StepGreen.org: Increasing Energy Saving Behaviors via Social Networks

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Abstract

Decades of research have explored factors that can influence green behavior. However, much less is known about how technology in general, and social technologies in particular can motivate people to participate in green activities. In this paper we describe the goals, design and evaluation of StepGreen.org, a site intended to promote energy saving behaviors. We present the results of a field study, during which participants chose to engage in different actions and reported when they had completed them. Our results suggest that motivating factors like public commitment and competition are effective, and better leveraging these factors will likely lead to even greater appeal and effectiveness. Our contribution is to create an understanding of the impact of different decisions on the success of StepGreen.org that can benefit the designers of other multifaceted, online systems for behavior change.

Introduction

In 2004, U.S. household energy consumption totaled 5,700 million metric tons of CO_2, with home utilities; private transport; and consumption as top categories under individual control (Weber and Matthews 2007). We focus on the U.S. because of its high overall impact and per capita consumption. By taking simple actions to conserve energy, such as lowering the water heater thermostat or using a computer's sleep mode, individuals can reduce their CO_2 emissions and thus greenhouse gas emissions. Prominent climatologist Jim Hansen (2009) argues that to avert the most serious consequences of climate change, a fundamental change in greenhouse gas emissions is urgently needed.

CO_2 emissions and dollars spent are often closely related (Weber and Matthews 2007), meaning many actions cost little or save money. For example, if all 100 million U.S. households replaced five 60-Watt incandescent light bulbs with five 16-Watt compact fluorescent bulbs, CO_2 emissions would be reduced by approximately 20 million metric tons and save $1.5 billion dollars each year. There are many similar actions, each of which could lower energy consumption and thus greenhouse gas emissions.

In this paper we describe the development and evaluation of StepGreen.org (Figure 1), a site intended to motivate people to make energy-reducing changes to their behaviors. StepGreen.org combines features such as committing to and reporting on actions and can serve information to a person's social network profile page. Although this approach has become popular in recent years, little is known about which design features are successful. We describe our design process and evaluation. Our contribution is our exploration of the impact of our design choices on the success of StepGreen.org. For example, StepGreen.org's social network presence was not sufficient to draw in new users, while new social features were requested on StepGreen.org itself, suggesting the need to shift from a piggybacking model to one with more direct support for social interaction. Other results include the need for more flexible client and visualization support, and the addition of new sources of data about impact.

Background

Decades of research in environmental psychology and other fields have shown the value of social activities in changing individuals' environmental behavior (see Abrahamse et al. 2005 for a review). Looking beyond experiments specific to environmental behavior, Deci and Ryan (1985) argue that when participants have a sense of autonomy, positive feedback is effective and negative feedback less likely to be demotivating. This suggests that site designs may motivate users if they support public commitment (Abrahamse et al. 2005), competition (e.g., Petersen et al. 2005), group participation (e.g. Staats, Harland, & Wilke 2004) and frequent feedback (e.g., McClelland and Cook 1979-1980; Seligman and Darley 1977; Van Houwelingen and Van Raaji 1989), particularly in combination with goal setting (e.g., McCalley and Midden 2002). Our design explores many of these ideas.

Studies of the interaction between technology and green behavior provide a different perspective on opportunities for motivation. For example, Chetty et al. (2008) studied 15 households that were not particularly green, exploring

