Early Experiences with Participation in Persuasive Technology Design

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ABSTRACT
Persuasive technology, designed to change behaviors and attitudes, stands on uneasy moral ground. A key concern is the appropriateness of the means of persuasion and the intent to persuade. Engaging with those who will use the persuasive technology can ensure that it aligns with their own desires for change. This paper presents an early case study applying participatory design methods to persuasive technology in the context of a college EcoHouse. After presenting the methods and results, I synthesize lessons learned for the intersection of participatory design and persuasive technology design: begin with participants who want change, attend to power relations, promote reflection, start with simple behaviors, use examples to educate and inspire, explore designs in parallel, and be open to not designing technology. Finally, I identify challenges for future work: designing an effective design process, negotiating tensions between effectiveness and reflectiveness, and evaluating the impact of participation.

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H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Persuasive technology is the study of computer systems designed with the intent to change people's behaviors and attitudes. For example, amazon.com seeks to persuade users to buy products, while 43things.com aims to persuade users to set and meet personal goals. The field draws strongly upon behavioral psychology, and there has been much attention to theories of persuasive technology strategies, beginning with the tool-media-actor model (Fogg, 1998) and today including the Persuasive Systems Design model (Oinas-Kukkonnen & Harjumaa, 2009) and the Ability-Motivation-Trigger model (Fogg, 2009a). However, there has been relatively little attention to methods for designing persuasive technology: Lockton's Design with Intent toolkit (2010) provides a provocative pattern language for inspiring persuasive designs, integrating a variety of disciplinary perspectives, while Fogg provides a structured design process based on several years of experience (2009b). Furthermore, although ethical issues have been a perennial topic in the Call for Papers for the annual Persuasive Technology conference, little research has addressed such issues (Torning & Oinas-Kukkonnen, 2009).

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Participatory design has the potential to address these two gaps (Davis, 2009). A key ethical problem in persuasive technology is the power relationship between the technology designer and the intended audience: the technology reifies the designer's values and beliefs, leaving the audience with limited opportunity to argue or negotiate (Fogg, 2003). Participatory design seeks to ensure that technology users have a voice in the direction that technology design takes, addressing exactly this concern. Beyond this, the ongoing practice of participatory design provides a rich palette of techniques to engage stakeholders in activities from envisioning new technologies to improving a prototype's usability.

Here, I address the question: How can participatory methods be used to design effective and ethical persuasive technology? Prior work on participatory design of persuasive technology does not fully engage with this question (Davis, 2009). DiSalvo, et al. (2008) focused on participation as empowerment and technology as rhetoric. Technologies provoke discussion, but are not deployed to change behaviors. Although Miller, Rich, and Davis (2009) intended to change behaviors and used a participatory approach, the final concept was developed mainly by the designers. Finally, Davis (2010) reports on the first two phases of the case presented here. She argues for the viability of participatory approaches to the persuasive technology, but her reflections on the design process are limited. Although it is too soon to definitively state best practices, this paper draws out lessons learned from this case to guide and provoke future designers.

The paper proceeds as follows. The next section addresses in greater depth the question, "Why participatory design of persuasive technology?" The following section describes the design context for this case, leading into three sections describing the methods used and results obtained in the three phases of design. The first phase, exploration, focused on reflection and mutual learning about EcoHouse as a space and an organization. The second phase, concept generation, centered on an Inspiration Card Workshop and aimed to generate design concepts for persuasive technology to support EcoHouse's mission. The third and final phase, implementation, put some of those concepts into action. The remainder of the paper discusses lessons learned and future challenges.

WHY PARTICIPATORY DESIGN?

Persuasive technology, like more ordinary means of persuasion, stands on uneasy moral ground. When we recognize that someone is trying to persuade us—say, to donate to a charity or buy a new car—we have many questions. What am I being asked to do? Who is trying to persuade me? Are they telling the truth? Are they open about their intentions? Do they care about my interests?

Although ethical guidelines appeared alongside the field of persuasive technology (Berdichevsky & Neuenschwander, 1999; Fogg, 2003) recent work provides a theoretical basis for such guidelines. Spahn (2011) interprets persuasive technology as a communication act, subject to the rules of discourse ethics. In particular, he argues that persuasive technologies are speech-acts subject to Habermas's four normative validity claims (1984): that the utterance is comprehensible (comprehensibility), that its propositional content is true (truth), that it is honest with regards to the intentions of the speaker (truthfulness), and that it is right or appropriate with respect to the speaker, the listener, and the context in which it is spoken (rightness or appropriateness). Spahn places "persuasive rationality" on a continuum between communicative rationality, in which the aim is mutual understanding and agreement, and strategic rationality, in which one party aims to accomplish their goals through manipulation of the other. Communicative rationality is symmetric—all parties act as equals—while strategic rationality is asymmetric, an exercise of power by one person over another. Persuasive rationality, Spahn claims, lies between, encompassing aspects of both symmetry and asymmetry. As Fogg (2003) points out, it is impossible for a person to negotiate with a computer, as computers do only what they are programmed to do, compounding the asymmetry in the persuasive relationship. Spahn (2011) argues that persuasive technology should ameliorate this asymmetry by obtaining the user's consent to be persuaded. His goal is "to limit the asymmetry of the 'persuasive situation' by linking it to a prior symmetrical relation" of consent requested and freely given.

