Generating Directions for Persuasive Technology Design with the Inspiration Card Workshop

Janet Davis

Dept. of Computer Science
Grinnell College
Grinnell, IA 50112, USA
davisjan@cs.grinnell.edu

Abstract. Participatory design methods may help account for the ethical implications of persuasive technology. But how can participatory design methods both address ethical issues and lead to effective persuasive technologies? This paper presents the early stages of participatory design with a college EcoHouse. I discuss concepts resulting from an Inspiration Card Workshop [1], finally considering further development of participatory methods for designing persuasive technology.

Key words: Persuasive technology, participatory design, Inspiration Card Workshop, conceptual design, design materials

1 Introduction

The discourses of persuasive technology [2, 3] and human-computer interaction more broadly [4] have engendered many technological interventions intended to promote more environmentally sustainable behavior. Although most would agree that helping people to reduce their environmental impacts is a good end, even design to a good end brings moral responsibility. The designer must be concerned not only with the ethical implications of persuasive strategies—for example, privacy in systems that monitor activity—but also issues of autonomy and consent raised by the act of persuasion itself [5].

While some have developed ethical principles for persuasive technology [2, 6], Davis argues that designers need methods to help them account for their ethical responsibilities [5]. Participatory design, with its commitment to engaging future users as full partners in the design process [7], has some promise. Moreover, Goodman argues that participatory design can help account for stakeholders' differing beliefs about the human relationship to nature [4]. In reference to the work of DiSalvo, et al. [8], Goodman explains that participatory design "can help empower potential users to surface, reflect upon, and creatively respond to their own unmet needs" [4]. But with the exception of recent work by DiSalvo [8] and Miller, Rich, and Davis [9], there has been little exploration of participatory approaches to persuasive technology design or to sustainable interaction design.

I aim to further such exploration through work with a student project house, EcoHouse. The design goal is to implement persuasive technology to support

EcoHouse's mission of enacting and promoting environmentally sustainable campus life. The research goal is to consider two questions. First, how can participatory design methods lead to effective persuasive technologies? Second, what are the ethical outcomes? How do participants and non-participants relate to the resulting persuasive technology—both the intentions behind it and the strategies it employs? Prior work in this space does not fully address these questions. DiSalvo, et al. focused on participation as empowerment and technology as rhetoric [8]; there is no evident intent to deploy any technologies. Although Miller, Rich, and Davis had this intent and used a participatory approach, the final concept was developed mainly by the designers [9]. This paper begins to address these questions by relating the early stages of participatory design with EcoHouse.

Thus far, there are few published methods for designing persuasive technology to draw upon. Fogg's 8-step process [10] is appealing in a participatory context because it provides a flexible framework for the early stages of design and is intended for new persuasive technology designers. Though deviating in significant ways, this work is informed by Fogg's recommendations.

In this paper, I will briefly present the design context, report on exploring the space through field study and generative tools [11], explain how the Inspiration Card Workshop [1] generated design concepts, and finally discuss this participatory approach and future directions in light of the questions above.

2 Design Context

This work is set at a small, residential liberal arts college in the midwestern United States. The college has three *project houses*, student residences allocated through an annual competitive process. EcoHouse's proposal for the 2009-2010 academic year sets forth not only a broad goal for residents to live sustainably, but also three more specific goals, each supported by a committee: first, to conduct educational outreach through events and workshops; second, to raise a garden in EcoHouse's backyard and use its produce; and third, to collaborate with the college's Facilities Management (FM) unit in testing new technologies and practices for possible use elsewhere on campus. I chose to approach EcoHouse as an opportunity space, "where many new things are possible but there is no clear requirement" [12], and therefore scoped the early stages of the design process to consider all aspects of EcoHouse's mission.

All ten of EcoHouse's residents for the fall 2009 semester (4 men, 6 women) initially agreed to participate in this design project. However, one resident left the house mid-term and withdrew from the project. The remaining nine residents participated to varying degrees over the course of the semester.