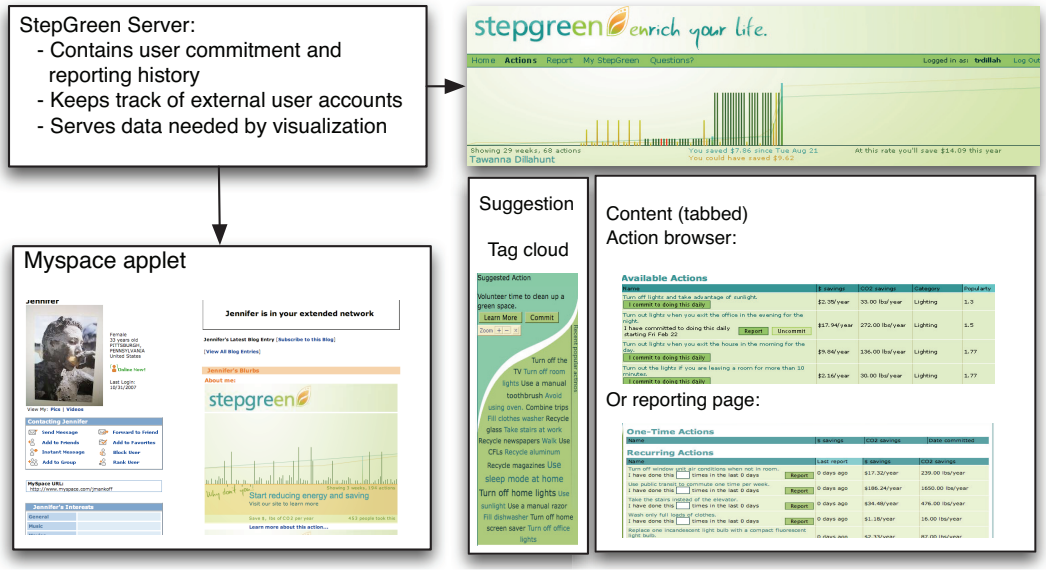

Figure 1 StepGreen.org brings together multiple components.

the factors that guide their resource consumption and existing behaviors for managing consumption. Common behaviors included replacing the thermostat, changing lights, and unplugging devices. Comfort and money were common motivations for managing resources. Participants asked for better feedback and visualization tools, and resource consumption was often *not* managed because it was simply invisible. These results suggest the value of including common behaviors as actions on a site and visually emphasizing a range of reasons for taking action, such as the dollar and emissions impact of actions.

Woodruff et al. conducted interviews in 35 green households, exploring an older, more settled population already committed to green behavior (Woodruff, Hasbrouck and Augustin 2008). Their participants fell into three groups: activism, self reliance and "trend-focused utopian optimism". Participants tended to take more difficult actions and become more interested in data as their confidence and knowledge grew.

Example Technologies and Websites

In a separate thread of research, persuasive technology (Fogg 2003) has been applied to the problem of engaging individuals in energy-changing behavior. For example, The PowerHouse is a computer game designed to change teenagers' attitudes and increase understanding using strategies such as timely suggestions, conditioning, and praise (Band, Tortensson and Katzeff 2006). A digital art project at Dartmouth College showed dorm residents an animated polar bear reacting to electricity use (Young 2008). In the home, feedback displays can lead to about 10% energy savings (Fischer 2008). Aleahmad et al. (2008) explored the impact of messaging on attitudes and actions in the context of a fish recipe search website. They found that indirect persuasion led to more positive environmental attitudes, while direct persuasion led to more environmental actions.

Numerous websites have appeared over the last two years to encourage energy saving behaviors. A common approach is to show possible energy saving actions users can take and ask users to commit to those actions (e.g., green.yahoo.com). Most of these sites do not track compliance – a user may commit to take an action but is not expected to report on whether or not that commitment was fulfilled. Some, like CarbonRally.com (which does include reporting) and Energy Race.com, engage users in a competition to take energy saving actions. Others, such as GreenNexxus.com, focus on social activities such as events, discussions, and sharing ideas. Little information is available about the effectiveness of these websites. Facebook publishes the number of users of its applications, which include some with a green focus. The most popular, GreenPatch, had over 800,000 monthly active users in January, 2010. Users of these applications may accrue direct impact (such as buying a square foot of rain forest) or simply be asked to reduce their own emissions through energy saving actions. Farnham (2008) reports on features that support adoption across all Facebook applications, such as usability and the ability to invite friends. But it is more difficult to understand which features of green applications impact user motivation/action.