Participatory design goes beyond prior consent, reciprocally engaging the future technology users as partners in the design process (Muller, 2003). In a participatory design process, the intent to change behavior arises at least partly from within the community itself (Davis, 2009). The technology takes form through a cooperative process in which all participants have a voice. The symmetry of the participatory design process, with its emphasis on mutual learning and respect for all stakeholders' unique expertise (Fowles, 2000), provides the "prior symmetrical relation" that Spahn (2011) writes of, and thus limits the asymmetry of user interactions with the resulting persuasive technology.

Participatory design can also strengthen the resulting technology's adherence to the four validity claims for speech-acts. Surely, it is appropriate for individuals to construct or adopt technology to support their own goals for behavior change, or for groups to agree to do so in a setting of communicative rationality. They can agree on where the boundaries of acceptable intrusion on individual autonomy lie, and what costs in manipulation, coercion, or other harms—if any—are worth paying to achieve their common goal. Participatory design is well-suited to addressing concerns about comprehensibility before the technology is deployed, as participants engage in testing and critiquing the design. Through the participatory design process, users become "authors" of the persuasive technology; they can know that their own intentions are honest. Moreover, the transparency of the design process, through symmetric relations between designers and users, should make it difficult for designers to incorporate falsehoods in their design.

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. Note that the mission is split in its focus, including both an internal focus on living sustainably within EcoHouse and an external focus on promoting sustainability at the college and in the surrounding community. I chose to approach EcoHouse as an opportunity space, "where many new things are possible but there is no clear requirement" (Hornecker, et al., 2006), and therefore scoped the initial stages of the design process to consider all aspects of EcoHouse's mission. However, I had a commitment to exploring methods for developing persuasive technology, and ideally to actually build and deploy such technologies.

Although residents were generally enthusiastic about participating in the project, the work was challenged by students' busy schedules, becoming increasingly busy as each semester progressed. All work stopped during breaks from classes. Finally, the membership of the house and thus the participants in this project changed, even during the academic year. All ten of EcoHouse's residents for the fall 2009 semester 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. In the spring 2010 semester, two further residents left the house to study abroad, and three new residents arrived.

EXPLORING THE SPACE

Exploratory Activities

We explored EcoHouse's physical and conceptual space through two main types of activities: ethnographically-inspired field methods (Blomberg, et al., 1993) and generative tools (Sanders, 2000). Both activities informed design and helped develop working relationships.

Ethnographically-inspired field methods took three forms. First, I acted as a participant-observer in EcoHouse's

weekly dinner meetings and occasional social events. Such participation nurtured trust and allowed me to observe the problems residents were facing on a weekly basis. Second, I analyzed key documents: the house "lifestyle guidelines" and proposals for the establishment and continuation of the EcoHouse project. These documents provided a formal statement of EcoHouse's mission, a description of its structure, and a list of agreed-upon house rules. Finally, I briefly interviewed the 10 residents early in the fall semester.

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 on their own time, which would feed into later stages of the design process. These generative tools are similar in form to those in a cultural probes package (Gaver, et al., 1999). However, as Sanders argues, generative tools have a further role in priming participants for co-design by actively engaging them in reflection, analysis, and creation (Sanders, 2000).

I delivered the materials shown in Figure 1a at the house's second weekly meeting. I told participants that materials could be completed in groups or individually, and that there was no need for consensus, nor to complete them all. The package included

- cards with questions and images to evoke stories, reflection, and analysis (e.g., as shown in Figure 1b);
- cards offering "three wishes" for EcoHouse (Blythe, et al., 2002), to help imagine 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".

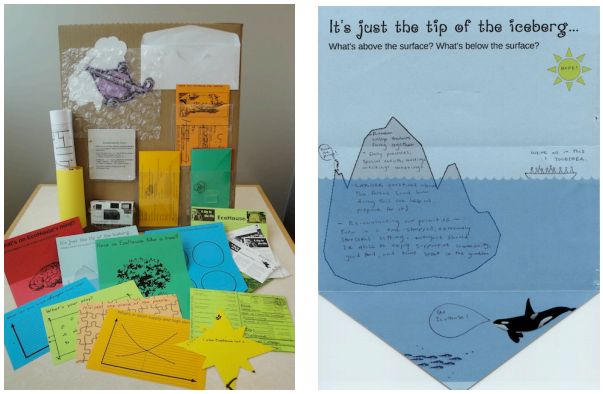

Figure 1. The generative tools package was designed for visibility, with an aesthetic of reused materials. The tools generated many thoughtful responses.

