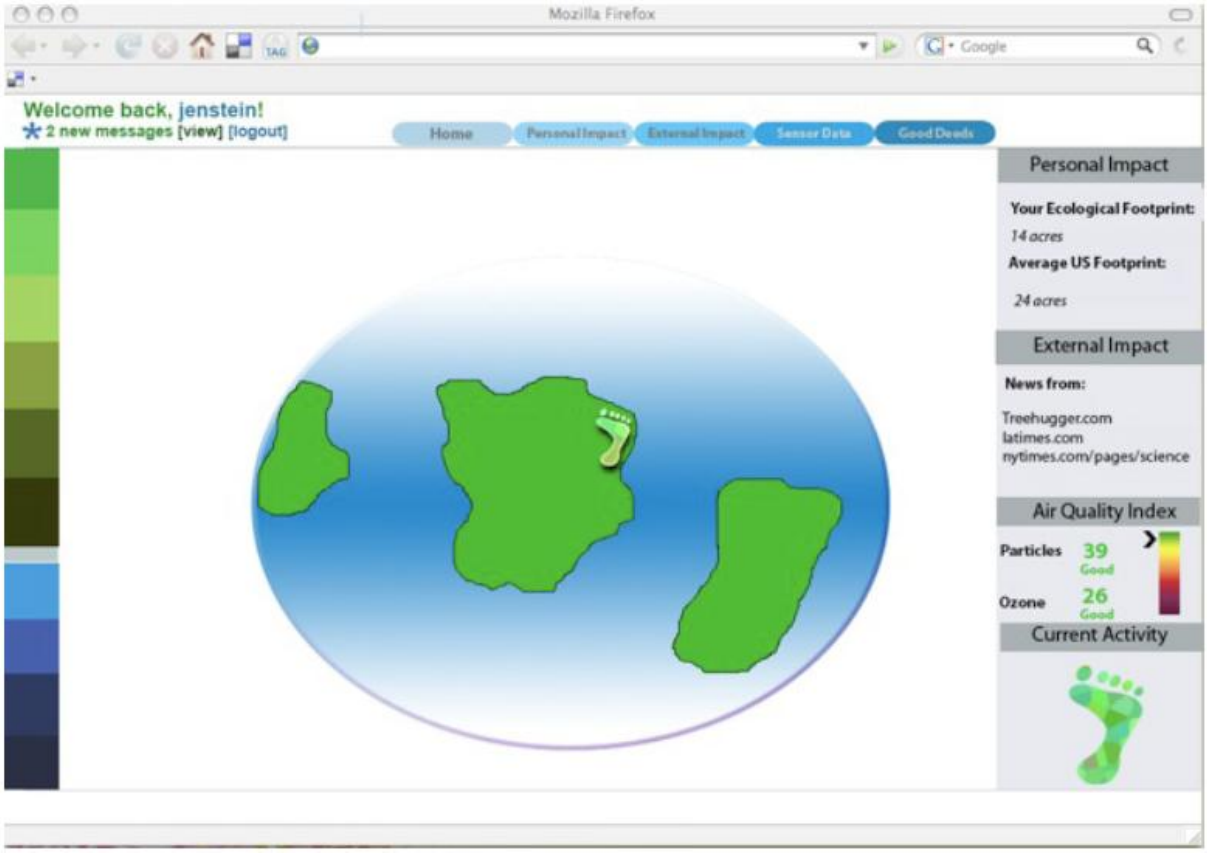
Stump is a malware program that counts the number of pages that one prints. When "the equivalent of a tree in pulp" is consumed the printer prints a "slice of tree". When one accumulates this paper one has a stump of a tree that one has consumed while printing. This stump is a "tangible representation of tree debt" (Stein, 2008).