Many green sites, within Facebook and outside of it, are structured around online social networks. As Kraut et al. (in preparation) argue, to be successful, a social site must deal effectively with newcomers and encourage contribution. In many social sites, members may associate with others who share their values and interests by reading and posting to one another's profile pages (Adamic, Buyukkoten and Adar 2003), creating a network of "weak" social ties (Granovetter 1973, Wellman et al. 1996). Perhaps these networks can function similarly to offline networks, which support social movements by "structurally connecting prospective participants to an opportunity to participate, socializing them to a protest issue, and shaping their decision to become involved" (Morris 2000).

In summary, a wide body of research and practice suggests promising avenues for engaging individuals in green activities. But how can these ideas be combined and instantiated in an engaging artifact that has compelling content, motivates green behaviors, enables self-reflection,

and supports recruitment and retention? Next, we describe our design solution, StepGreen.org.

Overview of Stepgreen.org

StepGreen.org piggybacks on popular social networks such as MySpace and Facebook via an applet that shows a progress visualization and suggests actions that may save money or energy (Figure 1 top). StepGreen.org is designed to appeal to a broad range of individuals, including those who do not currently consider themselves environmentalists. The site emphasizes financial savings and popularity in addition to CO_2 savings, and the name itself is designed to be ambiguous (in the U.S. "green" may refer to money or the environment, while "step" may relate to progress or increased activity). As shown in Fig. 1, top right, the branding is low-key, with a simple logo that hints of both a leaf and a foot and the subtitle *enrich your life.*

A user might be drawn to the site by an invitation from a friend or after seeing the applet on a friend's profile page. After initial account creation, the user may install the StepGreen.org social network plugin on a preferred site. Any friend who can view the user's profile page can see the visualization and suggested action. Thus, the visualization serves as a combination of public commitment and reminder. The reminder function is facilitated by the fact that many people visit their favorite social networking sites once a day or more. The applet can also lead to viral marketing, increasing membership on the site.

StepGreen.org uses a variety of mechanisms to advertise actions, including suggestions sent directly to a person's social network page (Fig. 1, top), a table of actions, and a tag cloud. Users can click on any of these to view a detailed description of an action or commit to it. Our intent is to provide clear instructions for change, while maintaining a sense of control and choice through the availability of many actions of differing impact and difficulty, both important persuasive strategies (Fogg 2003; Quinn and Wood 2004).

To encourage participation, suggested actions include many things that participants in our formative studies indicated they were likely to do. To encourage follow through, StepGreen.org combines committing to actions and reporting on whether commitments are fulfilled in the "real world." When a user logs into StepGreen.org, or explores the visualization, he or she sees information about commitments that have not been completed.

A multi-disciplinary iterative design process was used for each of the major components of the system. In addition to the studies described below, a group including professors of public policy, environmental engineering, behavioral HCI, technical HCI, and several students from design collaborated on each aspect of the site.

Actions

Actions represent atomic activities that a user can complete to reduce energy, such as "Lower the thermostat on your water heater to 120 degrees (save $90.00 and 1245 lb CO_2 per year)" and "Set your computer to automatically hibernate/sleep after a short period of inactivity (save $44 and 617 lb CO_2 per year)." For the site to succeed with our intended audience, it is important that the suggested actions be accessible and easy to complete.

Our first step in selecting actions was to examine 10 existing green sites including www.epa.gov and www.earthday.net, noting which actions appeared on them. We also examined our own green practices and those of friends and colleagues, to develop an expansive list that included actions related to electricity use (e.g., turning lights off, unplugging electronics), water use (e.g., taking shorter showers, washing full loads of dishes), gasoline use (e.g., carpooling, taking public transportation), and natural gas use (e.g., installing a programmable thermostat, wearing a sweater instead of turning up the heat).