The last three items were intended to help participants identify desirable behaviors and barriers that prevent them, both early steps of Fogg's (2009a) 8-step process. The generative tools remained for four weeks in EcoHouse's living room.

Results

Different roles in a common mission

Woodruff, Hasbrouck, and Augustin (2008) found that "bright green" households had three distinct types of motivations: "counterculture bio-centric activism", "American frontier self-reliance and rugged independence", and "trend-focused utopian optimism." EcoHouse residents were similarly diverse in their motivations. Some said that they had gotten involved in the environmental movement through outdoor activities or conservation work, reflecting a biocentric motive. Some saw their environmentalism as connected to action for social justice. Those motivated by independence and self-reliance cited prior living situations, for example, on a farm, or with a thrifty father. Finally, residents were motivated by societal trends. Several were excited about investigating new technologies, and one looked forward to "crafty" projects.

The EcoHouse project intentionally brought together residents with diverse areas of expertise. Residents looked for- ward to contributing their own expertise to the community and learning from each other.

We each have our own little thing. I'm really interested in environmental health... Noah's really into energy, and Jim's into local foods. ... We each bring our own component. — Betty

One of my things is cooking and gardening. ... I'd like to learn more from my fellow residents. Emma, for instance, is a master composter...so she knows a lot about vermiculture, which is something I'd like to learn more about. — Kendra

Beyond these differing areas of expertise, residents recognized and accepted that they were in different stages along "the path" to sustainable living, as found by Woodruff, et al. (2008). Residents looked forward to mentoring house- mates in one area while learning in others. A few residents indicated that living in EcoHouse was their first step on the path to sustainable living; it was mutually recognized that they had the steepest learning curve and needed to accept gradual change. Residents also recognized that EcoHouse could not be "zero waste."

Autogenous persuasive technologies

Fogg (1998) defines an autogenous persuasive technology as one in which the persuasive intent comes from the person adopting or using the technology. In the exploratory phase, I learned that EcoHouse was already full of technology— though not necessarily computing technology—adopted by residents to support behavior change, ranging from paper signs to off-the-shelf electronics. Residents used power strips to eliminate "phantom load," electricity drawn by appliances that are turned off but still connected to the power supply. Humorous cartoons reminded residents to turn off lights,

while a sign hand-lettered on a reused cardboard box admonished residents to "seize the day; do your dishes."

EcoHouse had already installed two digital systems for monitoring resource consumption: An off-the-shelf, whole- house, real-time electricity monitor (the TED[1]), and a system that reads and records pulses from electric, gas, and water meters for monthly review. Residents initially consulted data intensely, using the real-time monitor to explore the electricity consumed by different household devices, but they grew to distrust the TED's readings as it did not seem to reliably react to household activities. However, the residents retained an interest in more sophisticated data collection and analysis, as noted by Woodruff, et al. (2008). Residents found the recording system more useful, as it provided reliable data about usage over time, but it was also much harder to use. The recording device was inconveniently located in the basement with the gas, water, and electrical meters; some residents described it as a mysterious thing lurking in the basement. It was connected to an old, repurposed computer that residents turned on only to download and export the recorded data, turning it off again immediately after in order to save electricity. Because the recording system software was designed for billing tenants rather than for self-monitoring, visualizing the data was a complex, multi-step process. A subcommittee of residents (the "FM Battalion") downloaded data from the recording system on a monthly basis, exports the data into a spreadsheet, and pastes the data into another spreadsheet to graph the data and maintain long-term records. Members of the FM Battalion produced monthly and daily trend graphs, from which they have identified high-consumption activities (heating, cooking, and showering) as targets for behavior change. They also used the spreadsheet to discover periods during which consumption was unusually high, and then sought explanations. For example, they inferred that the thermostat had been turned up during a school break.

Finally, the bathroom was home to an elaborate low- tech system for self-monitoring and social motivation. Residents purchased a waterproof stopwatch and hung it from the showerhead to enable self-monitoring of shower duration and thus water use. A sheet of paper posted inside the bathroom door was divided into eight squares for eight weeks, and residents wrote their times anonymously into the square for the appropriate week. This allowed not only self-monitoring but also social comparison. Next to the recording sheet was a list of "water saving tips for the shower," suggesting behavior changes while in the shower ("take a navy shower") and changes to habits between showers ("wear warm clothes before you take a shower," "set aside one day a week for a luxury bath/shower"). These tips were clearly prepared by an EcoHouse resident—they cite a local professor—and thus also serve as a kind of social facilitation, showing that EcoHouse residents actually use these ideas. Finally, on the shower ceiling was a photograph of members of a similar house at a rival college, who had been in the national news. Residents explained that this poster was meant to motivate by evoking feelings of competition and a sense of being watched.