3 Exploring the Space

This project began with ethnographically-inspired field methods, which have a longstanding role in participatory design [13]. I briefly interviewed participants about their goals, hopes, and concerns for living in EcoHouse, their relation

to EcoHouse's mission, and their comfort with potential technology channels. I also obtained documents such as the aforementioned proposal. Finally, I acted as a participant-observer in EcoHouse's weekly dinner meetings. Although field study informed my work in other ways, here I will focus on persuasive technology channels and on one persuasive technology already in use at EcoHouse.

Fogg points out that designers should choose a persuasive technology channel based not only on the target behavior, but also on the habits of the target audience [10]. Somewhat surprisingly, not all of the college student participants reported being active Facebook or mobile phone users. Several participants have Facebook accounts but rarely use them; one has no account. Although all participants have mobile phones, some keep them turned off, due to cost, poor reception, or personal preference. Participants did report using email and the Web on a daily basis, making these potentially appropriate technology channels. Moreover, the common space of EcoHouse itself could support ambient displays.

Field study revealed a few simple, ad hoc persuasive systems already in place at EcoHouse. Most relevant here is a metering system installed last year to help residents monitor their energy and water consumption. This system has been a mixed success. On one hand, the system is inaccessible and hard to use. Some residents described the system as a mysterious thing lurking in the basement. On the other hand, members of the FM committee produced monthly and daily trend graphs, from which they have identified high-consumption activities (heating, cooking, and showering) as targets for behavior change.

Beyond my own analysis of the site, I wanted participants to be active partners in reflecting on their own behaviors and intentions. However, participatory methods for understanding workplace tasks seemed problematic in EcoHouse's home setting. Instead, I designed a package of materials for participants to complete and reflect upon on their own time, that would feed into later stages of the design process. While these generative tools are similar in form to those in a cultural probes package [14], in a participatory context they are intended to serve as "primes" to begin engaging the participants' creativity [11], as well as a source of information and inspiration for design.

I delivered the materials at the house's second weekly meeting, stressing the opportunity for fun and reflection. I told participants that the materials could be completed in groups or individually, and that there was no need for consensus, nor to complete them all. In keeping with the environmental focus, I constructed a display and many of the individual items from reused materials. The generative tools remained for four weeks in EcoHouse's living room. The package included

- cards with questions and images to evoke stories, reflection, and analysis;
- three cards offering "three wishes" for new things for EcoHouse [15], to get participants imagining changes to the house;
- a disposable camera with prompts to take photos of scenes such as "something to use more" and "a guilty pleasure", to promote playful reflection;
- floorplans of the house with instructions to annotate them with activities and resources consumed in different locations;

– a Sustainability Diary asking participants to complete the sentence "Today I'm proud of myself because I..." on a "green day" and "Today I wanted to...but I didn't because..." on a "not so green day".

These last three items were intended in part as a kind of "investigative participation" [16] to help participants identify desirable behaviors and barriers that prevent those behaviors, both early steps of Fogg's 8-step process [10].

Participants responded well to the generative tools, completing more than half the materials. Several participants contributed, sometimes even to a single item. Their enjoyment was apparent in some elaborate responses. Though not systematic, the responses revealed desires for behavior change—for example, to reduce food waste, take fewer or shorter showers, do chores more reliably, and avoid buying "cheap, industrial" food. Although some participants clearly desired these changes for themselves, some comments seemed more directed at others. One item, a blank pie chart, unexpectedly inspired a participant to classify ways in which EcoHousers act or fail to act sustainably. He divided sustainable actions into individual decisions such as turning off lights and group decisions such as buying a farm share. But he also considered *barriers* to sustainable action: "unconscious actions" or habits, "accidental unsustainability" due to a "lack of knowledge," "devil's bargains" where there is no good choice; and finally "laziness/apathy." Even in this group organized around environmental sustainability, the most apparent barrier was a lack of motivation to prioritize sustainability over other conflicting desires—for example, participants wrote in the Sustainability Diary about giving in to the desire to buy a favorite flavor of ice cream or overcoming the aversion to working outdoors on a muddy morning. Beyond the desire for comfort, three different participants cited a lack of time as a barrier to achieving house goals. The participants have some freedom in managing their time commitments, but may prioritize other highly valued activities, such as their academic work, over work for EcoHouse. Thus, although a lack of motivation may simply be "apathy," it may arise from competing values.