We next conducted an online survey with 122 participants recruited through CraigsList in two major metropolitan areas. Participants ranged from 18 to over 60 (40% male, 46% single, about half with children living at home). Thirty-five percent were students, most of the rest worked full or part time. Participants rated 78 actions in terms of the likelihood they would take these actions. Respondents expressed pro-environmental attitudes and already did some actions (such as turning off lights). However, their likelihood of doing many simple energy-saving behaviors such as "air drying clothing", was rated an average of 3 or lower on a scale of 1 (definitely wouldn't do) to 5 (already do), and there were many simple actions that participants did not do.

Design Outcome: We decided to include low impact, popular actions rather than risk having no actions to which people would commit.

Visualization

The visualization for StepGreen.org is intended to provide users with feedback about their actions and motivate them to commit to new actions and fulfill their commitments. We designed it to meet the following guidelines, derived from the literature on environmental behavior change:

Feedback should be provided frequently, if not continuously (McClelland and Cook 1979-1980; Seligman and Darley 1977; Van Houwelingen and Van Raaij 1989). Online, an easy way to do this is through a site that people already visit frequently, such as Facebook or My-Space. StepGreen.org provides an inter-active progress visualization on every page of the main StepGreen.org website, and a scaled-down down, fully functional version embedded in the social network applet.

Feedback should show users how close they are to attaining their goals (McCalley and Midden 2002), and highlight the steps they should take to come closer to their goals. StepGreen.org shows users both what they have completed and what they committed to do later.

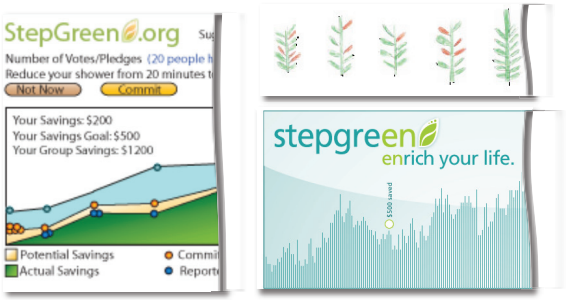

Figure 2: Some design iterations. The final visualization is shown in Figure 1.

Feedback should give participants a sense of control (Deci and Ryan 1985). StepGreen.org is designed to demonstrate progress after just one or two actions have been taken. It shows what has been done so far, and projects the user's impact for the remainder of the year.

With these goals in mind, the designers on our team iterated on visualization designs. Our iterative process included user feedback and adhered to the following additional guidelines. The visualization must: (1) scale appropriately to handle the data of a person who has used the site for a day, a week, a year or more; (2) respond dynamically to the user; and (3) be understandable with little or no explanation. Specific details of the interactive visualization are described in the implementation section.

Design Outcome: Fig. 1 shows the final design (top right). Each vertical bar shows one action. Orange bars are actions that were committed to but not fulfilled. Name and $/CO2 impact are shown as the mouse rolls over each vertical line. Both committed actions (orange), and fulfilled actions (green) are shown.

Interacting with StepGreen.org

Our group worked iteratively to settle on a specific design for interacting with StepGreen.org. Users can explore actions on the site in one of three ways. An *action browser* allows users to page through all available actions on the site. For each action, the browser displays the action's name, projected per-year dollar savings, projected per-year CO_2 savings, category, and overall popularity (See Fig. 1). Users can sort actions by any of the properties being displayed. The site prompts users to explore actions via a *suggested action* in the left sidebar that is updated every time the user visits a page on the site, as well as a *popular actions* display, which lists the names of the most popular actions in a *tag cloud* also in the left sidebar. Clicking on an action in the action browser or tag cloud takes the user to a detailed description of the action.

Reporting is done from the *report page*. To encourage timely reporting, recurring commitments are color coded and sorted by default according to the "staleness" of the user's last report for that action. Actions that recur frequently will go stale (and turn orange) faster and will tend to bubble up to the top of the recurring actions list.