Promoting reflection

The generative tools package was intended to promote reflection and set the stage for design. Participants responded well to the generative tools, completing more than half the materials and reporting that they were fun to think about. Several participants contributed, sometimes even to a single item. 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. A blank Venn diagram—three overlapping rings—was labeled with the resources electricity, water, and food. The overlaps identified behaviors that resulted in more sustainable consumption of two resources—for example, cooking in bulk to reduce energy use and food waste, and taking shorter showers to reduce both water and energy use.

Participants not only revealed desires for change, but also reflected on barriers to change. One item, a blank pie chart, inspired a participant to classify ways in which EcoHousers act or fail to act sustainably. He separately considered "individual sustainable decisions" such as turning off lights and "group sustainable decisions" such as buying a farm share. But he also considered a range of explanations for why he and his housemates did not always act sustainably: "accidental unsustainability" due to a "lack of knowledge," "laziness/apathy," and finally "unconscious actions" or habits. These align with the Ability-Motivation-Trigger model (Fogg 2009a).

Participants also reflected on values that compete with environmental sustainability. 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 in the garden on a muddy morning, reflecting on tensions between sustainability and comfort.

Finally, four probe responses reflected a belief in the power of a committed, supportive community. For example, the response shown in Figure 1b includes a sketch of ten people in a boat with the legend, "We're all in this TOGETHER." At the same time, another response—"Now what do we do?"—shows uncertainty about goals and next steps.

GENERATING CONCEPTS

To move from analysis and reflection to design, I used Halskov and Dalsgård's Inspiration Card Workshop (2006). The key materials are the Inspiration Cards, providing 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 Domain and Technology Cards, the workshop, and its results.

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 back uses words to further evoke or explicate the concept (Figure 2). The Domain Cards are intended to support

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

participants in making design moves such as juxtaposing concepts or shifting from the concrete to the abstract (Halskov & Dalsgård, 2006).

Figure 2. Comfort, Waste, and A Supportive Community are three examples from the 27 Do- main Cards used to represent concepts from EcoHouse.

Halskov and Dalsgård (2006) suggest that Domain Cards can be created by designers or by participants. In the interest of fostering participation while respecting participants' time, I first identified 55 possible Domain Cards by reviewing materials from the exploration phase. 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 photos taken by participants at EcoHouse. For the remainder, I chose stock photos or enlisted a participant's help in taking additional photos. I used participants' own words on the card backs whenever possible.

Technology Cards

Technology Cards depict inspirational technologies. 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 has a description (Figure 3).

Figure 3. The Virtual Polar Bear (Froehlich, et al., 2009), One Million Acts of Green[2], and Infotropism (Holstius, et al., 2004) are examples of the 18 Technology Cards.

Halskov and Dalsgård (2006) recommend that the designers determine the set of technology cards based on their expertise. In selecting the Technology Cards, I followed Fogg's (2009b) recommendation to work from examples that share an audience, technology channel, or target behavior with the problem at hand. However, because of the broad scope, the 18 Technology Cards cover a range of behaviors related to environmental sustainability: conserving energy, water, and paper, making sustainable choices while shopping, increasing recycling, and setting goals. Based on the interviews, I included both ambient displays and web sites as preferred technology channels. Finally, I considered not only the college student audience, but also the context of home. Some Technology Cards fit in more than one way: for example, Oberlin's dorm energy competition (Peterson, et al., 2007) overlaps in audience, technology channel, and target behavior.

I included as provocation two cards that fall on the borderline of persuasive technology. First, "These Come from Trees" stickers[3] are not a computational technology at all, but provide a well-placed trigger to reduce paper towel use. Second, the Shower Manager[4], a device marketed to parents of teenagers, allows parents to lock in a pre-set shower duration. After that time has elapsed, the device reduces the water pressure by two-thirds so that there is just enough water to rinse off. The Shower Manager is coercive, rather than persuasive, in that its user does not control or even consent to the pre-set shower duration. Its intended use reflects the asymmetry of power between parents and teenagers.

Workshop

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 promote a design mind-set (Muller, 2003).