4 Inspiration Card Workshop

To move from analysis and reflection to design, I used Halskov and Dalsgård's Inspiration Card Workshop [1]. As suggested by the name, the key materials are the Inspiration Cards, which provide simple, tangible representations of domain concepts and inspirational technologies. During the workshop, participants and designers select and combine cards to create new design concepts. Below, I discuss the the Domain and Technology Cards, the workshop, and its results.

4.1 Domain Cards

Domain Cards represent concepts from the design domain: in this case, EcoHouse. The front of each Domain Card comprises a title and an image; the

Fig. 1: *Comfort*, *Waste*, and *A Supportive Community* (shown front and back) are three examples from the 27 Domain Cards used to represent concepts from EcoHouse.

back uses words to further evoke or explicate the concept (figure 1). The Domain Cards are intended to support participants in making design moves such as juxtaposing concepts or shifting from the concrete to the abstract [1].

Halskov and Dalsgård suggest that Domain Cards can be created either by the designers or by participants [1]. In the interest of both fostering participation and respecting participants' time, I first identified 55 possible Domain Cards by reviewing EcoHouse documents, interview transcripts, my notes from participant-observation, and the generative tools and then I met with three participants to validate and prioritize the concepts. Groups of "unimportant," "vague," and "redundant" cards emerged. Of the final 27 Domain Cards, participants helped to distill, augment, clarify, or rename ten concepts, more than a third of the total; participants also proposed two entirely new cards. Finally, I chose pictures and words to illustrate each concept. When possible, I selected a photo from the results of the generative tools, thus reflecting participants' own work back to them in this intermediate product [17]. For the remainder, I enlisted a participant's help in taking additional photos at EcoHouse, or chose stock photos. For the backs of the cards, in most cases I used participants' own words. For concepts that were clearly important but less explicitly discussed, such as *Water*, I used quotations from published sources.

4.2 Technology Cards

Technology Cards depict inspirational technologies. Like the Domain Cards, these serve as tokens to support design moves, but also to educate participants about technological options. The front of each card shows a photograph or screen shot, while the back gives a description and a citation (Figure 2).

Halskov and Dalsgård recommend that the designers determine the set of technology cards based on their expertise [1]. In selecting the Technology Cards, I followed Fogg's recommendation to work from example persuasive technologies that share an audience, technology channel, or target behavior with the design problem at hand [10]. However, because of the broad scope, the 18 Technology Cards cover a range of behaviors related to environmental sustainability: conserving energy (4 cards), water (2), and paper (1), making sustainable choices while shopping (1), and increasing recycling (1). I also included two persuasive

Fig. 2: The *Virtual Polar Bear* [18], *One Million Acts of Green* [19], and *Infotropism* [20] (shown front and back) are examples of the 18 Technology Cards.

web sites concerned with "sharing goals" for environmental sustainability, as classified by Zapico, Turpeinen, and Brandt [3]. Based on the interviews, I included both ambient displays (8 cards) and web sites (5) as preferred technology channels. Finally, I considered not only the college student audience (5 cards), but also the context of home (5). Some Technology Cards fall into multiple categories: for example, Oberlin's dorm energy competition [21] overlaps the current project in audience, technology channel, *and* target behavior.

