Workshop on Defining the Role of HCI in the Challenges of Sustainability: Position Paper

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ABSTRACT

Individuals could drastically reduce their carbon footprint by changing daily behaviors to more sustainable practices. In order for this change to occur, individuals must be made aware of their impact and must be provided with an incentive to change their consumption patterns. In this paper we provide a literature review of the current research in the areas of energy feedback, social psychology, and social visualization to determine functionality that is important in a computer-based feedback system to motivate users. Future work would include creating a visualization based on these findings.

Introduction

In the United States, residents have complete control over a large portion of their energy consumption [8, 11]. By changing daily habits to more sustainable practices, individuals could greatly reduce their carbon impact [8, 9]. However there exists a general ignorance on the part of individuals to the fact that their actions directly impact the environment [5, 8]. In order to change behavior patterns, individuals must be made aware of their carbon footprint.

Many studies have shown that individual feedback on energy usage is essential in increasing personal awareness on the ecological impact of daily actions [3, 5, 6, 10, 11]. Darby, in a thorough literature review of energy feedback systems, found that direct feedback, in the form of an interactive computer display, could contribute to reducing household energy consumption by twenty per cent [3]. Furthermore, individuals report being interested in receiving information about other households [4]. In fact, comparisons to other individuals could be a motivational stimulant [5]. Moreover, social comparison visually emphasizes the position of the individual within the collective by making individuals "gain understanding that [their] contribution is part of a larger picture: personal practices accumulate into collective practices" [5]. To create a carbon footprint awareness system that would show an individual's performance compared to others, we must understand the different parameters of social comparison.

There are different types of social comparison such as implicit and explicit comparisons, which result in different emotions [13]. My current work focuses on studying social comparisons and describing the specific characteristics of our data that must be taken into consideration for the implementation of a carbon footprint comparative visualization on the Stepgreen.org website.

Social Comparison Design Space

Social comparison is defined as "a phenomenon wherein people match their rate of performance to the rate of people working around them" [12]. Depending on different parameters of comparison such as relative performance, scale, explicitness, and anonymity, this phenomenon can make individuals motivated to adjust their behavior. In this section we briefly present a preliminary map of the social comparison design space to understand how the different parameters interact with one another.

Relative performance

Engaging in upward comparison with someone similar and slightly better could have a positive motivating effect on the lower performer [14]. In fact it is best to always have someone better; being the overall highest performer could be a source of apathy [15]. In contrast, comparing oneself to a lower performer is downward comparison [14]. Extreme downward comparison can make an individual feel very good while extreme upward comparison can lead to discouraging feelings. This type of impact is true unless the other person is very dissimilar in which case the comparison has no effect [14].

Scale

The number of comparison others is an important aspect as well. Festinger, the first psychologist to introduce the concept of social comparison, found that interpersonal comparison, or individual-to-individual comparison, led to personal identity definition [14]. Turner et al. found that at the group level, or individual-to-group comparison, social identity is emphasized [1]. Individuals evaluate their performance based on the performance of the group [1]. Thus the intimacy of individual-to-individual comparison will bear different outcomes on self-definition than individual-to-group comparison.

Explicitness

Comparing people on a single performance, or one-dimensional comparison, is an explicit comparison. In contrast, implicit comparison involves a multi-dimensional comparison [13]. With implicit comparison, it is difficult to tell whether someone is better or worse than someone else; they may be better on some dimensions and worse on others [13].

Anonymity

When an individual is characterized by personal identification, such as by name or by photograph, the individual's reputation is at stake. However, if users are anonymously identified, by an avatar for example, the results of a good or poor performance are much less significant. Shepherd studied an online brainstorming application where anonymous users were shown to be more productive than explicitly identified participants [12]. Shepherd also acknowledged that anonymity allows more social loafing and public identification may lead to more responsible behaviors. However, it is possible that public recognition would dissuade low performers from participating.

In the context of creating social application to motivate individuals to engage in sustainable actions, it is important to understand these parameters of social comparison. In the next sections we will explore how social comparison has already been applied in the context of environmentalism.