4.1.11 TerraPed

TerraPed (Stein, 2008) is an online-community that tries to visualize human impact on the environment by means of ecological (measured in global hectares) and carbon footprints. On this interactive platform the ecological and carbon footprint of each user is measured and visualized in a dynamic graphic footprint. *TerraPed* is a data-driven fantasy world (called "Planet of Gaia") that depends upon the physical world, namely the ecological and carbon footprints of the participants. The **data sources** for this online-platform are the following (besides the participant's personal ecological and carbon footprint): RSS news feedback, a location-specific air quality sensor data (the location is provided by the zip code of the participants), changes in lifestyle by the participants, news related to climate change, technological development in sustainable energy etc. Participants are invited to **limit their consumption of resources** (compare to the system in section 4.1.1 EcoIsland) and to **upload photos** depicting them when doing an action such as: recycling, using public transportation,

using alternative energy (solar power, wind power) etc. The application is extended with a "Facebook Footprint widget", where users can share their personal carbon footprint on Facebook and compare to their friends. *TerraPed* is an application that can be accessed with an Internet browser. First, the participants have to complete a survey to measure their ecological and carbon footprint. The calculation is based on statistical data about biocapacity of the earth, waste from people in general, statistics about transportation, home energy consumption etc. After the calculation of the footprint, the participant is given a piece of land in the virtual world and can witness the change of the land with time. The change is induced by a change of air quality and other data sources. When participants log in to the *TerraPed*, they see the fictional world with their ecological footprint, messages from other participants as well as (textual as well as graphical) information about ecological impact and external information like a news-section and air-quality. See **Figure 26** for this first interface.

Figure 26: Main interface of *TerraPed*

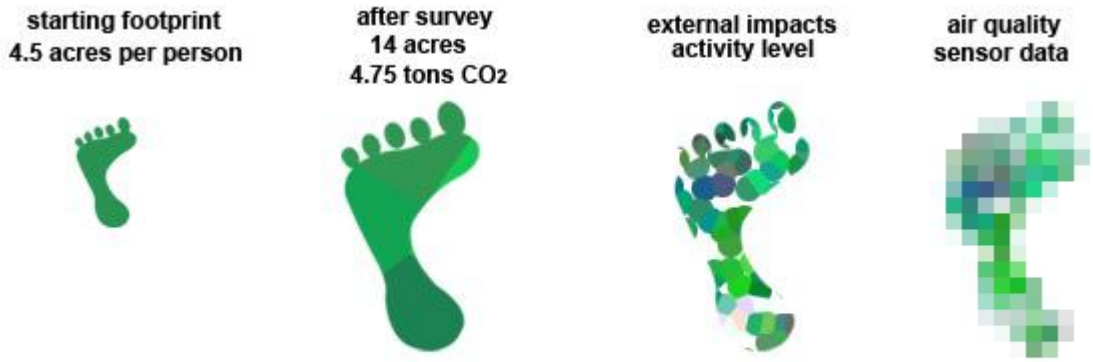


The graphical representation of the ecological footprint can change due to three parameters:

The first parameter is **size**. The initial size of the footprint represents the size that would be the optimal ecological footprint that makes the *TerraPed* –world sustainable. The second parameter is **color**. The initial color is green; any discoloration from that initial color green represents the carbon footprint of the participant ("amount of carbon produced by the inhabitant"). The influence of external factors is also represented by a change of color.

The third parameter is **blurring**. A blurred footprint is due to a change of the air quality measured by a sensor. **Figure 27** shows four possible ecological footprints. The first footprint is the *sustainable* ("ideal") footprint. The second footprint is the footprint after the participant completed the calculation-survey ("real"). The third footprint shows the influence of external factors (news etc.) and the fourth footprint shows the quality of the air in the users' hometown.

Figure 27: Graphical representations of factors influencing the users' ecological footprint



Updates on personal impacts for the calculation of the ecological footprint can be done by a visual analogue rating-system for questions like "*How often do you eat meat-based products?"* (bipolar discrete scaling from "*Never"* to "*Almost Always"*).