I included as provocation two cards that arguably fall on the borderline of persuasive technology. First, the Shower Manager [22], marketed to parents of teenagers, reduces the water pressure after a pre-set time has elapsed as negative feedback to discourage long showers. Second, "These Come from Trees" stickers [23] are not a computational technology at all, but are an excellent example of the *kairos* strategy [2] when placed on a paper towel dispenser.

4.3 Workshop Agenda

The Inspiration Cards served as the basis for two, two-hour workshops on consecutive Saturdays, one with four participants and the other with three. These workshops were audio recorded, and took place in my research lab in order to gain distance from the context of use and shift into a design mind-set.

First, I introduced the agenda and goal for the workshop: to generate ideas for new technologies in support of EcoHouse's mission of promoting sustainable living. The Domain Cards were presented by one of the participants who had helped to review them, while I presented the Technology Cards. Where the domain concepts were familiar to participants, the technologies were mostly new and prompted questions and discussion. The main part of the workshop is the Combination and Co-Creation phase. I explained that participants could select any cards to create a new idea; illustrate the idea as a poster using the cards, tape, and markers; and use blank cards to introduce other inspirational technologies or domain concepts. As Halskov and Dalsgård recommend [1], the workshop had no rules for taking turns or combining cards, so participants could use the cards in a variety of ways. At the end of the workshop, participants explained their ideas to each other; I photographed each poster to capture its final state. At the participants' request, this became a discussion of next steps.

4.4 Workshop Results

The primary results of the workshops are the posters depicting design concepts. Participants generated a total of 26 concepts, 14 in the first workshop and 12 in the second. Table 1 gives participants' spoken descriptions of selected posters, while Figure 3 shows examples of the posters themselves.

Design concepts combined as many as eight cards and as few as one, with a median of one Technology Card and three Domain Cards. One pattern was to combine a single Technology Card with a few Domain Cards showing how the technology could support EcoHouse's mission. For example, a participant explains how the *Weather Beacon* [24] could help them to proactively manage the house's heating system, in relation to *Energy* and *Changing with the Seasons* (Table 1, B8). However, other ideas were more innovative in their combinations: for example, combining the domain concepts of *Energy* and *Cooking and Eating* with the *Breakaway* [25] technology to produce an ambient display that suggests taking advantage of the oven's residual heat after it is turned off (Table 1, B10).

All the design concepts reflect an intent to change behavior. By my analysis of the posters and participants' spoken descriptions, each concept employs at least one persuasive strategy. Moreover, as shown in Figure 4a, the strategies used by participants are similar to those represented in the Technology Cards. While most strategies are drawn from the taxonomy of Oinas-Kukkonen and Harjumaa [26], I decided to include negative feedback because it is the strategy used by the provocative *Shower Manager* [22]. I also included setting goals [27] and connection with nature [18] as strategies evident in the Technology Cards.

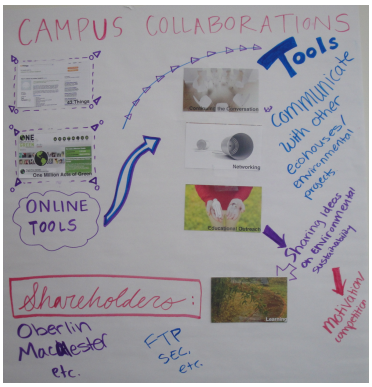
Furthermore, nearly all the design concepts target behaviors related to EcoHouse's mission. Conserving energy was the single behavior most frequently targeted by participants (8 of 26 concepts). However, 9 of the 26 concepts, including that described in Table 1, A14, aimed to generally promote sustainable behaviors and sustainability projects, falling into Zapico, Turpeinen, and Brandt's "sharing goals" category of climate persuasive services [3].

Participants considered themselves an audience for most (20/26) of the design concepts. However, in keeping with the domain concepts of *Educational Outreach* and EcoHouse as *A Testing Ground* and *An Example for Others*, eleven of the design concepts explicitly consider other students; in four cases, other students are the sole or primary audience. Moreover, participants in each workshop proposed engaging with students with similar goals at other colleges or universities.

