USER AWARENESS AND USER BEHAVIOR IN A SHARED SPACE

Using plant as the information display

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Abstract. People are aware of objects in physical spaces to which they may act responsively. We are interested in human behavioral changes in the presence of reactive displays in shared environments. In a limited 2-week field study, using plants (both natural and artificial) as reactive displays, we observed human trash disposal/recycling behavior. We found that there is a significant increase in recycling ($p=0.08$) when there are reactive display with natural plants. We also noticed increase in recycling with displays with artificial plants. These findings suggest that people can and do alter their behavior in shared environments, and that such behavioral changes can be effected by the use of reactive/responsive information displays.

1. Introduction

Awareness is important. In a shared environment, people are aware of the environment and of others in the environment. Such awareness influences their behavior. It is well known that, in computer supported cooperative work systems, awareness within individual and group activities in virtual space is critical for successful collaboration (Dourish and Bellotti, 1992). Our interest is the shared physical space, and in exploring whether one can design (or

manipulate) the space in order to influence human awareness, and thus, human behavior.

In a limited physical setting, namely, a cafeteria, taken as the experimental shared space, we observed trash disposal/recycling as the exemplar for human behavior. Natural and artificial plants along with trash cans were used as real-time reactive information displays. The choice of using elements from nature as the media for responsive/reactive display was based on the assumption that people tended to care more for things natural such as plants or fish (in bowls) found in offices. As Ishii et al. (1997) remarks: "People know what to expect of a flashlight, know what to expect of lenses." In extending this line of thinking to nature, we can say that people know what to expect of plants. Moreover, there is trend amongst designers to borrow materials and metaphors from nature, especially in the design of spaces (Ishii and Ullmer, 1997; Dahley, Winsneski and Ishii, 1998). Designers also draw upon the living parts in nature, imitating biological forms and behaviors with artificial materials and techniques. This is also known as *biomimetics* (Bohlen and Mateas, 1998; Antifakos and Schiele, 2003; Holstius et al., 2004).

We believe that, from the human standpoint, use of plants as active displays is much more persuasive and engaging. In these circumstances, people are likely to be more aware of the display, which could lead to altered behavior.

2. Methodology

The methodology for this study has three parts: information design, field survey and analysis.

2.1. INFORMATION DESIGN

The goal of the information design is to convey information, by using plants, on trash disposal/ recycling. Recycling is dispersed over time, but localized in space, as are the stimuli to which plants respond. For simplicity, directional light was chosen as the stimulus. Disposals to recyclable or trash were translated into bursts of light, directed toward one or the other side of a group of plants. Corn seedling was chosen as the plant.

If trash receives more light than recyclables, the plant eventually leans toward the trash and vice versa. In this we can communicates a very simple idea, which is when it is that people throw away more than they recycle.

While generating concepts for our living plant display, we also began, in parallel, developing prototypes, fostering living plants while sketching and constructing robotic plant components. We constrained the robotic display,

equipped with individual photosensors, to movements in a single plane. This simplified information mapping and increased the legibility of the display.

Figure 1. Design of natural and robotics plants displaying information.

2.2 FIELD STUDY

We evaluated the information design in a field study, conducted over a two-week period. The physical location was a cafeteria in a school building. The cafeteria customers were, generally, highly educated and are familiar with systematic methods of experimentation. About 2/3rd were male, ranging between 18-27 years of age. The first week serves the baseline with the displays introduced in the second week.

2.2.1. Week 1-Baseline

In the first week, we introduced the display stands, trash and recycling containers along with sensors, but without any plants displays or lights. During this week, which serves as the baseline, gave the cafeteria customers time to get accustomed to the new design. We kept to the same locations as the original trash/recycling containers in the cafeteria. There were four locations for the displays, spread equally around the perimeter of the space. For each display, its left side was for recycling and its right side, for trash. Each day we weighed the trash and hand-counted the recycling items.

2.2.2. Week 2- Display Introduction

In the second week, we introduced the displays. See Figure 3. The four displays conditions were Control (no lights or displays), Robot + Lights, Living + Lights and Lights. The natural and robotic plant displays were located at B and C, the two most equivalent places in terms of waste-recycle activity, which was indicated by the observations in the previous baseline week. Midweek, we exchanged the locations of the two displays.

In this second week, we conducted 13 10-minite interviews with people we observed talking about, pointing to or interacting with at least one of the displays. Respondents gave informed consent and were asked a series of questions about when they first noticed the displays, what they thought they were for, if they elicited any feelings, and what effect the displays might be having on them.