Actions all include a CO_2 impact and dollar impact (which may be 0, or negative if there is an up-front cost) and a default frequency (*e.g.*, weekly, daily, etc.). Some also include other impacts such as natural gas. We calculate the values for each action using basic formulas for determining electricity or fuel consumption and standard assumptions about typical household behaviors. The cost savings and carbon dioxide savings for an action are calculated using relevant U.S. averages (to our deployment locale) for retail electricity price ($0.0985/kWh, EPA 2007), personal fuel economy (21 mpg., USEPA 2006), and so on. Estimates of appliance wattage and electricity consumption are based on surveys of typical residential usage (Dillahunt et al. 2008) or various operating requirements based on Energy Star criteria (e.g., Energy Star 2007). Carbon dioxide emissions are calculated from electricity production (1.36 pounds CO_2/kWh, EPA 2005).

Although individual use varies widely, these values provide an example of the potential savings from an action. For example, for the action "replace one incandescent bulb with a compact fluorescent bulb" we assume the individual is replacing a 60 Watt bulb with a 16 Watt bulb with equivalent lumens (light output) and that the bulb is typically used 4 hours per day, 365 days per year. Calculating energy (electricity) consumption as power consumed during a period of time (E = P*T), this results in 64 kWh of electricity saved annually. Each action also has annual dollar savings, identification of upfront costs, and total emissions reductions. This action results in approximately $6 of annual savings on one's electricity bill, but $2-$3 of upfront additional spending on the CFL bulb in the first year. Approximately 87 pounds of CO_2 emissions are avoided annually by this change.

StepGreen.org is implemented as a web application. An Apache web server serves passes requests to the application tier and serves content. The application, implemented using Ruby on Rails (www.rubyonrails.org), performs request processing and generation of dynamic content by communicating with the back-end relational database (MySQL). The StepGreen.org application provides two main components. A website component allows users to browse and commit to actions, report on commitments, and track progress. An external access component allows the syndication of a user's progress data on external websites via clients such as an Adobe Flash application that can be embedded in a user's MySpace profile page.

Field Deployment

In-situ data is crucial to the successful iteration of a complex, large-scale system like StepGreen.org. Releasing a web application "into the wild" is a one-chance endeavor. Although a controlled field deployment necessarily limits the testing of things like viral spread and retention, it is a crucial step to confirm the validity of a design. Note that our deployment was designed to shed light on the usability of our system, not to test behavior

change. Not all behaviors will be reported, and not all user reports are accurate. Instead, our analysis focuses on use of the system including individual and social interaction, the usability of our actions, and the effectiveness of the visualization.

We deployed StepGreen.org for 3 weeks to 32 members of the local community who had an active MySpace account (53% female). The sample consisted of 37% undergraduate students, 37% graduate students and 26% members of the greater community. Thirty-six percent owned or rented a house and 19% were responsible for maintaining a car.

Participants completed an online pretest questionnaire about their energy-saving behaviors, environmental attitudes, decision-making styles and daily life habits (e.g., car ownership, home rental vs. ownership). We also installed their MySpace applet. They were then asked to use the system for three weeks, during which they should log into their MySpace accounts and view their profile page at least twice a day. A new action suggestion was presented each time they visited their MySpace profile page or logged into the site. Suggestions were presented in order of popularity from the action survey.

Logging tools were used to record when each person viewed an action, committed to an action, and reported fulfilling an action; and when a stranger viewed a participant's MySpace profile page. After the three weeks were over, participants completed an online posttest questionnaire asking their feedback on various features of the StepGreen.org site (e.g., the actions, the visualizations). We also asked them the same environmental attitude questions we had asked in the pre-test survey to assess attitude change. Most gave intermediary responses to these questions that did not change from the pre- to the post-test, suggesting they were neither strongly green nor anti-green.

In a post-hoc analysis, we determined that almost half (14) of the participants had added 7 or fewer friends to their MySpace account, stopped using their account shortly after the study, or both, indicating that the account was used mostly or only for participation in the study.