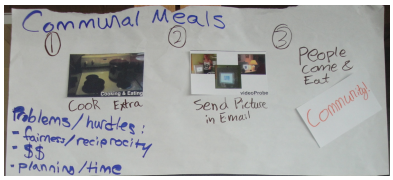
The technology channels used in participants' concepts reflect the Technology Cards, but with some differences (Figure 4b). Participants based more than a third (10/26) of their design concepts on the Web, perhaps because of its familiarity. Participants also envisioned two email-based persuasive technologies, even though email was not represented in the Technology Cards. Two types of design concepts were questionably persuasive *technology*. First, one poster proposed a policy concerning technology distribution: "Every Student Gets a Power Strip" to help reduce standby power consumption on campus. Second, six of the design concepts are uses of non-computational devices that nonetheless embody persuasive strategies. For example, one participant proposed a salad spinner to store

Table 1: Participants' descriptions of selected design concepts.

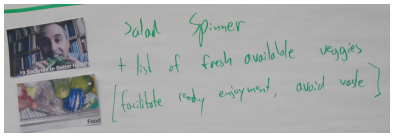
ID	Participant's Description
A1	"A way to provide feedback on how much water we're using and...not to exceed our stated goal.... When you use water, it drains water out of the fish tank, and if you you too much water, you risk killing the fish."
A5	"Some sort of visual display of how much energy you're using.... Option one is like the mug where when you put hot water into it the glaciers melt and the water floods the land. And then option two is that the globe would glow red if you're using a lot of energy and glow blue if you're not."
A12	"Send a picture in an email of the delicious food that you are cooking, and that can be an extra incentive for hungry people [to come share it]."
A14	"Using online tools...so that we can share what kinds of projects we're doing, what ideas we have...talking to other eco-houses about what they're doing and ideas that they have, how they overcame their conflicts with sustainability.... That would offer us motivation, kind of like the competitive urge to do more...."
B5	"The journal in the Cultural Probes was good for making us think of what we were actually doing in EcoHouse and what we were succeeding at, and also, the ones that said, today I am not so proud of myself because I ... those were also a good way to keep us on track. And we don't have anything like that right now."
B8	"If we had something that had a very visual forecast of the weather, then we could anticipate changes in the weather, and adjust the heating system accordingly.... If it's going to get warmer, we could turn the heat off in advance. If it's going to get colder, we could close the windows."
B10	"Every time people use the oven, maybe the thing would perk up, and then gradually settle down as the oven cooled. So that if people were walking by, they could see someone had used the oven recently...and say, I was planning to bake later, but I'll bake now...go ahead and use that energy."
B11	"Especially with greens, a lot of the time they didn't get eaten...and part of it for me was just that I didn't want to have to worry about taking them out and washing them. But with the salad spinner we could prepare everything when the CSA comes so that it's ready and available to eat."



(a) Campus Collaborations (A14)

