Social Incentive & Eco-Visualization Displays: Toward Persuading Greater Change in Dormitory Communities

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ABSTRACT
In this workshop paper, we describe the design, implementation, and early results of an *eco-visualization* of Indiana University Bloomington campus dormitory energy and water consumption. We (i) present initial results of our ongoing study examining the role eco-visualizations might play in impacting dormitory communities' behavior, (ii) discuss what these findings suggest with respect to how situated displays could help improve community uptake in future work and (iii) describe an emerging conceptual design direction with an eye toward the intersection of situated displays and social incentive.

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

General Terms
Design, Human Factors

Keywords
Eco-Visualization, Situated Displays, Interaction Design

1. INTRODUCTION
The intersection of human-computer interaction and environmental sustainability represents a nascent and growing area of interest in the HCI community [e.g. 1, 2, 3, 5]. Moreover, the combined application of situated visualizations and pervasive computing technology presents a compelling context to persuade individuals and communities to intentionally act in more sustainable ways [3]. This design space is particularly well suited to support exploration into *eco-visualization* (EV), which we have elsewhere described as *"any kind of interactive device targeted at revealing energy use in order to promote more sustainable behaviors or foster positive attitudes towards sustainable practices*" [5]. The notion of eco-visualization strongly owes to the work of artist and designer Tiffany Holmes [2], as well as many others [5]. Essentially, EVs shift focus away from frequently hidden engineering solutions toward the design of graphical interfaces and systems to actively persuade participants to reduce their consumption through dynamic—and often engaging—feedback.

Our ongoing project focuses specifically on exploring the role that eco-visualizations of energy and water consumption in Indiana University Bloomington (IUB) campus dormitories could play in motivating student dorm residents to reduce their resource consumption. Campus dormitories are pervasive structures across most major university campuses and consume considerable amounts of energy and water [4]. In such buildings, student residents often have a high degree of control over their own consumption, however dormitory dwellers typically do not pay directly for their utilities bills and may have less incentive to conserve than a residential occupants who directly pays for their own consumption. Thus, university dormitories present an interesting context to investigate non-financial motivations to conserve in a space where residents have high control over their own consumption and owners have high control over the possible situated display design interventions introduced in the building.

We designed, developed, and implemented a dynamic visualization interface that was deployed in a campus-wide conservation competition (titled the *Energy Challenge*, see http://energychallenge.indiana.edu). The immediate goal of this project was to transform student behaviors during the competition, in addition to facilitating changes in participants' long-term behaviors and attitudes toward resource consumption. While initial results from the Energy Challenge competition were notable and encouraging, contextual user research suggested that integration of new design concepts more strongly stressing the social dimensions of student dormitory life could help increase and sustain use among our population; potentially persuading greater behavioral change and a larger total reduction. In what immediately follows, we (i) describe the initial Energy Challenge concept and outcome, (ii) discuss an emerging conceptual design direction for situated displays aimed at more explicitly targeting social dimensions of student dormitory populations, and (iii) conclude with a workshop contribution statement.

2. BACKGROUND
2.1 The Energy Challenge 2008
The Energy Challenge took place from March 20th to April 17th, 2008. Students in 10 dormitories on the IUB campus took part in the competition to conserve electricity and water; and the winning dorms received cash prizes and celebratory cookouts. The competition resulted in an estimated combined avoidance of 33,008 kilowatt hours (KWh) of electricity and 724,322 gallons of water compared to baseline consumption of the previous three years. Participants received feedback primarily through the Energy Challenge website (which visualized data from an utilities information database), however there are plans to implement this EV through situated displays more pervasively throughout campus for the 2009 competition. Additionally updates were sent to participants via a facebook group and email.

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2.2 User Research

We initially conducted several contextual interviews with undergraduate residents of dormitories across the IUB campus. Key insights arising from our interactions with students included (i) dormitory rooms are often cluttered with electronic devices, (ii) residents are largely unaware of how much energy particular devices and behaviors consume, and (iii) students did not know how to reduce their energy consumption beyond the most common strategies. While some students voiced concern over environmental degradation, participants appeared to be largely unmotivated to change their behavior based on environmental consequences alone. Our observations indicated that students' consumption behaviors are strongly influenced by their peers. Social motivation surfaced as a key component required to ensure our competition's success. According to a student we interviewed, "*…if all the girls on my floor really wanted to win, I'd try to save energy; otherwise, I probably wouldn't do anything differently.*" This suggests our visualization must include a social dimension to obtain a critical mass of participants and facilitate widespread conservation.