First, I introduced the agenda and goal for the workshop: to generate ideas for new technologies in support of Eco-House's mission of promoting sustainable living. The Do-main Cards were presented by one of the participants who helped to review them: the participant read the title aloud, sometimes commented on the picture or words, and laid the card out or passed it around. Then, I presented the Technology Cards. Where the domain concepts were familiar to participants, most technologies were new and prompted questions and discussion. In one workshop, a participant was struck by an idea during the presentation of Technology Cards; bridging naturally into the heart of the workshop, the Combination and Co-Creation phase.

I explained that participants could combine 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 (2006) recommend, the workshop had no rules for taking turns or combining cards, so participants could use the cards without restriction. At the end of the workshop, participants explained their ideas to each other. At the participants' request, this became a discussion of next steps: choosing concepts to pursue immediately and a venue to consider other concepts.

Results

The main workshop results are the posters depicting design concepts. Figure 4 shows one example. As reported by Davis (2010), the 26 concepts reflected a wide range of behaviors, channels, and strategies:

Send a picture in an email of the delicious food that you are cooking. ... It can be an extra incentive for hungry people to come share it. — Kendra

[2] http://www.cbc.ca/green/

[3] http://thesecomefromtrees.blogspot.com/

[4] http://www.showermanager.com/

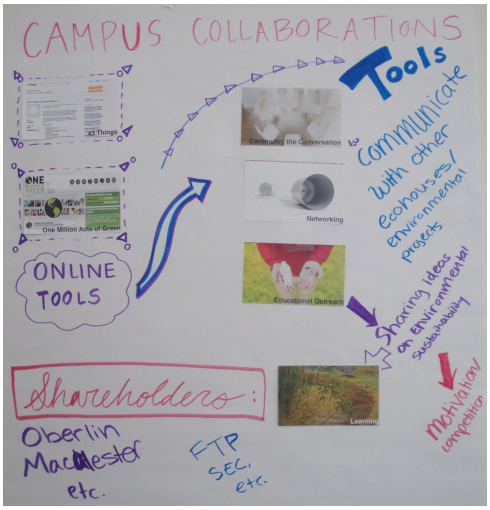

Figure 4. Sample design concept poster from the Inspiration Card Workshops.

If we had a very visual forecast of the weather, then we could anticipate changes in the weather, and ad- just 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. — Nicholas

Using online tools ... we can share what kinds of projects we're doing ... talk to other eco-houses about what they're doing and what ideas they have, how they overcame their conflicts with sustainability ... That would offer us motivation, the competitive urge to do more. — Noah

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 on campus. Participants' reaction to the Shower Manager is illustrative of their thinking about audience and power relationships. One participant considered installing the Shower Manager in EcoHouse, and reacted,

I just resent the [idea] that we might need technology to enforce [our goal of taking shorter showers]. — Carla

The device might have been morally acceptable if EcoHouse residents all agreed to use the device and came to a consensus regarding the maximum shower length. But this participant thought EcoHouse residents should not need such heavy-handed technology to make the right choices; rather, they should learn to make good choices on their own. Participants also discussed using the Shower Manager to change others' behavior: specifically, installing Shower Manager in college locker rooms, where it would restrict the length of athletes' showers. Participants also rejected such this approach as too coercive, but for a different reason.

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. — Jim

Though "informing" athletes does not go far enough, this statement recognizes the power asymmetry between the college administrators who would direct the installation of the Shower Manager, and the athletes whose choices would be restricted. If the device is installed without equalizing this asymmetric power relationship through the involvement and consent of the athletes, then a "backlash" is likely to result.

Some of the design concepts were questionably persuasive technology. Seven 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 clean salad greens; he intended a reduction strategy (Fogg, 2003), simplifying preparation of the greens:

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 [Community Supported Agriculture share] comes so that it's ready and available to eat. — Jim

Discussion

The workshop resulted in many creative and feasible design concepts related to EcoHouse's mission, as intended. The Technology Cards guided participants to use a range of persuasive strategies in their designs. Several design concepts were deemed worthy of pursuit. Moreover, 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. Participants recognized this value:

I wish everyone could have been here. — Noah

On the other hand, there was not a clear path beyond the workshop. Although all of the design concepts related to EcoHouse's mission, they encompassed a wide range of behaviors and multiple audiences. Nearly every design concept addressed a different combination of audience and behavior change, making the concepts difficult to compare. Where Fogg (2009b) recommends rapidly testing several design approaches to changing a single behavior, the workshop as implemented did not generate such alternative approaches. A related challenge, discovered in retrospect, was that the participants who helped select Domain Cards did not have a clear idea of how the cards were to be used in the workshop. Participants chose concepts based on their centrality to EcoHouse, rather than their potential role in design. These problems uncover a gap in the process that lead up to the Inspiration Card Workshop: to jointly envision the ultimate result of the design process, the "where to" artifact (Bødker & Iverson, 2002). In the context of persuasive technology, this "where to" might be first selecting a behavior to change, and then developing a means to change it. Sharing "where to's would have enabled greater intentionality at each stage of the process.