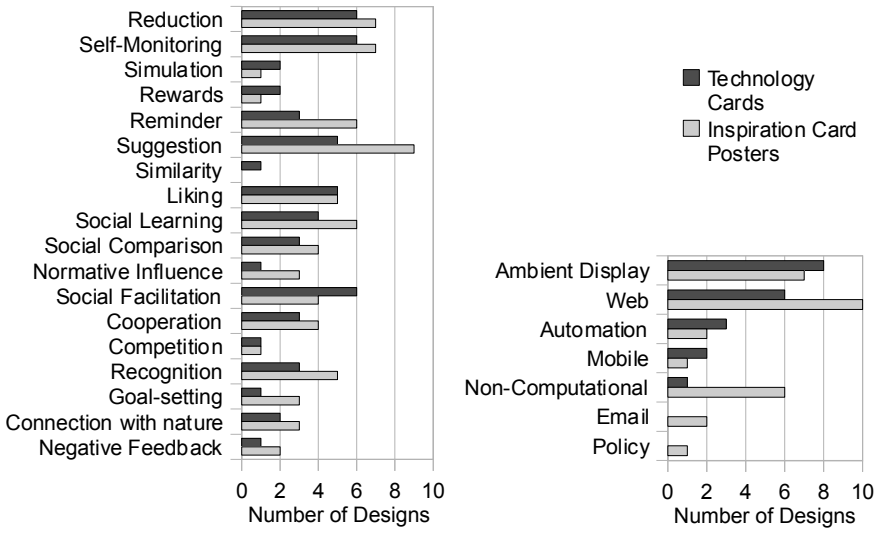


(b) Communal meals (A12)



(c) Using a salad spinner (B11)

Fig. 3: Sample design concept posters from the Inspiration Card Workshops.



(a) Persuasive strategies (b) Technology channels

Fig. 4: Persuasive strategies and technology channels in the participants' design concepts versus the input Technology Cards.

clean salad greens; he intended a reduction strategy [2], simplifying preparation of the greens when they are used (Table 1, B11).

Finally, the design concepts are all feasible, though some require more fleshing out. Indeed, we are working towards implementation of several. At the end of each workshop, participants identified a non-computational design to implement immediately: A "Props Board" to promote positive recognition of each others' contributions, and a return of the Sustainability Diary, described in Table 1, B5. In plenary discussions, we decided on four other directions:

- the oven tell-tale described in Table 1, B10, a fairly simple intervention;
- evolving the "Every Student Gets a Power Strip" policy, to consider "smart" power strips and targeted distribution;
- systems to make feedback on resource consumption more visible and frequent, perhaps through an ambient display such as those of Table 1, A5;
- a social networking site to connect college eco-houses, promoting sustainable behaviors through recognition, social learning, and so on.

I began this exploration with concern about the ethical implications of persuasive technology. Although participants were not prompted to discuss ethical issues, some such discussions arose. Indeed, the very first concept, involving a live goldfish (Table 1, A1), understandably raised concerns about the welfare of the fish and the users: "You'd have to set [the target consumption] high enough that you'd have to try pretty hard to kill the fish. But then if you did, how

traumatic is that?" Arguably, the stakes are high enough that this is coercion rather than persuasion. One participant seemed to recognize the potentially coercive nature of the Shower Manager [22], saying, "I just resent the fact that we might need technology to enforce that." In considering its use in college locker rooms, one participant said, "the danger is that there would be a backlash.... We're infringing on their right to have a long shower, so [we must] inform people as to why it is important." Although "informing" might not be enough, the participant seems aware that the Shower Manager might change behaviors but is unlikely to positively affect attitudes. Furthermore, in one case participants questioned not only the means of behavior change, but the change itself. They proposed a system to facilitate impromptu communal meals (Figure 3b and Table 1, A12), to promote community and save energy. But they soon realized this could cause not only practical problems with planning meals, but also problems with "reciprocity and fairness in terms of who's cooking all the time."

5 Conclusions and Future Work

The EcoHouse Inspiration Card Workshop succeeded in several ways. Participants generated a range of feasible design concepts. The Technology Cards seem to have guided participants to use persuasive strategies in their designs. And the workshop created a space for participants to reflect upon desired behavior changes in EcoHouse and on campus, and consider means for achieving those changes. One participant said, "I wish everyone could have been here."

However, the method as applied also had shortcomings. In the space of persuasive technologies, the concepts generated by participants are not wildly innovative: social networking sites are already being used for persuasion, and there are off-the-shelf systems for monitoring resource consumption and reducing phantom load. Furthermore, participants' non-computational approaches to persuasion were a surprise. But, the research problem here is not to develop novel persuasive media or strategies, rather to explore participatory design methods. A successful participatory design project could adapt *existing* technology to participants' needs. Moreover, Fogg's 8-step process suggests that novice persuasive technology designers learn and build confidence by closely imitating existing persuasive technologies [10]. At the same time, the broad scope of this Inspiration Card Workshop means that concepts differ in behavior, audience, and technology channel, and cannot be directly compared as Fogg recommends [10].