3. Energy Challenge 08 EV Display

Based on initial user research, we developed two major design components for our EV display (Figure 1).

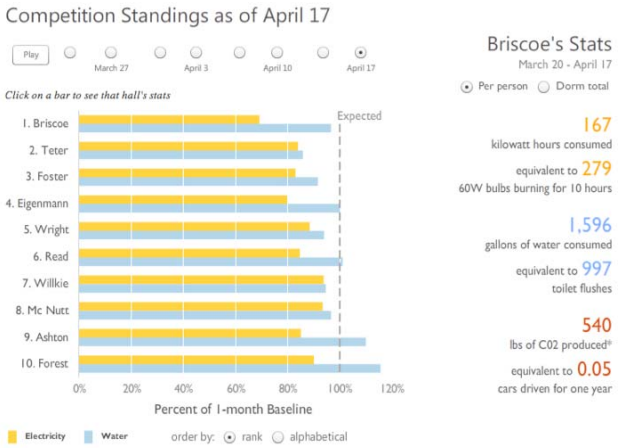

Figure 1. The dynamic Energy Challenge 08 EV display.

The competition standings view communicates the current winning dormitory (i.e. using the least amount of electricity and water) and by how much. The goal of this view is to motivate and facilitate conservation through competition. We explored several different ways of communicating competition standings, ranging from a simple "Top 10" list, to a set of bar charts showing the percentiles of each dormitory's respective standing, which was measured as a percentage of a 1-month baseline. The detailed consumption information view communicates the amount of energy and water being consumed, as well as the environmental impacts of this consumption. The goal of this display view is to motivate conservation behavior by encouraging and facilitating reflection on consumption and its consequences. To communicate detailed consumption information, we listed several different figures to right of the competitions standings. These figures include more abstract quantities (dollars, kilowatt hours, and pounds of CO2) and more concrete quantities (number of trees to offset CO2 emitted, number of cars worth of CO2 emitted), which are expressed in terms of per person or per building.

3.1 Evaluation & Interviews

Following the implementation of our EV display, we conducted a series of interviews and concept evaluations with IUB students. Our participants' responses suggested several key insights related to designing potentially more effective EV displays for student dormitory communities, namely:

• *Concrete consequences*—figures such as number of trees to offset CO2 emissions are more meaningful when they are large, aggregate figures (e.g. per building, campus). However, even if they provoke reflection, their potential to motivate action is still questionable, particularly without prescriptive suggestions for actions or social motivation.

• *Abstract quantities*—(e.g. KWh, pounds of CO2) are more meaningful when presented on a per person basis, where they appeared to make people feel like their actions are having an impact. With large numbers, people felt hopeless to effect change.

• *Numbers and statistics are generally not motivating*—narratives or data-driven photographic visualizations may be more meaningful.

• *Relevant Instructive Information*—even if people are surprised by their consumption impact, they are unlikely to take actions if they do not know what to do; offering people the ability to calculate estimated savings from a variety of energy-saving behavior suggestions could provide more engaging alternatives.

In terms of motivating conservation behavior, it appears that leveraging social motivation and competition should take first priority, along with providing concrete suggestions for conservation behaviors. The social networking group created for the competition using Facebook accumulated approximately 150 members over the course of the competition—and noteworthy interactions did emerge. Nonetheless, even considering it is unlikely all 10,000 students living in IUB dormitories were frequent users of Facebook, this rate of adoption remains low. Among other things, this may suggest more pervasive design interventions, such as situated displays more strongly targeting our population's social dimensions are necessary. Moreover, in response to the survey question "*What issues, if any, prevented you from participating more fully in the Energy Challenge*", 44.2% of respondents (n=49) selected "*No one else was competing so there didn't seem to be a point.*" While significant amounts of students did in fact participate, these patterns of interaction need to be made visible in ways meaningful to participants and relevant to their social context. Essentially, without strong social incentive, it seems unlikely that students will even take

the time to investigate our detailed consumption view, no matter how interesting and informative it may be.

