Breakaway: An Ambient Display Designed to Change Human Behavior

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ABSTRACT
We present Breakaway, an ambient display that encourages people, whose job requires them to sit for long periods of time, to take breaks more frequently. Breakaway uses the information from sensors placed on an office chair to communicate in a non-obtrusive manner how long the user has been sitting. Breakaway is a small sculpture placed on the desk. Its design is inspired by animation arts and theater, which rely heavily on body language to express emotions. Its shape and movement reflect the form of the human body; an upright position reflecting the body's refreshed pose, and a slouching position reflecting the body's pose after sitting for a long time. An initial evaluation shows a correlation between the movement of the sculpture and when participants took breaks, suggesting that ambient displays that make use of aesthetic and lifelike form might be promising for making positive changes in human behavior.

Author Keywords
Interaction Design, Product Design, Design Study, Lifelike Motion, Ubiquitous Displays

ACM Classification Keywords
H. 5. m Information interfaces and presentation

INTRODUCTION AND MOTIVATION
Everyday objects provide rich opportunities for information display [3, 16]. They are distributed in location, viewed in social settings, and make use of aesthetic qualities. Ambient, peripheral, and ubiquitous displays (referred to in this paper collectively as "ambient displays") receive varying and unpredictable levels of attention. They need to be aesthetically designed because they are situated among other personal objects in the home and office [5, 7]. Additionally, they must balance issues of privacy while presenting information.

While many novel ambient display designs have been proposed for everyday environments [9, 16], little is known about how interactions over time with an ambient display can potentially change human behavior.

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In response, we designed Breakaway to explore the possibility of using an ambient display, imbued with aesthetic qualities, to present people with peripheral information that can potentially change their behavior. We explore the principle of giving meaningful presence [6] to information that is not readily explicit for the user.

Breakaway is a small sculpture placed on the desk of stationery office workers. It draws from performing arts and animation by using pose and gesture to remind the user that she has been sitting for too long and needs to go for a short walk (Figure 1).

BACKGROUND AND RELATED WORK
Recently, there has been an increasing interest in the design of calm technology that engages both the center and the periphery of our attention by moving back and forth between the two [16]. Calm technology allows the user to initiate the interaction based on her needs, rather than the technology providing the information push.

Calm Technology has been used to convey a wide variety of data; including network traffic [9], stock market values [9], daylight [12], and presence information [1, 13]. Numerous concepts for ambient, peripheral, and ubiquitous displays have been proposed. Some displays are physical, using materials such as wire, string, pinwheels, water ripples, and bubbles [9, 16]. Some reference lifelike forms such as plants, water, and grass. Other displays rely on projected digital images, and have a high consideration to aesthetic design [5, 8].

Figure 1. Shows Breakaway in its upright position.

There has also been an increasing interest in biomimetic, lifelike, anthropomorphic, and zoomorphic product forms and product behaviors. A set of studies have investigated the use of anthropomorphic and zoomorphic forms in designed products in particular[2], concluding that we use anthropomorphic and zoomorphic constructs to help understand how human values play a role in interacting with a largely inanimate environment.

As interaction designers, we believe that aesthetics and mimicry of our world play an important role in the success of a display design, since the ambient display must function as a decorative, inquisitive object when it is not attended to. Calm technology is not designed for a specific 'function' and thus, usability criteria such as ease of use, low error rate, etc. are usually not the relevant criteria of evaluating its success [12]. Rather, it is important to investigate if people are willing to accept their presence in their environment:

"The perspective on artifacts as expressing something, rather than as being specifically used for something, places aesthetics at the center of design. Aesthetics is not about the creative or artistic surface of these everyday computational artifacts, but about how their expressions form an identity that can make them meaningful building blocks in someone's lifeworld. [6]."

DESIGN PROCESS

Our design process had two intended goals: 1) to explore how an ambient display that features aesthetic and lifelike qualities might be used to change human behavior, by bringing previously inaccessible information to one's attention, 2) to use the concept of pose, gleaned from performing arts and animation, as a way of conveying this information.

Office Workers as the Primary Audience

It is known across a variety of demographics and age groups that sitting in one position for long periods puts excessive ergonomic strain on the body [15]. This in turn, can lead to major health complications – backache and obesity are two major symptoms caused from this habit.