My process thus far has made use of established design methods, filling in the blanks with topics and examples related to persuasive technology. In future work, I plan to explore further development of participatory design methods to directly address persuasion and its attendant ethical issues. With more specific couplings of target behavior, audience, and technology channel now identified, one approach is to conduct further Inspiration Card Workshops. Technology Cards could be more tightly focused; Domain Cards could more directly represent contexts for the desired behavior and the barriers that prevent the behavior. Where a number of possibilities have already been identified—notably, in consid-

ering the many commercial devices that help reduce phantom load—we can move directly into a participatory process of gaining concrete experience [28] with the technologies, testing them more or less as Fogg suggests [10]. But, when should ethical issues be an explicit focus? How could design activities or materials help foreground these issues in a participatory process?

Returning to the earlier steps of Fogg's process [10], it seems that an audience and target behavior must be identified to bring participants together. Selecting a single technology channel may create opportunities for more structured participatory design activities. For example, DiSalvo, et al. [8] and Miller, et al. [9] both selected sensor-actuator systems, and developed games in which participants explored a physical space to identify possible target behaviors. Could a similar approach be effective for mobile persuasion? How might games or other activities get at behaviors that are better suited to other technology channels? And how might participatory methods go beyond the generative tools used here to facilitate reflection on value conflicts and other barriers to desired behaviors?

Finally, EcoHouse is interesting as an extreme group: not only are participants already committed to sustainable living, but many have some expertise. .expertise. What, then, might be the role of experts in a participatory design process where users desire behavior change but are not experts themselves?

Acknowledgments. Thanks to the fall 2009 EcoHouse residents for their investment in this work, to Kim Halskov for answering my questions, and to the reviewers of an earlier version of this paper for their helpful advice.

References

1. Halskov, K., Dalsgård, P.: Inspiration card workshops. In: 6th Conference on Designing Interactive systems. pp. 2–11. ACM, New York (2006)
2. Fogg, B.: Persuasive Technology: Using Computers to Change What We Think and Do. Morgan Kaufmann, San Francisco (2003)
3. Zapico, J.L., Turpeinen, M., Brandt, N.: Climate persuasive services: changing behavior towards low-carbon lifestyles. In: 4th International Conference on Persuasive Technology. ACM, New York (2009)
4. Goodman, E.: Three environmental discourses in human-computer interaction. In: CHI '09 Extended Abstracts on Human Factors in Computing Systems. pp. 2535–2544. ACM, New York (2009)
5. Davis, J.: Design methods for ethical persuasive computing. In: 4th International Conference on Persuasive Technology. ACM, New York (2009)
6. Berdichevsky, D., Neuenschwander, E.: Toward an ethics of persuasive technology. Communications of the ACM 43(5), 51–58 (May 1999)
7. Bødker, S., Grønbæk, K., Kyng, M.: Cooperative design: Techniques and experiences from the Scandanavian scene. In: Schuler, D., Namioka, A. (eds.) Participatory Design: Principles and Practices, pp. 157–175. Lawrence Erlbaum (1993)
8. DiSalvo, C., Nourbakhsh, I., Holstius, D., Akin, A., Louw, M.: The neighborhood networks project: A case study of critical engagement and creative expression through participatory design. In: Tenth Anniversary Conference on Participatory Design. pp. 41–50. Indiana University Conferences, Bloomington, IN, USA (2008)

