ECO|Balance – Exploring Design Issues for Mobile Persuasion

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Abstract
Engaging people to regularly reflect on their own behavior is a crucial step towards changing it for the better. In this paper we present ECO|Balance, a set of interactive design metaphors for mobile devices that aim towards enticing continued engagement through using visual appeal and avoiding factors that chastise. As a bridge between data visualization and information art the idea is to keep people interested in repeatedly working with and analyzing their data. We chose the scenario of personal mobility and reducing one's carbon footprint and created a series of four animated designs: *Pie Flow, Jelly Fish*, *Footprints* and *Organic Flowers* that explore different approaches to representation and interaction. We discuss our main goals of long-term enticement through visual appeal and subtlety.

Author Keywords
Persuasive computing; mobile; personal informatics.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
Every seemingly minor and personal choice on mobility has an effect on carbon emission. Relying on the comfort of one's car instead of taking the crowded and

unpunctual bus might seem inconsequential but millions of people reaching that same decision will quickly add up. While most people are aware of the "right" thing to do, short term benefits usually outweigh the more abstract long term ones in a given situation. Persuasive technologies (cf. [3]) promise to make the right decision easier through suggestions and by turning the abstract benefits into concrete and comparable numbers. Ideas from educational psychology indicate repeated reminders and feedback may create lasting behavior changes [5]. To enable such changes, however, the persuasive system has to be used long enough. Thus one challenge in designing for persuasion is keeping people engaged.

Visual appeal is a promising direction that has been shown to create immersion and engagement (e.g., [2]). Consolvo et al. [1] suggest that the aesthetics of tools play an important role in supporting long-term engagement. Also, Viégas and Wattenberg discuss switching from analysis to art in data visualization to help in subtly bringing a message across [6]. With the ECO|Balance designs we aimed to create mobile persuasive applications that entice long term engagement. Our focus was to create appealing visuals and to avoid a patronizing tone through explicit text or suggestive visuals (similar to Watt-Lite [4]). By avoiding visuals and interface components that chide and focusing on letting people decide for themselves, the ECO|Balance designs may lead to long-term engagement and subsequent behavior change.

ECO|Balance

ECO|Balance aims to inform people about their personal mobility behavior and empower people with choices about their carbon footprint. Our intention was that people would not perceive the applications as artifacts of their failure but rather enjoy looking at and interacting with them. We therefore focused on mobile platforms where people could always start ECO|Balance whenever they wanted to pass the time. Smartphones also promise to collect all relevant data for such persuasion scenarios in the near future. To make our designs more realistic, we created an exemplary data set upon which to base our visualization designs.

Data Collection

During ten days, three members of our research lab tracked information about their self-locomotion and subsequent CO_2 emissions. They collected data on: (1) *activity* or means of transport (sitting, walking, car, public transport, bike); (2) *date and time* of the activity; (3) *amount of steps* performed during this activity; (4) *distance* covered; (5) *location(s)* (stationary and transit); and (6) *duration* from place A to place B. We also calculated (7) *carbon dioxide emissions* produced by the chosen means of transport. Information was tracked manually and by pedometers. While this manual method of data collection brought inaccuracies due to mistakes and forgetfulness, it gave us a sensible starting point for the visualizations.

Design Process

In order to create as many sketches as possible, we relied on a drawing with coloured pencils first and switched to using water colours for the most promising designs. To convey the look & feel of the applications, we then created animated versions of the most important interactions and transitions as PowerPoint slides. We drew inspiration mostly from nature. When thinking about enjoyable and peaceful places in nature, terms like "light", "floating" or "calm" come to our

Figure 1. *Organic Flowers*, represents days and activities as flowers.

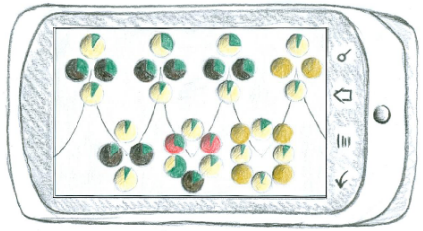

Figure 2. *Pie Flow* uses traditional pie charts to show activity distribution (here, over one week).

mind. Those are attributes that we also wanted to convey, as one of the requirements for our application was to be unobtrusive and avoid applying pressure.

ECO|Balance designs

Here we discuss four different design approaches (*Organic Flowers, Pie Flow*, *Jelly Fish*, *Footprints*). In these explorations, we picked promising designs along a broad spectrum from traditional visualization techniques to ones more informed by metaphor.

Organic Flowers

With the *Organic Flowers* design (see Figure 1) we focused on visuals, intentionally avoiding labels making the result look more like artwork than visualization. This decision makes only relational comparisons (bigger, smaller or equal) between data points possible. Flowers stand, depending on the chosen timeframe, either for months, single days or single activities. The length of their stem encodes the amount of steps taken during that time/activity, while the size of the bloom is the amount of carbon dioxide produced. Month/day flowers have petals that stand for single, colour-coded activities with their width encoding the duration. Flowers are arranged chronologically from left to right. On the level of single days, all activities are displayed as petal-less flowers. Comparing two days is possible within the same view, with one day at the top and one at the bottom of the screen (see Figure 1 top). By dragging one day towards the other (see Figure 1 middle) both days can be seen side-by-side (see Figure 1 bottom). While all specific activities are still visible at the bottom, the large flower in the middle shows an aggregated version. Not only is *Organic Flowers* unusual in its lack of text labels, but also in its interaction: Selecting a month from the year display happens by plucking the respective flower, creating the side-by-side comparison view requires melting together both days with a pinching gesture. Animations have an organic feel based on growing, dodging and perishing and thus emphasize the metaphor.