4.2 Persuasive Systems and Technologies in the context of mobility

4.2.1 In-Time – application

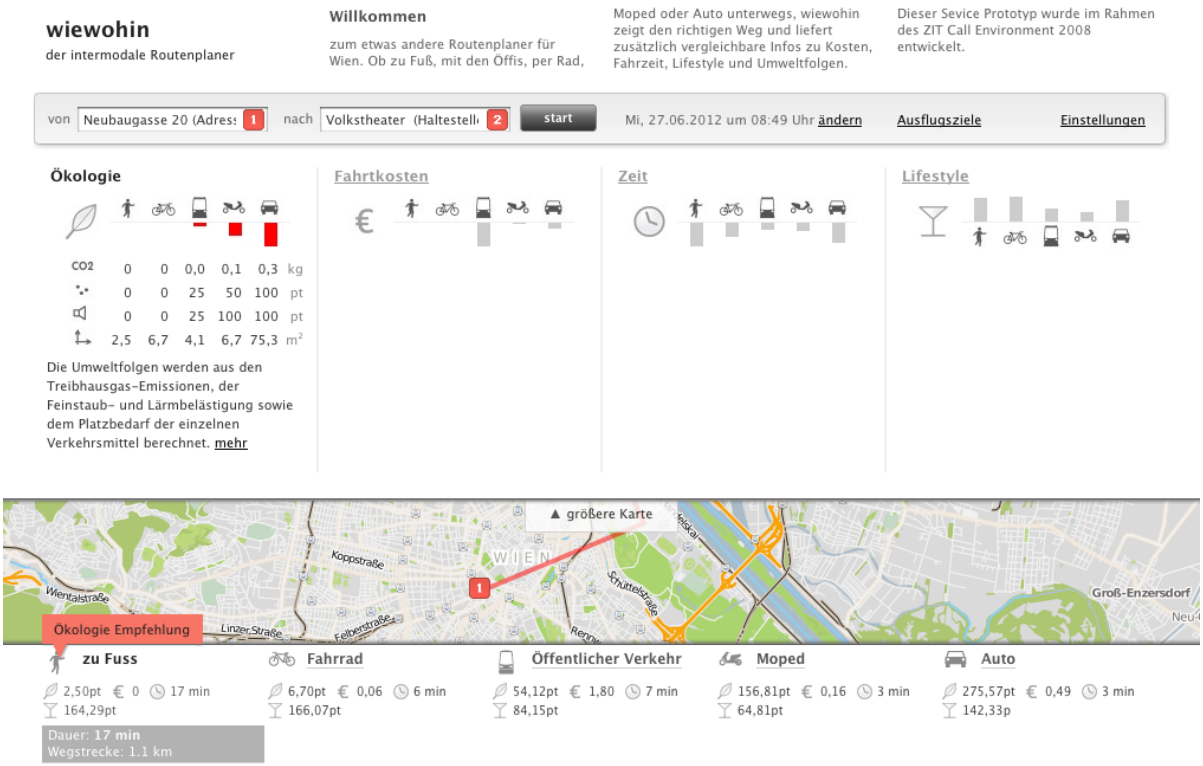
The *In-Time - application* is a navigation- and routing application that gives the user feedback about the CO_2-emission of several trip modes by graphical bars. See Figure 28 for interface examples of the application.

Figure 28: Interface examples of the In-Time-application

4.2.2 Wiewohin – website

The *Wiewohin – website* is a service for intermodal route planning and informs the user about costs of the trip, travel time, a lifestyle-parameter and ecological-impacts (such as CO_2-emissions, dust exposure, noise pollution and space requirements). See Figure 29 for an interface example of the Wiewohin-website.

Figure 29: Interface example of the Wiewohin-website



4.2.3 Kongressnavigator – application

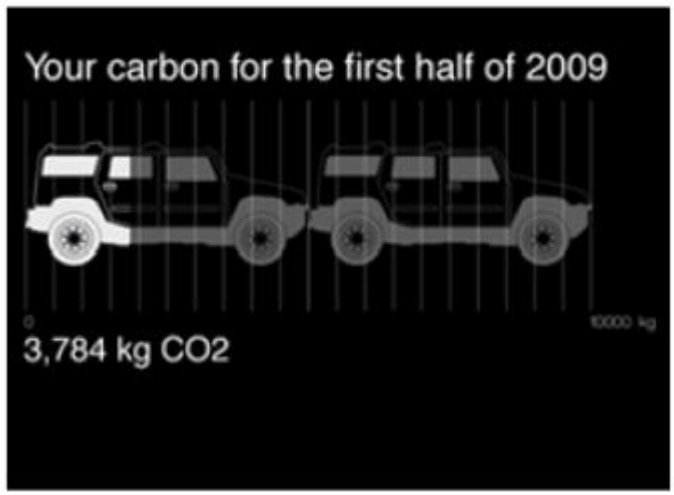
The *Kongressnavigator-application* gives similar feedback about trip parameters (such as CO_2-emissions), but is not a website but an iOS-application. See Figure 30 for interface examples of this application.