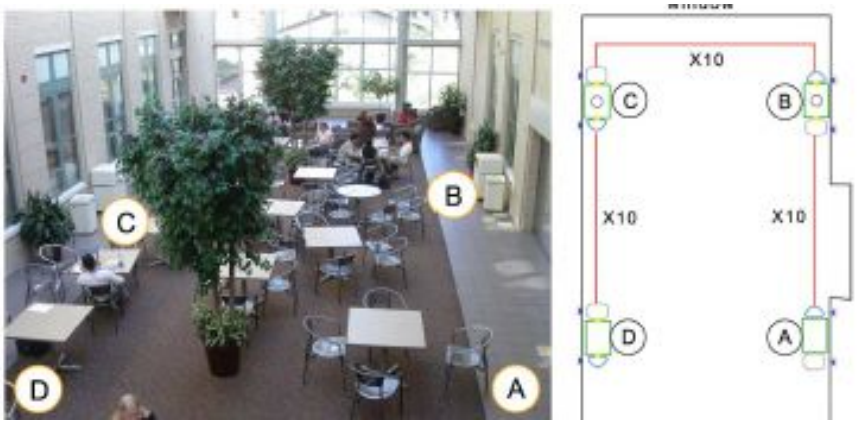

Figure 2. Arrangement of units in cafeteria. During Week 2 the initial conditions are: A=Control, B=Robot + Lights, C=Living + Lights, and D=Lights. Locations of the Robot and Living displays were switched midweek.

2.3 ANALYSIS

We generally observed an increase in recycling and no change in trash disposal across Weeks 1 and 2. As this study was only 2 weeks long, we note that these increases are not statistically significant. There are reasons to take into consideration both measures (trash and recycling) simultaneously. After all, if the disposal of trash had increased much in comparison to recycling, we would certainly not consider this to be a positive change in human behavior.

After standardizing the trash and recycling scores, and combining them in a ratio, a MANOVA analysis indicates that the display featuring living plants start out worst and end up best. This effect is marginally significant, $F[3, 9] = 3.1$, $p = .08$. Though our other quantitative results do not reveal significance, the effects are generally in the direction anticipated.

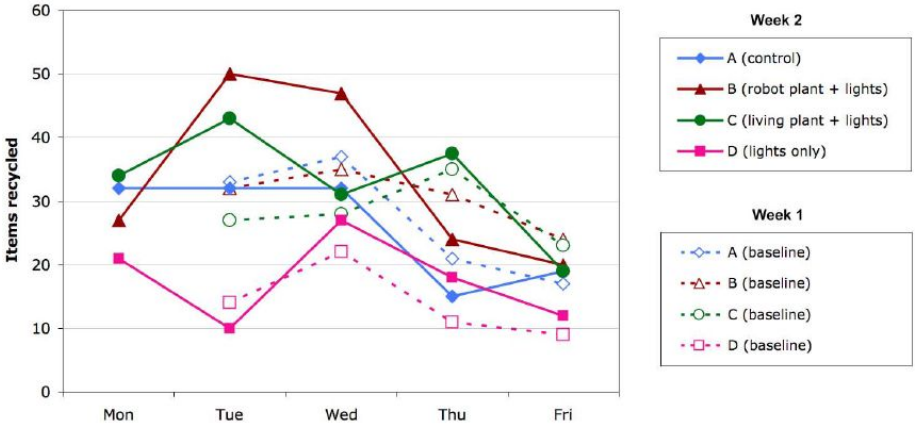

Figure 3. Changes in recycling during study. Dashed lines represent Week 1 (baseline). Solid lines represent Week 2 (conditions). Similar shapes represent the same condition across days. Recycling data are missing on Monday, Week 1.

3. Findings

As we had hypothesized, the use of things from nature in the displays contributed to more engaging compelling awareness. This idea was further supported by our interviews. Several people showed high appreciation for using plants as the displays. One person even declared that these displays made his day.

The overall design appears to have increased recycling behavior. The immediate feedback of a light turning on may have encouraged people to recycle. Although we cannot be certain of what happened, we do believe our displays made a change in the awareness of some people, just at the point recycling a plastic bottle. And this idea is supported by quantitative and qualitative evidence.

Figure 4. Progression of changes in both plant displays.

4. Conclusion

The objective of this study was to observe whether human behavior changes when their shared space is manipulated by reactive displays. The results appear to indicate this. We find that people do change their recycling behavior in the presence of reactive displays. We also observed an increase in recycling activity with display of natural plants and a semi-significant increase from the use of a biomimetic display and even lights alone. The findings argue for the development and deployment of lightweight interactive artifacts to deliver simple rewards in appropriate contexts. Our designs stand as a contribution to research in new spaces made up of hybrid artifacts, biomimetic design, and lightweight robotics. How human behavior changes after longer-term exposure to such hybrid designs would be an intriguing topic for future study.

Acknowledgements

This work was supported under NSF grant IIS-01215603. Special thanks to Scott Hudson, Sara Kiesler, Jim Skees, Rege Kostlof, Barb Kviz and the Carnegie Mellon CPS staff for their cooperation and support.

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