4. Social Incentive & Dormitory Communities

We have developed additional concepts pertaining to each of the aforementioned design insights, however incorporating social incentive in the design of future EVs appeared particularly promising to persuade greater behavioral change in dormitory communities. As noted, many students felt that they would only be willing to participate in the conservation competition if their peers were also motivated. Our EV display encourages social motivation to the extent that it facilitates competition to conserve by providing clear indicators of the competition standings and feedback on consumption. However, the power of social incentive can further be leveraged to raise awareness and encourage conservation behavior; and will likely be most effectively implemented in situated displays *apropos* of the high frequency of social spaces and contexts characterizing student dormitory life.

4.1 Student Pledge Wall Situated Display

One design concept we are developing in this conceptual direction is the *student pledge wall* (figure 2). The idea of this design is to complement our initial EV with the ability for students to pledge conservation behaviors selected from a pre-defined list. The pledges will be shown on situated displays in key social areas, such as lobby dormitories, and pledge data will also be used to dynamically calculate projected savings and competition standings.

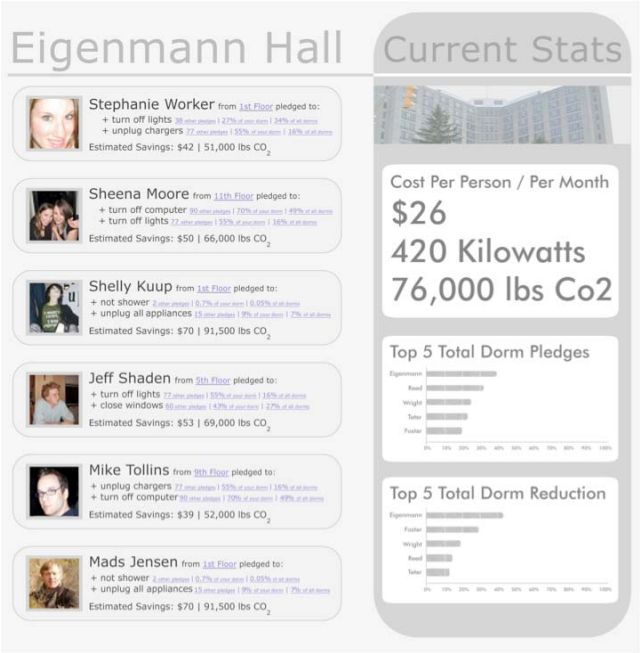

Figure 2. This early prototype of the pledge wall illustrates the combination of social networking with consumption feedback.

By allowing students to make pledges, the hope is they will feel more empowered to enact change and also become more engaged in the competition. The public display serves as a persistent reminder to students to keep their pledges and also provides an informal medium for students to receive credit for their contributions. We also plan to experiment with using dynamic quantitative graphs to illustrate the comparative relationship between *projected* impact of pledged behaviors and the *actual* ongoing tabulated reduction. This technique could reveal deeper insights into underlying motivations behind communities' commitment to change with respect to particular behaviors and their actual actions. Moreover, this information could lead to new design techniques and strategies to effectively impact this disconnection. By publically displaying student pledges in key social spaces of each dormitory building, students may be more likely to engage in and sustain participation in the competition.

5. Conclusion

While the field of eco-visualization is becoming increasingly diverse, at present the dominant approach to designing EVs is to create consumption monitors that clearly present—often quantitatively—consumption patterns. While past studies have indicated that this approach can lead to decreased consumption [e.g. 4], we believe that other approaches, such as those employing situated displays, may lead to more engaging experiences and further reductions in consumption.

In this workshop, we hope to contribute reflections on (i) challenges faced in designing the Energy Challenge EV, (ii) feedback obtained from our target population, and (iii) new design concepts on the horizon. In particular we aim to discuss the intersection of social incentive-oriented EVs and situated displays as a means to persuade greater resource conservation in student dormitory communities; ultimately in the service of construction of future design interventions to facilitate more sustainable behaviors and interactions.

5. ACKNOWLEDGMENTS

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