Results

During the study, participants viewed detailed information for about 16 actions and committed to about 16. In addition, they reported completing 88% of those actions to which they committed one or more times. Most of those were repeating actions that could be done daily. Participants reported fulfilling almost 300 actions total including repetitions. Only two of the participants failed to request information on, commit to or fulfill any actions. The other 30 participants were actively engaged with StepGreen.org. Four participants continued to use the site for some time after the end of the study. Three primarily viewed action details, and may have been showing the site to someone, while one engaged in more active use.

Participants logged into their MySpace profile page from 1 to 352 times (Mean = 59.75, SD = 66.97). The most direct influence this had on participants was through the suggested action (see the bottom of Figure 1 for an example). By clicking through that action, participants could reach a more detailed description of the action on the main site. This was particularly effective for participants who frequently visited their MySpace pages.

Participants were shown an average of 57 different suggested actions during the study. In follow up interviews, participants reported relying heavily on suggested actions when deciding what to commit to, and rarely using the tag clouds. Participants reported using suggestions less when they started repeating after all possible actions had already been shown.

Of the 18 participants with public, active MySpace accounts, the number of their friends ranged from 8 to 198 (M=78). We did not observe any posts on public MySpace walls or blogs about the site. As a result, we had to rely almost exclusively on participant reports to learn about contacts with individuals not participating in our study.

In our interviews, ten participants told us that they showed the site to others. Communication about the site happened through diverse channels. In some cases, it happened through shared physical spaces. One participant and her 14 year old daughter had a joint MySpace account. The daughter started reminding that participant to follow through on her commitments. Two other participants reported showing the site to their partners or housemates.

Two participants reported that multiple friends contacted them by IM with questions and one participant reported getting questions directly on her MySpace. We used IP addresses to determine if anyone not associated with the study viewed a participants' MySpace profile page. During the study period, six friends of participants went as far as clicking on the "Sign Up" link and one requested an account after clicking through to the StepGreen.org main site. Although small, we consider these numbers a promising indication of the potential for viral marketing: increasing numbers of participants should cause a corresponding increase in sign up requests.

Although participants felt it was easy to show information to friends, few reported doing this in follow up interviews. However, a friend viewing a participants' MySpace page would see the visualization regardless. Participants asked for better support for comparison with other users. For example, in our post-study interviews one participant, who joined the study with a friend, asked to see her friends' data overlaid on her own visualization. Comparison currently requires looking at one's own page and a friend's page side by side or one after another.

Participant criticisms included that each action had to be reported separately and that clicking on an action did not provide valuable information in some cases. Finally, participants wanted to see more information about themselves: The most popular new feature request was a way to calculate one's current ecological footprint.

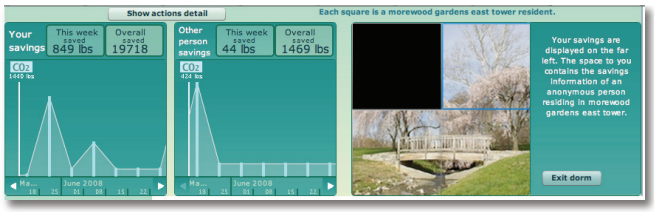

Figure 3: An updated visualization tha suppor s comparisons among groups and ...s.