Existing Social Visualizations

Paper-based environmental social comparison

Results from paper-based (e.g. energy bills) feedback studies can be valuable for computer-based visualizations because they focus on the graphical display of social comparison. Egan explored comparative feedback on energy bills to determine the most effective graphical representation of comparisons [4]. This study revealed users have difficulties interpreting graphs in general but non bell-curve graphs were more preferable than bell-curved distributional graphs for comparing one's household energy usage to others [7]. Another study considered the differences between individual feedback and comparative feedback of energy consumption in the workplace [11]. The data was displayed on bulletins and through announcements in the company's magazine. The graphs displayed weekly savings over all energy saving behaviors and were expressed as percentages of the total potential [11]. The results indicated that individuals who received comparative information saved more energy than those who did not [11]. As opposed to paper-based feedback where information is given intermittently, public displays of a building's energy usage give residents an immediate response to their actions.

Public displays of energy usage

Eco-visualization is the public display a building's or a community's energy usage [7]. Such displays have also been used in college dormitory buildings for energy saving competitions at Oberlin College [7] and Indiana University [19]. Studies evaluating the effectiveness of these displays indicate an overall decrease in energy use in the targeted building [7]. While public visualizations are useful for sparking environmental interest and for showing a building's carbon impact, they fail to make the residents understand their personal conservation contributions within the global savings. In online social networks, users can have access to their personal profile and contrast their results with other participants.

Online environmental social networks

Over the past few years, online social networking websites have been flourishing. Many have focused on connecting people through a conservation objective such as www.carbonrally.com [18] and www.carbondiet.com [17]. Most of these environmental social networks foster competitions between individuals or groups of individuals, and publically recognize the highest performers. Even though these websites are relatively successful, meaning they have substantial amounts of users, the comparative visualization is often limited to leader boards or to general geographical summaries [18].

Most environmental social feedback systems posit that social comparisons of environmental data are valuable in encouraging personal conservation behavior. However the paper-based feedback methods lack important technical qualities, eco-visualizations omit individual performance and existing online personal displays don't focus on the format of the comparative visualization.

Figure 4. Current Stepgreen.org visualization

Characteristics of Environmental Data on stepgreen.org

Stepgreen.org is a website developed by the Footprints team at Carnegie Mellon University to encourage users to save energy and money. To track their progress, users commit to taking green actions and can see their personal progress.

Network-based virtual community

Users will generally be strangers to each other. They have a purpose or motive for joining the website (for environmental activism) and thus share a common identity through their concern for the environment. The website may lead to new relationships but does not specifically be a support for existing real-life relationships.

Inequality in amount of data

Some users may make large contributions while others make smaller ones and some users may have been participants for a long time while others are newcomers. Therefore the visualization should not proportionally calibrate an individual's representation in the space based on amount of contribution. In the Comtella study, Sun and Vassileva assigned a fixed set of different avatar sizes rather than displaying users proportionally to their participation [16]. However another possibility could be to give everyone the same size in the space and numerically assign rankings. Moreover users who have been members of the system for longer will have accumulated more data than new users. This could be discouraging to new users, and may reduce motivation for high performers. To avoid this, we could base all comparisons on daily or weekly savings.

Data source

The data collected can come from self-reports and sensors in the environment. Part of the data could record real-life activity, such as energy saving habits, and another part could record online activity data, such as the last login time. In other words, the data can potentially have different levels of accuracy. Thus, we believe showing trends rather than details is preferable.

Indefinite number of users

In the individual-to-group visualization, the visual representation would be different when there are many users as when there are few users. Moreover the data of one individual could be negligible among that of a large crowd. To avoid this we could compare an individual to a small group (chosen on similarity with the individual or randomly), and minimize the rest of the space.

Public recognition

For environmentalism, public recognition is an incentive for saving energy [2]. Thus public recognition on Stepgreen.org could have positive benefits for high performers.

Future Work

Future work in this area would be to study one of these particular comparisons and produce innovative designs to support it, followed by detailed usability studies to measure its effectiveness. Currently we are focusing on implicit comparison, representing individuals on multiple dimensions, because we believe it would have the greatest benefit for people who aren't very green. Moreover we are studying the integration of implicit comparison in a space that could accommodation possibly thousands of users.

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