Figure 30: Interface examples of the Kongressnavigator – application

4.2.4 Dopplr – an Online Service for Smarter Travel

Dopplr – an online service for smarter travel is an application for iOS5 that is originally intended to be used in a social media context. It allows sharing personal and business travel plans with other people. Additionally, it increases the awareness of CO_2 emissions by representing it graphically in bars. It compares the CO_2 emissions between train trips (short bars in the upper area) and flights (long bars in the lower area) (Zapico et al., 2010). The implicit hypothesis underlying this graphical representation is that a change of attitude is induced by the creation of awareness for certain facts. Additionally, *Dopplr* offers a yearly report to the users. In this report the system compares the users' total carbon footprint to the carbon footprint of a Hummer (in one year) and represents it graphically. The "white filling" in the Hummer shows the users' CO_2 emission in comparison to the Hummers' emission (see **Figure 31**) (Zapico, 2010).

Figure 31: Yearly Report of the Dopplr application



4.2.5 Volkswagen Jazzcalculator

The *Volkswagen Jazzcalculator*[11] is a web service that "compares the CO_2 emitted by driving a Volkswagen to the numbers of hours that a jazz band needs to play for emitting the same amount of CO_2 (based on the breathing volume)". The user first have to define a route (for example from "Stockholm" to "Linköping"), the service then calculates the distance between the two destinations (in case of "Stockholm" and "Linköping" 207km) as well as the Emissions in Grams CO_2 (here: 4140 CO_2) and then the lengt of time for a Jazz Band toemit the same amount of CO_2 (here: 06 hours 56 min 04 sec). See **Figure 32** for an example of the interface.

[11] URL: http://www.adqualifier.com/cannes2009/volkswagen/

Figure 32: Interface example of *Volkswagen Jazzcalculator*

4.2.6 RideNow

RideNow (Walsh et al., 2005) is an online-service that helps single people or a group of people to coordinate shared rides and targets groups or small organisations. This project aims at reducing CO_2-emissions by fully utilise the seats in a car, that means instead of only using one car for one person, people should fully use the space available in each car. However, it is difficult to coordinate rides (especially ad hoc rides) due to a difficult coordination of routes and schedules. The design of *RideNow* is determined by two principles: **Incrementalism** and **tailoring to local needs and resources**. **Incrementalism** refers to the fact that the user of the system can make many small sets instead of one extensively planned large initial set. **Tailoring to local needs and resources** refers to physical spaces that are shared by the users and a personalized software environment as well as shared knowledge of the community (for example about events and special locations).

4.2.7 SmartTrip

SmartTrip (Johnson et al., 2007) is a system that encourages more efficient use of cars and therefore reduces congestion. Concluding that American drivers are not interested in public transport and instead favour the usage of their cars, this would be a promising approach. In an initial research the authors found a special target group that only focuses on their car as mode of traveling. This target group consists of **heads of households that are between 30**

and 50 years old and have children that live in cities and suburbs. The most aims of trips of this target group are: **"grocery shopping"** and "**picking up children from events".** *SmartTrip* is an application for smartphones. The user can type in the aim of the trip into the phone (for example "dry cleaning"). The application gives an example for the closest "dry cleaners" as an output.

Additionally, the user can add a shopping list. The application can handle reoccurring errands but also unplanned errands and always **"suggests the most efficient route for the trip".** The system takes following factors into account when calculating routes: **location of the user, selected destinations and the current traffic situation on the route**. The system also informs the user about the remaining time that it takes to conduct the errands. When asked about which options the user wants to be informed of (possible options: **gas usage, greenhouse effect, time of each errand**) the overall results showed that the users were most interested in **the total time of multiple errands.**