IMPLEMENTATION

At the conclusion of each of the Inspiration Card Workshops, each group chose a simple persuasive technology to deploy immediately. One group chose the Props Board dis- cussed below, while the other proposed the return of the Sustainability Diary. At the next weekly house meeting after the Inspiration Card Workshops, participants presented their design concepts to each other and to residents who had not participated in the

workshops. The two groups took turns presenting their ideas as we hung the concept posters on the living room walls. The group as a whole decided to take a week to reflect on the design concepts before deciding which to pursue. The three design concepts that got the most support were "Every student gets a power strip" (combined with the "Room off switch"), "Energy monitor" (collapsing concepts from both groups into a single design direction), and "Campus connections" (again, connecting de- sign ideas from both groups). The development of these concepts is discussed below.

Props Board & Sustainability Diary

Participants in the first Inspiration Card Workshop invented the "Props Board" as a response to feeling that their contributions to the house's mission and functioning were not always appreciated, which was demotivating. The Props Board was a whiteboard placed in a prominent area of the house near the kitchen Residents would anonymously write words of appreciation such as "Good job on the compost, Kendra!". Complaints and other negative comments were explicitly not allowed. Thus, the Props Board would provide a general-purpose, low-technology channel for social persuasion using the praise and recognition strategies, intended to increase motivation. The Props Board was immediately instituted by the workshop participants, and remained in use during the remainder of the year (Figure 5).

Figure 5. The Props Board.

The proposal to re-institute the Sustainability Diary was less successful. The goal was also to motivate: to let individuals anonymously brag about successes and confess failures. Although the group was willing and a used notebook was re-purposed to this end, little was written. When I asked about it at later meetings, residents didn't know where it was. Unlike the Props Board, the Diary was more directed to self than others and lacked an anchor to a physical place.

Reducing the Effort to Turn Things Off

The most popular design concept was not to develop a new technology, but to explore policies for deploying an existing technology: "Every Student Gets a Power Strip." EcoHouse residents already used power strips to reduce phantom load. Giving each student a power strip would eliminate a significant barrier to others taking up the practice. But, this design concept was controversial. Some residents were concerned that their classmates don't even remember to turn off the lights; would they remember to turn off a power strip? The policy might even backfire, if owning a power strip let students plug in more electrical appliances. This idea met with a related design concept: the "Room On-Off Switch", requiring a card to be inserted to use any electricity in the room. This raised its own objections, but inspired us to consider other off-the-shelf devices that require less effort.

I researched and purchased a number of off-the-shelf devices intended to save electricity, including timers, sensors, and remote controls. I brought these to a Sunday EcoHouse meeting for discussion; residents decided to test them out in their own rooms and in the shared living room. At the next meeting, and again after two weeks, participants reflected on which devices were useful for saving electricity in the context of a college residence, and which devices were difficult to use or enabled waste. One device, a simple, inexpensive remote control, was selected as particularly useful. A resident worked with the college's Campus Environmental Coordinator to purchase them and distribute them through student Dorm Environmental Coordinators. Although no new technology was designed, the participatory process supported EcoHouse's mission to diffuse conservation practices into the broader college community.

Monitoring Resource Consumption

Coupled with the desire to save electricity was a desire to expand monitoring of resource consumption and make feedback more prominent in the house. This idea was pervasive in early discussions of the project (prior to Fall 2009), was discussed in both Inspiration Card workshop, and received support in the meeting of all residents. Despite the excitement, this design direction posed many technical challenges. As noted earlier, the TED instantaneous monitoring system was unreliable. We agreed to update to a newer version of the TED, which would have enabled new visualizations of resource consumption, but continued to have problems with reliability. The recording device in the basement was unsuited to providing instantaneous feedback, although I collaborated with the FM battalion to improve the spreadsheet they used for data analysis. I experimented with developing an ad hoc system for capturing meter pulses, but ultimately lacked the required technical expertise. Though monitoring systems intended for commercial buildings would have accomplished much of what we wanted, we lacked the institutional support to purchase software and equipment costing tens of thousands of dollars.

Campus Connections

Participants in both Inspiration Card Workshops discussed an online community as a venue for encouragement, recognition, and social learning. They recognized that EcoHouse is not unique; institutions around the United States have residences similarly devoted to demonstrating sustainable living. One resident took the lead in identifying desirable and undesirable features from web sites with similar themes (campus sustainability) and purposes (motivating users to act in the physical world). A group of five residents met to make key decisions about the site: what information would be included in member and residence profiles, what discussion topics would be suggested, what information would be public versus private, and how

people would become members. The issue of a site name was deferred to the Sunday meeting of all residents; the name GreenRes.Net was selected. In early May, I hosted a launch party, during which ten EcoHouse residents created accounts, seeded the site with content, and invited residents of similar houses at other institutions.