Pie Flow

Based on familiar pie charts, *Pie Flow* (see Figure 2) displays one pie chart for each location and each route between locations. Each of these charts shows the distribution amongst *activities* (either sitting/walking or mode of transportation) at that given time. Additional information and a legend for the colour-coded activities can be activated by tapping an element. Information is displayed on different time frames and a pinching gesture allows zooming in from the initial month view, via weeks to single days (the phone's physical back-button moves back again). By dragging one pie chart on top of another, the app switches to a dedicated view for comparing the two charts showing them adjacently.

Jelly Fish

In this design, each day is represented by one jelly fish (see Figure 3); its size and elevation encode the amount of CO_2 produced. Each tentacle stands for one activity, colour for the type and their length for the duration. All jelly fish are sorted by time. In design discussions this approach was liked since the underwater metaphor seemed light and calming. Different timeframes, such as months, weeks, single days, are provided with navigation between them and detailed information accessed by tapping on a single fish. For more information about one specific day we used a different layout (see Figure 3 bottom): The jelly fish moves to the left border of the display and all tentacles (=activities) stretch towards the right making

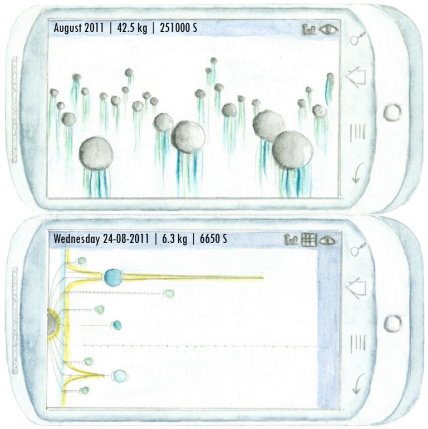

Figure 3. In *Jelly Fish* timeframes such as days are represented by abstract animals.

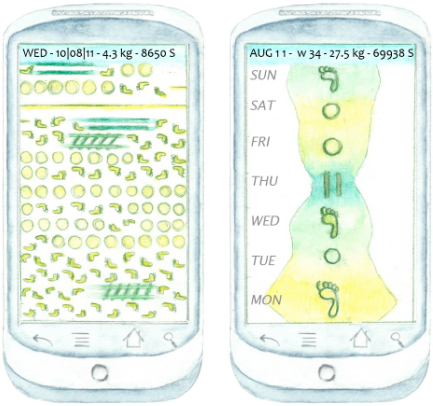

Figure 4. *Footprints* is the most verbatim of our designs. Activities are encoded as icons.

comparisons easy (small tick marks also encode the number of steps taken during an activity). Dragging the eye-icon from the upper right corner over reveals details. Tapping on the bar chart-icon in the upper right toggles a line graph overlay that displays the average carbon emissions per activity. The same layout is also used to compare two days, with both jelly fish sharing the left border.

Footprints

The most verbatim design, *Footprints*, is based on the idea of the ecological footprint. The main view shows a single day (see Figure 4 left) with each row standing for an hour and each column for 6 minutes. Icons depict activities, colour-coding from yellow to blue shows the amount of CO_2 created. Tapping on single icons switches to a timeline-view of the respective activity that also shows activities before and after. Another tap displays detailed (numerical) information. Pressing the physical back-button in the day view switches to the whole week (displaying the dominant activity for each day and a graph whose width shows the number of steps and the colour the amount of carbon dioxide, see Figure 4 right). Another button press leads to a similar view for four weeks and then the whole year. People liked the design and the icons as they are easy to interpret (e.g., footsteps = walking).

Discussion

We found that using the combination of water colours, Photoshop and Powerpoint is a very suitable way for designing for small screens. This technique is quick and creates beautiful results. It is a good alternative to more time consuming hi-fi approaches like Flash prototyping. Also, relying on a pre-defined data set at least for parts of the visualizations (yearly data, e.g., was not available) made the results much more realistic and eased the feeling of developing applications for "elastic" data, fitting the needs of the visualization.

Conclusion

With ECO|Balance we focused on creating visually appealing mobile visualizations that might change their owner into more prolonged interaction, thus having a greater chance to influence their behavior. We explored our design space with four designs and relied on water colours, Photoshop and Powerpoint to create animated sketches. These contain detailed descriptions and pictures of animations, interactions and the look & feel of the application. Our next steps in this research direction are implementing one or more of our designs and making them available. An in-the-wild long-term evaluation should be able to show the benefits of relying on subtleness instead of scolding for persuasion.

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