4.2.8 Samsung Blue Earth S7550 – *EcoWalk*

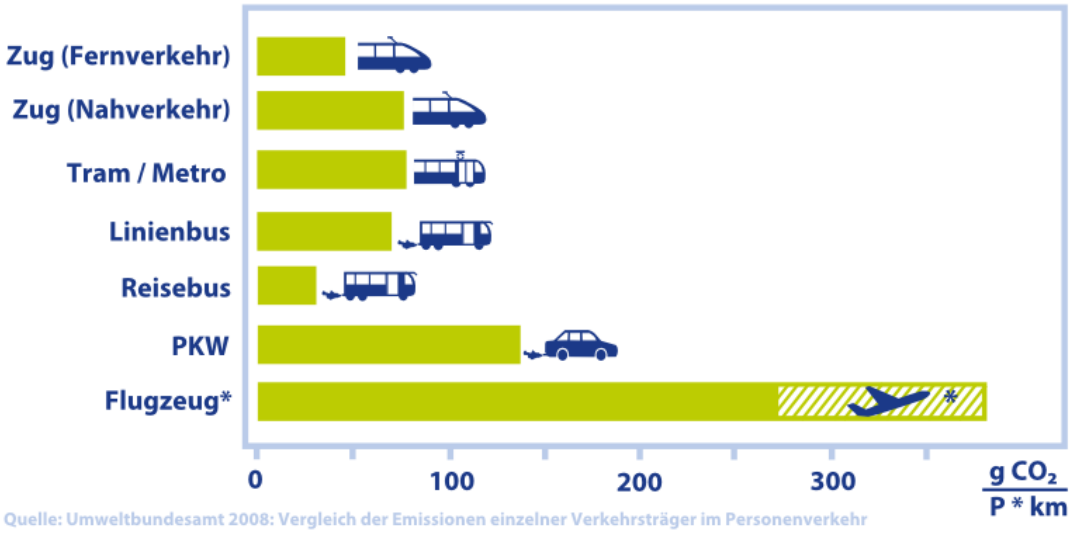
The Samsung Blue Earth S7550 *EcoWalk*-app has an internal step counter that calculates how much CO_2 would have been emitted when one would have driven a car and how many trees were saved by walking. The user has the possibility to see his *EcoWalk*-history and informative statistics. See **Figure 33** for an interface example.

Figure 33: *EcoWalk* on Samsung Blue Earth S7550

4.2.9 Atmosfair

Atmosfair[12] is a web service that compares (graphically and numerically) the CO_2-emissions for several transport modes for a definable length of a planned trip.

Figure 34: Interface of *Atmosfair*



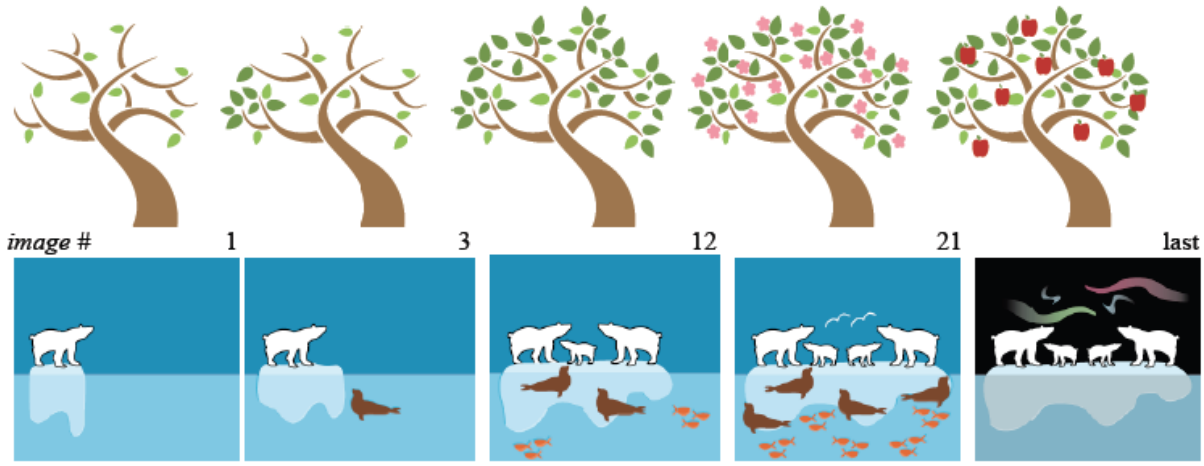
4.2.10 UbiGreen: A Mobile Tool for Tracking and Supporting Green Transportation Habits

UbiGreen (Froehlich et al., 2009) also visualizes CO_2 consumption of sensed and self-reported travel behavior with the help of graphical metaphors (like for example trees that grow or with more or less animals like polar bears, seals and fish – according to CO_2 consumption). See **Figure 35** for an interface example of the *UbiGreen*-app and **Figure 35** for the changing of trees and animals.