GreenRes.Net quickly gained about 40 members at 9 different institutions. However, the site suffered from a lack of a core group of leaders and content authors (Preece & Shneiderman, 2009), exacerbated by the lack of continuity as students left for the summer break; many did not return. Moreover, the site was not persuasive towards any particular behavior change, but rather served as a channel or platform for persuasive messages. Although I prompted residents to share their goals, I felt uncomfortable suggesting specific behavior changes, as I was a guest in the community, not a resident.

LESSONS LEARNED

Here, I glean lessons learned from these experiences—both successes and failures—to guide and provoke future participatory design of persuasive technology.

Begin with participants who want change.

Fogg (2009b) recommends that designers new to persuasive technology choose a receptive audience for their first efforts. Designing persuasive technology for those who are resistant to change is simply more difficult than designing for a receptive audience. For this design project, I worked with a college EcoHouse to develop technologies that promote sustainable behavior. The design project was congruent with the group's core mission; participants were already committed to environmentally sustainable behavior. This meant that participants were fairly enthusiastic about participating in designing and using persuasive technologies to help them achieve their goals. Had they been lukewarm, getting their time would have been more difficult. Had I selected an audience resistant to behavioral change—for example, tax evaders—even recruiting participants would have been hard. Another model might be to engage participants who have already changed their behaviour and wish to help or reform others; *former* tax evaders might fall into this category. Engaging reluctant participants, who must be persuaded to even consider a behavior change, will be a significant challenge for future research.

Attend to power relations.

With persuasive technology, the key power inequality is that between the persuader (the designer or implementer of persuasive technology) and the audience (the users, perhaps unwitting or unwilling). By fully engaging the audience in the design process, these two categories are collapsed, thus collapsing the asymmetry between persuader and audience. However, the asymmetry that participatory design has historically been concerned with does not go away. For example, if the college administration decided to use persuasive technology to promote resource conservation, just engaging students in the process would not by itself prevent coercion. Facilitators must take care to ensure that all stakeholders have a voice and that decisions are not made unilaterally by those in power. In EcoHouse, rather than subverting institutionalized power inequalities, participatory design built on an existing culture of egalitarianism and consensus. However, the process ran up against power issues when the institution's resources were needed to pursue a project; greater inclusion of those with power may have led to greater buy-in.

Promote reflection on behaviors.

Sengers, et al., (2005) define critical reflection as "bringing unconscious aspects of experience to conscious awareness, thereby making them available for conscious choice." Although they are concerned with reflection on technology design, this definition also applies to reflection on the behavior changes that persuasive technology is meant to promote. Moreover, Fogg (2009b) recommends that persuasive technologies address the particular barriers that prevent desired behaviors, but leaves open the question of how to identify those barriers. Participants can introspect on the barriers that prevent them from changing their behavior. In this project, generative tools such as the Sustainability Diary provoked participant reflection early in the design process. Future participatory design work could include greater structure for reflection, e.g., by introducing the Ability-Motivation-Trigger model (Fogg 2009a).

A challenge is promote deeper reflection on desired behaviors: to bring to light participants' unquestioned values and assumptions about what they should be doing in order to accomplish their goals. A participatory design process that accomplished this would overcome one of the limitations articulated by Sengers, et al. (2005): that shared values and assumptions tend to go unexamined. For example, while expressing a commitment to sustainability, EcoHouse residents continued to participate in our institution's culture of unsustainable "busy-ness"; none of us challenged this value.

Start with simple, measurable behaviors.

Fogg (2009b) directs new persuasive technology designers to choose a simple, observable behavior to enable focused design and evaluation. This simple behavior could be an approximation of a more desirable but more complex behavior, or it could be a first step towards a larger goal. As I started this design process, I did not want to choose a target behavior for my participants, but rather to explore possibilities for persuasive technology. While this approach generated a broad range of ideas that to explore in parallel, it did not enable thorough development of effective persuasive technologies. The simplest and most successful design direction was reducing the effort to turn things off. GreenRes.Net, by contrast, did not target a specific behavior, took the most design effort and had the least payoff. Therefore, I recommend that future participatory design efforts heed Fogg's advice to choose simple behaviors to target. Miller, Rich, and Davis (2009) demonstrated a simple participatory game for identifying simple, concrete target behaviors through hands-on, in situ explorations. Groups of participants can work on several behaviors in parallel, as in Miller, et al.'s (2009) design approach, or the group can choose one behavior.

Use examples to educate and inspire.