Nevertheless, our lifestyle forces us to sit for long periods everyday. Our jobs require that we sit at an office desk or work with computers. Similarly, our entertainment activities force us to sit for long stretches of time (to watch TV or play video games, for example).

For this study, we chose employees whose job requires them to be sitting for long periods of time as our main audience. In the early stages of this study, we performed quick anecdotal interviews of employees and researchers in three departments at two universities. Almost everyone had identified being too stationary while at work as a problem. Some had even come up with solutions for it. One of them had two offices on either end of the department, and in order to force herself to get up and walk, kept some books and other materials that she needed on a daily basis in the space that she didn't regularly use. Another employee had set up her online calendar to remind her to get up and walk every two hours. So, we identified this as a valid problem.

Design Goals

Given our problem space and our audience, we defined the following design goals:

1. *Abstract.* We wanted to use data abstraction, rather than raw sensor data collected from the user, to display information to encourage people to be more active, and to draw attention to the harm that is done to the body by sitting for long stretches of time.
2. *Non-intrusive.* We wanted to present data in a non-obtrusive manner and to make it available at all times during the work day without interrupting work.
3. *Public.* We wanted to present data in a way that people would willingly display it in a public place like the office. We needed to present the data, which is personal by nature, in a way that is appropriate to be presented in a public environment.
4. *Aesthetic*. Since the display would function as a personal object within the office space, it would need to be inquisitive and sustaining interest over time.

Ideation Phase

In this phase, we explored a variety of concepts that engaged all of the senses. These ranged from a simple display showing a graph of presence in the chair, to vibrotactile feedback indicating that the sitter has been present in the chair for too long. The goal of the concepts was to inspire the sitter to get up and walk without aggressively prompting her to do so.

We also looked at theater to learn about the use of body language. We found out that in theater, certain gestures, attitudes, expressions, and timing have come to connote specific emotions, some regional, others universal. The pose of the character, the position of the hands, the head, and the whole body in the space, is a fundamental element for communicating these emotions. Dance, mime, and other performing arts also rely heavily on body language to express emotions. These arts have inspired the use of pose in the art of animation.

To educate novice animators about the concept of pose, Disney would issue the Sack of Flour test [10]. Animators were instructed to "*breathe life*" into an ordinary sack of flour and in so doing, convey expression and emotion in a convincing way. Figure 2 portrays the simplicity and richness of this method. Use abstraction is interesting here — for example, no facial features are needed to express lifelike qualities given to the sack of flour. We also looked at another Disney concept known as Line of Action [10, 11]. Line of Action is an imaginary line used through the main pose of a figure to expressively describe its action.

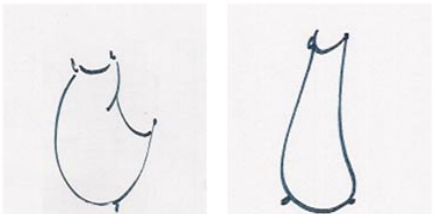

Figure 2. "sack of flour" exercise. The image on the left expresses joy and the one on the right is stretching. Redrawn from [10].

Figure 3 show some examples of the line of action. The idea is to identify and isolate the path that every part of the body follows through space to build characters.

Disney's work inspired us to use pose and line of action as a way of creating an expressive, lifelike, and emotive design. To quickly iterate on these concepts, we collected a variety of images that showed a state of fatigue. We sketched a variety of action lines, and performed an evaluation of the interim designs, showing them in a random sequence to ten people.

Responses to the designs are reflected in the paper prototypes shown in Figure 4. For example, the majority perceived lines of action that were almost flat, such as the one shown in Figure 4e, as relaxed or asleep. Lines of action that were highly curved such as the one shown in Figure 4a were perceived as sad or tired.

This study led to the natural use of a slouching pose as an abstraction of when it is time to take a break. A simple vellum sculpture that imitates this pose was designed using the concept of line of action. This is in accordance with [7] which describes simplicity in material and complexity of form as key features of slow technology.

TECHNICIAL SPECIFICATIONS

Sculpture's Moving Mechanism and Chair Sensors

The movement of the sculpture could not demand too much attention, and needed to reinforce the simple form of the sculpture. It would have to accommodate slow and graceful movement from upright to bowed. To design the movement, we experimented with several moving mechanisms with a variety of servo motors and types of control. We chose Parallax (Futaba) Standard Servo [14] which was controlled by microcontroller in the Parallax Basic Stamp Board of Education [14].