[12] URL: https://www.atmosfair.de/klimafreundlich-reisen/wasbedeutetdas/

Figure 35: Interface of the *UbiGreen*-application

Figure 36: Metaphorical growing of trees and representation of CO2 consumption by more or less animals like polar bears, seals and fish.

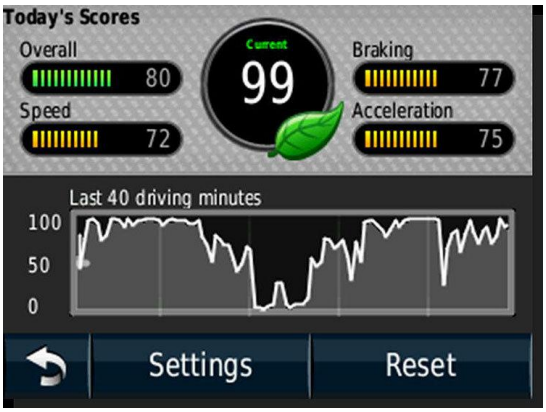


4.2.11 Garmin Nüvi *EcoRoute*

The Garmin Nüvi *EcoRoute*[13] navigation system shows the actual gasoline consumption rate and CO_2-emissions. It analyses and optimizes the driving behaviour of the user and suggests eco-friendlier routes. It has several eco-scores (like for example score for breaking or accelerating; see **Figure 37**).

[13] URL: http://www.garminonline.de/strassennavigation/ecoroute-hd/

Figure 37: Interface of Garmin Nüvi *EcoRoute*



4.2.12 Other persuasive systems and technologies in the mobility context

Similar to the *Dopplr*-application (see section 4.2.4), *RideNow* (see section 4.2.6) or *SmartTrip* (see section 4.2.7) there are several other persuasive systems and technologies in the mobility context that give the user feedback about their driving behaviour and several ecological parameters: *Fiat Ecodrive*[14] (see Figure 38), Ford *EcoMode*[15] (see Figure 39), *Honda EcoGuide*[16] (see Figure 40), *MINI Minimalism*[17] (see Figure 41) and *FIAT Ampera*[18] (see Figure 42).

[14] URL: http://www.fiat.co.uk/ecodrive/Default.aspx#ecodrive/abouttheapp

[15] URL: http://www.contracthireandleasing.com/car-leasing-news/super-green-ford-focus-econetic-set-for-2012-bow/

[16] URL: http://alternativefuels.about.com/od/2010hybridreviews/fr/2010Insight.htm

[17] URL: http://www.minispace.com/de_de/article/mini-connected/456/

[18] URL: http://auto.freenet.de/pictureshow/tests/fahrberichte/opel-ampera-eco-drive-ams1611-fahrbericht-geladener-gast_2856164_553994_2856160_20.html