Halskov and Dalsgård's (2006) Inspiration Card Workshop, Fogg's (2009b) 8-step method for designing

persuasive technologies, and Lockton's (2010) Design with Intent toolkit all converge in their use of examples to inform and inspire design. This project took advantage of that convergence. I selected example technologies according to Fogg's recommendation, but since there was no single target behavior, I selected a range of examples from the domain of environmental sustainability. The Technology Cards portraying these examples served to educate participants about the nature of persuasive technology and the technological possibilities; they inspired many appropriate design concepts. However, while the Inspiration Card Workshop is fairly unprescriptive, as is the Design with Intent toolkit, Fogg's (2009b) 8-step method directs designers to carefully analyze example technologies in order to imitate as closely as possible the elements that led to their success. Future designers may find it effective to engage participants in such analysis.

Explore designs in parallel.

This project pursued several design concepts in parallel, with some concepts finding greater success than others. This is consistent with Fogg's (2009b) reminder that persuasive technology fails as often as it succeeds. He recommends developing a number of design concepts around a single target behavior, then rapidly evaluating and iterating on those design concepts, investing only a few hours of work in each implementation and test. This is related to Bødker and Iverson's (2002) strategy of systematic prototyping, in which several prototypes are developed and tested to explore design alternatives, with no single prototype leading directly to the final design. This project was most successful with the power saving devices, where we did a rapid, parallel evaluation of several alternatives: We spent one or two hours shopping, fifteen minutes discussing how they could be used, less than an hour per person installing and learning to use each device, and less than an hour reflecting on their use. This was possible because we had identified a very simple target behavior (turning lights and appliances off) that off-the-shelf products already supported. Such an approach requires both a simple behavior and a technology channel that enables rapid prototyping.

Be open to not designing technology.

As Baumer and Silberman (2011) argue, sometimes the most appropriate technology is no technology or low technology. For example, EcoHouse residents were content with their low-tech persuasive technology in the shower and showed no interest in changing it. With all group members living in the same house, a whiteboard was a visible and easy-to-use technology for supporting the Props Board; making it electronic may have reduced its effectiveness. There was no need to invent a new power strip; off-the-shelf products needed only to be adopted. Moreover, Baumer and Silberman (2011) ask designers to consider, "Might deploying the technology result in more harm than the situation the technology is meant to address?" Residents were very careful to limit the energy consumption of monitoring systems. Like the "bright green" households interviewed by Woodruff, et al. (2008), they would have resisted new systems that consumed too much electricity. Finally, Baumer and Silberman (2011) admonish designers not to oversimplify real problems into problems that are computationally tractable. EcoHouse residents proposed and then rejected a system to promote meal sharing, after realizing the proposal reflected a oversimplified view of the desired behavior that left out moral concerns about reciprocity and fairness. The design community should accept the value of participatory design practices that lead to the intentional deployment of existing technologies to promote behavior change—or even the decision not to use computing technology at all—when such means are more appropriate than designing new technology.

CHALLENGES

At this early stage in the development of participatory design methods for persuasive technology, there are at least three significant challenges.

The first challenge is to develop comprehensive, coherent strategies for participatory design of persuasive technology that are informed by both participatory design practice and persuasive technology theory. As Bødker and Iverson (2002) write, participatory design practitioners must move "beyond the initial fascination of user involvement" to a professional practice; such practice should involve "where-to" and "why" artifacts reflecting a shared understanding of the design trajectory and the purpose of each design activity. Though I have shown that participatory design can be informed by methods such as Fogg's (2009b) 8-step method, more work is needed to consider how theories such as the Ability-Motivation-Trigger model (Fogg 2009a) and the Persuasive Systems Design model (Oinas-Kukkonnen & Harjumaa, 2009) can inform participatory design processes. Future work should go further in purposefully selecting and tailoring methods for each stage of persuasive technology design and reflecting on the methods' effectiveness. Moreover, future work should implement, deploy, and evaluate a persuasive technology to assess the validity of the participatory design approach.

A second challenge is to find balance in creating a reflective participatory process that leads to effective persuasive technologies. Sengers, et al. (2005) critique participatory design for being too uncritical of shared assumptions. Persuasive technology, too, has been critiqued as uncritical in the scope of behavior changes that are considered (Goodman, 2009; Dourish, 2010). Careful reflection should lead towards desirable behavior changes and away from persuasive technologies that would be unacceptable or counterproductive if actually implemented. To build effective persuasive technologies, we must have faith that they are worth building—but not so much faith that we do not question their methods or intent.

Finally, a third challenge is to evaluate participatory design of persuasive technology with respect to the reasons for adopting this approach. To what extent do participants take ownership of the persuasive technology that is designed? How does participation affect the symmetry or asymmetry of their relationship with the technology? Can participatory methods effectively account for the needs and values of even those who are reluctant to change?

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