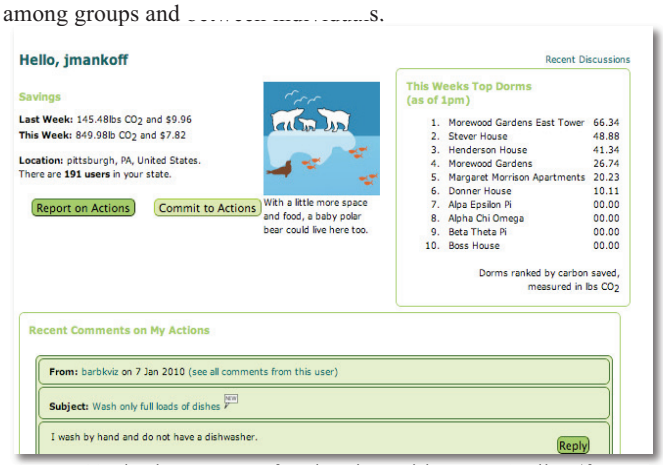

Figure 4: The home pag- fo- the site, with a top 10 list (from a recent dorm competition) and the new polar bear visualization. At the very bottom is a discussion post.

Privacy was a concern that was explicitly mentioned by several participants. Most seemed to assume that only the graph would be shared, and even that was a problem for three. One participant mentioned wanting to exclude hygiene-related actions from friends' views of her data. Despite this, sharing the visualization with others was one of the top features requested in the post study survey, with ratings of 3.93 out of 5.

We also asked participants where they wanted to see information and suggestions besides MySpace. The most popular site was the desktop, with 59% saying they would like access there. Next in popularity was access from another social network site (41%). About a third wanted access from their blog or email, and about 20% wanted access from a cell phone or browser default page.

The Actions: Almost every participant mentioned that they learned about new easy actions that could have a positive impact. Additionally, 45% of participants indicated on the post-test survey that they believed household energy use was more of a factor in global warming than they had previously believed. Many participants also commented on the positive realization that they were "doing a lot of things to save energy [already]" (Participant 30).

> … learning about how simple it is to conserve energy was really cool. I liked finding things that I already did and knowing that it all helps (Participant 6)

> Giving new ideas on how to reduce energy consumption. It gives suggestions you might not have thought of on your own. (Participant 7)

The Visualization: When asked what aspect of the site they liked best, almost half of participants mentioned the visualization; comments highlighted the value of showing current savings and projected savings.

> It was nice to see as I was going how much effect I was having in quantifiable amounts rather than just being told "you're helping!" (Participant 4)

> I liked seeing what I did and knowing that it made an impact. (Participant 6)

> I liked the specific actions with their cost benefit which was highlighted. The graphs indicated very clearly what could be saved and how much has been saved by me. So it lead me to follow some of the points like the recycling suggestions which i never used to really note. Also it makes one realize that by daily actions how much we can save both energy and money which would benefit the user as well the environment and other users as well. (Participant 10)

Participants also valued the interactive nature of the visualization, "i liked the highlighting on the graph with the cursor over it as it very easily shows how many tasks have been reported and how much saved." (Participant 9)

Redesigning StepGreen.org

Based on the data gathered during our field deployment, we have implemented a redesign of StepGreen.org. Below we discuss some of the key challenges found in our study, and how they influenced our redesign.

Ongoing Use and Social Interaction

Although our study was not a true open deployment, the observed reduction in active use at the study's end was a warning sign to us. As argued by Kraut et al. (in preparation), to be successful, a social site must deal effectively with newcomers and encourage contributions. Our results indicated that the MySpace plugin succeeded in encouraging individual contributions but was not very successful at bringing in new users or retaining users. In addition, participants explicitly and repeatedly requested additional social features on the main StepGreen.org site. For example, in the survey at the end of our field study, discussion boards for actions were highly rated. This suggests a need to shift from a model in which we piggyback on top of the social interactions at other sites to supporting social interaction directly on StepGreen.org.

Redesign Decision: To enhance the social interaction within StepGreen.org, we added the option for explicit comparisons between users (Fig. 3), along with discussions boards for each action. We also added a home page that highlights these features (Fig. 4). To enhance the value of individual feedback outside of StepGreen.org, we added support for Twitter, Facebook, and email reminders.