9. Miller, T.M., Rich, P., Davis, J.: ADAPT: Audience design of ambient persuasive technology. In: CHI '09 Extended Abstracts on Human Factors in Computing Systems. pp. 4165–4170. ACM, New York (2009)
10. Fogg, B.: Creating persuasive technologies: An eight-step design process. In: 4th International Conference on Persuasive Technology. ACM, New York (2009)
11. Sanders, E.B.N.: Design research in 2006. Design Research Quarterly 1(1), 1; 4–8 (Sep 2006)
12. Hornecker, E., Halloran, J., Fitzpatrick, G., Weal, M., Millard, D., Michaelides, D., Cruickshank, D., De Roure, D.: Ubicomp in opportunity spaces: Challenges for participatory design. In: 9th Conference on Participatory Design. pp. 47–56. ACM, New York (2006)
13. Blomberg, J., Giocomi, J., Mosher, A., Swenton-Wall, P.: Ethnographic field methods and the relation to design. In: Schuler, D., Namioka, A. (eds.) Participatory Design: Principles and Practices. Lawrence Erlbaum Associates (1993)
14. Gaver, B., Dunne, T., Pacenti, E.: Cultural probes. interactions 6(1), 21–29 (Jan 1999)
15. Blythe, M., Monk, A., Park, J.: Technology biographies: Field study techniques for home use product development. In: CHI '02 Extended Abstracts on Human Factors in Computing Systems. pp. 658–659. ACM, New York (2002)
16. Graham, C., Rouncefield, M.: Probes and participation. In: Tenth Anniversary Conference on Participatory Design. pp. 194–197. Indiana University Conferences, Bloomington, IN, USA (2008)
17. van Rijn, H., Stappers, P.J.: Expressions of ownership: Motivating users in a co-design process. In: Tenth Anniversary Conference on Participatory Design. pp. 178–181. Indiana University Conferences, Bloomington, IN, USA (2008)
18. Froehlich, J., Dillahunt, T., Klasnja, P., Mankoff, J., Consolvo, S., Harrison, B., Landay, J.A.: UbiGreen: Investigating a mobile tool for tracking and supporting green transportation habits. In: CHI '09 Conference on Human Factors in Computing Systems. pp. 1043–1052. ACM, New York (2009)
19. One million acts of green. `http://www.cbc.ca/green/`
20. Holstius, D., Kembel, J., Hurst, A., Wan, P.H., Forlizzi, J.: Infotropism: Living and robotic plants as interactive displays. In: 5th Conference on Designing Interactive Systems. pp. 215–221. ACM, New York (2004)
21. Petersen, J.E., Shunturov, V., Janda, K., Platt, G., Weinberger, K.: Dormitory residents reduce electricity consumption when exposed to real-time visual feedback and incentives. Int. Journal of Sustainability in Higher Ed. 8, 16–33 (2007)
22. Shower Manager. `http://www.showermanager.com/`
23. These come from trees. `http://thesecomefromtrees.blogspot.com/`
24. Weather beacon. `http://www.ambientdevices.com/cat/beacon/`
25. Jafarinaimi, N., Forlizzi, J., Hurst, A., Zimmerman, J.: Breakaway: An ambient display designed to change human behavior. In: CHI '05 Extended Abstracts on Human Factors in Computing Systems. pp. 1945–1948. ACM, New York (2005)
26. Oinas-Kukkonen, H., Harjumaa, M.: A systematic framework for designing and evaluating persuasive systems. In: Oinas-Kukkonen, H., Hasle, P.F.V., Harjumaa, M., Segerståhl, K., Øhrstrøm, P. (eds.) PERSUASIVE 2008. LNCS, vol. 5033, pp. 164–176. Springer, Heidelberg (2008)
27. Consolvo, S., Klasnja, P., McDonald, D.W., Landay, J.A.: Goal-setting considerations for persuasive technologies that encourage physical activity. In: 4th International Conference on Persuasive Technology. ACM, New York (2009)
28. Kensing, F., Munk-Madsen, A.: PD: Structure in the toolbox. Communications of the ACM 36, 78–85 (June 1993)