Figure 38: Interface of the FIAT Ecodrive software

Figure 39: Interface of the Ford EcoMode-installation

Figure 40: Interface of the Honda EcoGuide

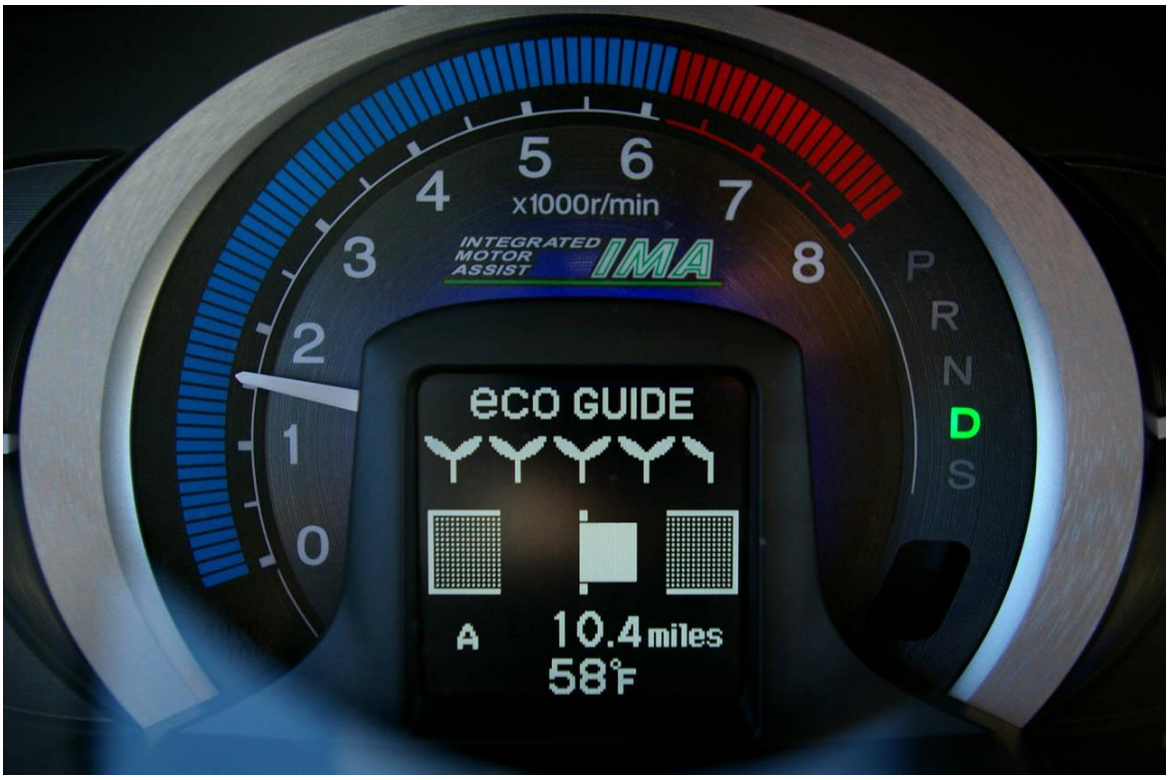


Figure 41: Interface of the MINI Minimalism-installation

Figure 42: Interface of the FIAT Ampera-installation

4.3 Persuasive Systems and Technologies in domestic and leisure context

4.3.1 General approaches

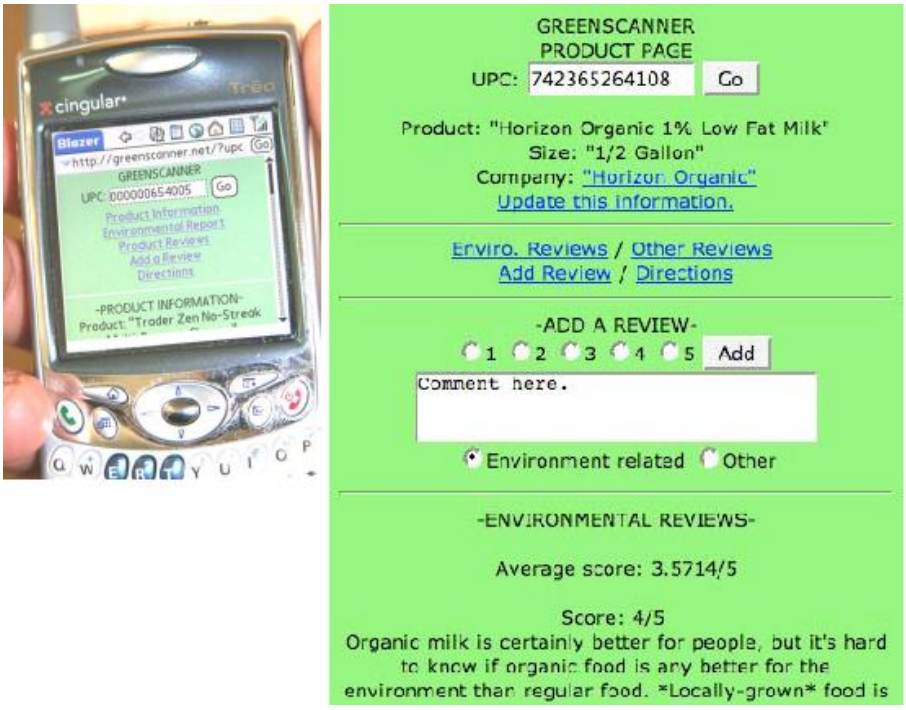
Gerdenitsch et al. (2011) describe an approach for integrating persuasive strategies within technology that provide feedback on energy consumption to increase user's acceptance and usage of those technologies (see Gerdenitsch et al., (2011). This was done for an exploratory field study with the aim of designing persuasive technologies for reducing domestic energy consumption).