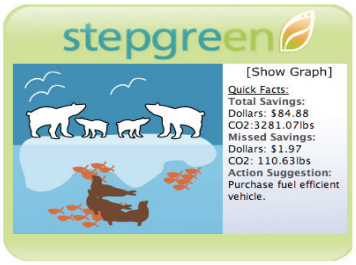

Figure 5: The new MySpace/ Facebook plugin

Learning About and Reporting on Actions

Users found many actions that they already did or were willing to start doing. Since past work indicates that simply identifying green actions can help shift a person's self-perception to be more environmental (Corneelissen et al. 2006), this is a promising result.

As participants are socialized to the problem of climate change, they may switch from "not caring" to "feeling powerless" because the problem seems overwhelming. An approach that helps people appreciate the value of small steps that they may already do can combat this. Our data suggests that StepGreen.org supports this, leading to comments such as "energy conservation is a process that involves taking baby steps toward a greener life." (Participant 1)

At the same time, we do not really know how many actions participants fulfilled, and our interview data confirms the presence of inaccuracies. Reporting is time consuming and relies on memories that may not be accurate. And actions may be difficult to implement or may not fit a user well. Additionally, some users did not want to report or track consumption on a per-action basis.

Redesign Decisions: The addition of a carbon calculator, automated sensing of actions, and automated sensing of impact can help to address participant concerns with reporting. These represent major additions to the site that are still in progress. To date, we have improved the reporting interface, run two studies of systems that can help automate the sensing of transportation activities (Froehlich et al. 2008) and overall impact (Schwartz, Mankoff and Matthews 2009), and begun implementation of a carbon calculator along with support for systems such as Google PowerMeter. In addition, we now support user created actions, which can enhance the ability of individuals to take small steps and identify personally relevant actions.

Visualizing Progress

Participants indicated interest in better comparative visualizations and visualizations that would preserve privacy. Perhaps most importantly, no one visualization fits all users and contexts, and this is especially true when integrating with the social web. A top 10 list, a Twitter feed, a MySpace badge, and a Facebook application all have very different requirements that do not map well onto our one size fits all solution. A more dynamic approach to visualization that supports customization is necessary.

Redesign Decisions: To support increased flexibility, we have developed an Application Programming Interface (API) provides the underlying mechanism for a variety of systems to operate independently on the same data.

Concurrently, we have designed and begun user testing two new visualizations. Our first design, shown in Fig. 3, allows direct comparison among groups of participants. We ran a dorm competition showing a trend toward increased participation with the social visualization and overall positive results for usability (Grevet, Mankoff and Anderson 2010). Comparative feedback, in which one's energy use is contrasted with that of others, can generate feelings of competition, social comparison or social pressure (Abrahamse et al. 2005). Our design also aggregates data to preserve privacy. Our second design, shown in Fig. 5 focuses on a high level, iconic representation of progress. This design gives summary numbers and shows progress in terms of a growing polar bear ecosystem derived from (Froehlich et al. 2008), something that may enhance motivation (Dillahunt et al. 2008; Young 2008). Our hope is that the polar bear will also support viral spread (*e.g.,* participants will be able to "give a baby polar bear" to friends) (Farnham 2008).

Conclusions and Future Work

We have described the motivation, design and field evaluation of a system of technologies for motivating environmental action, the StepGreen.org site and its associated social network plugin. Each of the site components (suggested actions, visualization, personalization, and MySpace plugin) were designed based on a combination of behavioral, environmental and design research along with iterative user input.

Our field study provides substantial evidence that people seek a means of communicating with others about their energy use. However, we quickly discovered the impact of that old truism, *the devil is in the details*. While many of the principles for creating environmental behavior change had been explicated in the literature, turning them into a functional online website was non-trivial. Our contribution is an understanding of the impact of different decisions on the success of StepGreen.org that others can learn from. In particular, we show that a shift from piggybacking on existing social networks to creating internal support for social interaction was needed; that a single visualization is not a viable solution but instead flexible support for many types of visualizations is needed; and that users wish to explore their impact from many perspectives, using many different kinds of data.

Acknowledgements

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