To move Breakaway from an upright to a slouching pose we attached a string of beads to the back of the paper. Pulling the sting would move Breakaway to the upright position. When released, the weight of the beads would cause Breakaway to slouch.

We used a set of binary sensors for this study. The sensor is made from two conductive fabrics separated by a non-conductive mesh. The mesh separates the conductive fabrics so that there is no electrical contact between them unless a pressure is applied to them. This sensor is put in a slipcover and placed on a chair. Sitting on the chair causes electrical contact that is detected by the microcontroller.

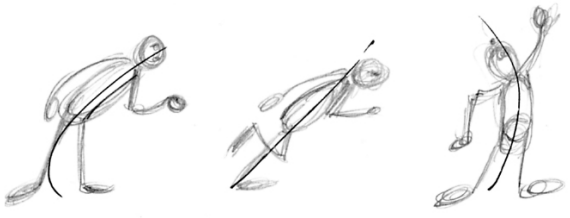

Figure 3. An example of using Line of Action to show emotions. Redrawn from [11].

The microcontroller is programmed to check for presence in the chair every two minutes and increment or decrement a counter based on the result. After the user has been in her chair for an hour, the servo motor releases the string, causing the sculpture to move to its first slouching pose.

After 60 and 90 minutes of sitting, the sculpture responds with three further slouching poses. Absence in the chair causes the sculpture to move back to upright position over a period of ten minutes.

EVALUATION

We evaluated our design in a period of two weeks in an office setting with a single user. She was a staff member at a local university, aged 55, who had identified the problem of inactivity while at work. We interviewed her before and after the study, and collected both quantitative and qualitative data during the two weeks.

Week 1. We instrumented the participant's office chair with the sensor pad in order to detect and log the time that the participant is present in the office chair. This measure was used as baseline data on sitting time of the user.

Week 2. We added Breakaway to the setup, placing it on the desk in a visible line of sight. We collected data with the same measure. In the end, we interviewed our participant about subjective preference and perceived changes in behavior when using Breakaway.

DISCUSSION

This study showed that there is a relationship between the break times and the first and second instances of the sculpture's slouching pose. This is indicated in the data that was gathered during the experiment. However, long-term experiments with more participants are required to

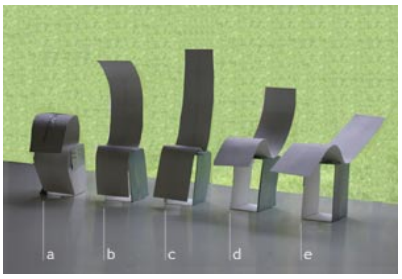

Figure 4. Incorporating Line of Action in the sculpture design.

test the validity of this preliminary observation. In the debriefing interview, the participant stated that Breakaway played a role in the times when she took a break. She mentioned that she never waited for Breakaway to assume a fully slouched position, often choosing to get up from the chair when it assumed its first position of slouching. She also mentioned how she appreciated the fact that she could easily ignore Breakaway when she was too busy, unlike the reminder in her computer calendar, which would keep interrupting her in such a situation.

Limitations

Time and Subject Limitation. While the limited time and number of subjects does not present statistically reliable data, we believe this study as an integral part of the design cycle. The results of this study will refine the design of the display as well as the evaluation protocol, before we commit to a long-term study with multiple participants.

Implementation. Breakaway was connected to the sensors in the chair using a long cable. In the next iteration, we will implement wireless technology for communication between the sensor and Breakaway. We believe that this is an integral part of an unobtrusive presence device.

FUTURE WORK

In our future work we will refine the sculpture and design study based on our evaluation results, and perform a long-term study with a number of participants.

CONCLUSION

Ambient displays that are situated in office and domestic environments provide rich opportunities for information display. Because they are distributed, are viewed in social settings, and make use of aesthetic qualities, little is known about how they might be best designed.

In this paper, we have presented the design and evaluation of Breakaway, an ambient display that encourages people whose job requires them to sit for long periods of time to take breaks more frequently. Breakaway is a sensor-driven ambient sculpture that takes information from the user's chair and suggests when it is time to take a break. An initial evaluation of Breakaway was positive, showing a relationship between the movement of the sculpture and the user's break times. It also confirmed the clarity of the lifelike and aesthetic aspects of the display to the user. These results show that ambient displays that make use of aesthetic and lifelike form might be promising for making positive changes in human behavior.

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