4.3.2 GreenScanner

GreenScanner (Tomlinson, 2008; see **Figure 43** for a picture of the prototype) aims at reducing trash and aims to persuade people to handle the resources of the earth in a careful way. This application for smartphones is for consumers that are willing to engage in "**environmentally preferable purchasing**". The problem is that consumers lack (reliable) information about products at the time of purchasing. According to the authors factors that usually influence consumers purchasing behavior are: **price, labeling, imperfect memory and force of habit**. With the help of cameras in mobile phones it is possible to scan the product code on the product that the consumer wants to have information on. The application then accesses to a database and gives a review score for the product.

The database contains reports about **environmental impacts** of products. Also, users can rate and review products concerning either "environmental related" or "other" issues on a *GreenScanner* product page.

Figure 43: Prototype of *GreenScanner* (left) and *GreenScanner* product page



The authors report following evaluation data: The hits ("*GreenScanner*") on the search engine *Google* showed more than 15,000 hits in the first few weeks the service was released. The GreenScanner website received approximately 73 hits per day.

4.3.3 *Imprint:* Visualizing environmental issues from a printer

Although the goal of *Imprint* – a system for visualizing environmental issues concerning a printer – is not explicitly to reduce paper, energy consumption or the use of toner, it should raise awareness about what counts as waste when using a printer (Pousman, 2008). *Imprint* is a monitoring system for one or several printers that visualize the data stream that passes the printer. The visualization of this information is on a large touch screen that is mounted upon the printers. The presentation of the data happens in an ambient way (resembling ambient information systems). The following environmental informations are displayed: How much paper is used, how much toner is used, and how much energy is used. In comparison to persuasive systems ambient information systems do not intend to modify attitudes or behaviour.

4.4 Criticism on persuasive systems and technologies

Pousman et al. (2008) argue that persuasive systems and technologies (in comparison to ambient information systems) are systems "that bull[y][es], badge[], cajole[] or shame[s]" users. They do not believe that long-term effects on attitudes and behavior are possible. They believe instead that users become resilient against interventions like this and even try to circumvent the systems: In their developed system *Imprint* (see section 4.3.3) they imagine a scenario where users avoid the printers that are observed by the *Imprint*-system: They simply evade to their printers at home when they feel the (social) pressure to reduce consumption of paper, energy and toner.

They argue not to change attitudes and behavior in the first place, but to evoke awareness for environmental problems and to trigger reflection about those problems in a *playful*, but non prescriptive way.

5. Conclusions, implications and consequences for the prototype

Means to reduce CO_2 are urgently needed and as personal transportation is one of the greatest contributors to the emissions of CO_2, there is a need for an attitudinal and behavioral change of people towards personal transportation in a pro-environmental direction.

According to Dillahunt et al. (2008), strategies that effectively motivate behavior change contain following components: **Simple messages that are easy to understand, messages that are submitted just at the right time, messages that are submitted just at the right place and in a non-annoying way**.

The persuasive strategies used in the prototype will contain these four components. Research activities in the project will focus on the extraction of simple messages that can be understood by the users, the identification of suitable time points to present these simple messages to the users. Also, the implementation of the strategies will happen without annoying or forcing the users to behave in a certain way. The integration of the strategies and principles will therefore happen in an ambient way.

All persuasive systems and technologies that have been presented have certain things in common: First, the systems and technologies have an emphasis on the creation of **awareness** for certain problems (like the urgent need to reduce CO_2 emissions).

Second, most of the presented systems and technologies that deal with CO_2 emissions and focus on pro-environmental attitudes and behaviour try to **translate the concept of** CO_2 (that can hardly be understood and represented by the users) in other units that are easier to understand.

The evaluations of persuasive systems and technologies have shown that changes of attitudes and behavior can be evoked through such *technological interventions*. At least, short-term changes have been shown to be a possible outcome.

A special focus in the Peacox-prototype will be a focus on long-term changes through the usage of the application. The project consortium will try to integrate as much persuasive strategies and principles as possible in the prototype.

The main strategies that will be integrated in the prototype are presented in section 2.1.1, from these strategies we will identify the most promising ones in dedicated research designs.

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