Mirroring Bodily Experiences Over Time

Abstract
The Affective Health system is a mobile lifestyle application that aims to empower people to reflect on their lives and lifestyles. The system logs a mixture of biosensor-data and other contextually oriented data and transforms these to a colorful, animated expression on their mobiles. It is intended to create a mirror and thereby empower users to see activity patterns and relate these to their experiences of stress. People’s different cultural backgrounds and their different physiological and psychological composition give them different perceptions and associations of time. We explore the time dimension of our system through working through a set of different designs that organize events as time going linearly forward, in a circular movement or relating to geographical places. Here we discuss the process of designing a mobile interface for presenting temporal data in a way that allows multiple and subjective interpretation.

Keywords
visualization, graphics, interaction, time

ACM Classification Keywords
H5.m. Information interfaces and presentation
The Affective Health application
The Affective Health system is a mobile application that aims to make people equipped to better cope with stress and stressful situations. It is a tool for visualizing patterns and trends of bodily and contextual information over time. This information is intended to empower users to reflect on their behavior in everyday life.

Figure 1. The current application running on a mobile phone.

At the beginning of the project we identified two kinds of events that can give the users valuable information to reflect on: Data about bodily reactions and contextual information through which users can connect the bodily data to their ongoing everyday life. Note that the system does not provide a diagnosis of stress but is intended as a tool for people to develop a sense of how their everyday lifestyle can be related to their stress levels. It is well known that people’s real ability to deal with stress is connected to their own subjective experience of their ability to deal with stressful situations [4].

The data is not intended to give users an entirely true or full story about their everyday behaviors, stress reactions or life styles, but the material can let users link the data to their subjective experiences. It should be designed to support people in forming their own stories about their own lives and in their own ways. The bodily data is collected via biosensors attached to the user’s body. The sensor signals are transmitted via a Bluetooth device to the application running on a mobile phone. Depending on reliability, wearability and maintenance requirements [5] we chose to use three kinds of sensor data: we monitor some aspects of users’ arousal through GSR (Galvanic Skin Response), which can be connected to peaks in stress experiences. We also monitor users’ pulse through a heart rate sensor since prolonged increases in pulse may also indicate stressful experiences. Finally, to help users to distinguish stress from normal physical activity, we measure movement through accelerometers.

In stress medicine it is claimed that physical exercise that evoke similar processes in the body as negative stress does, can train our bodies to be able to deal with stress in a purely biological way. If we go out jogging, our sweat levels and pulse will increase. The jogging experience is probably a positive experience, whereas the negative stress reaction that evokes similar bodily reactions is not. Apart from movement, we also collect other contextual data that can help users to remember and distinguish different activities in their lives assisting them to sort out what is stressful in a negative way. We collect various data from their mobile phones, such as photos, text messages sent and received, Bluetooth presence of other devices nearby.
**Related products**
There are a number of body monitoring systems (e.g. emWave and the CocoroMeter\(^1\)) developed that are claimed to have the ability to monitor emotions and stress through bodily signals such as heart rate, temperature, movement, hormonal levels of e.g. cortisol or adrenalin, arousal. Many of these systems though, do not help users connect the sensor information to everyday behavior. The overall approaches are directed at measuring users’ stress levels and provide this feedback as diagnosis and warning [3].

**Research challenges**
Peoples’ activities and experiences occur over time and time is a thread to which information can be tied. People’s different cultural backgrounds and their different physiological and psychological composition give them different perceptions and associations of time. This can be a source of stress since the post-industrial society is largely organized around a common perception of time where e.g. work-, leisure-, food- and resting activities is regulated by the time at which it should occur.

How can we through Affective Health present alternatives to the linear progression of past, present, future? How can we inspire people to create meaning from the bodily and contextual information that we present? The ultimate goal with Affective Health is to provide a tool that can support users in prioritizing reflection as a means of reaching insights into their stress related behaviors To achieve this we are designing a beautiful application that evokes desire and which inspire usage for a group of users that are motivated to get to know themselves better. It is not possible to represent our continually changing lives with one complete and accurate picture. In the Affective Health project we assemble a collage of information that creates living pictures and impressions. This builds a dynamic model to reflect upon and compare to different events and occasions in life. To better understand how to represent stressful experiences back to users, organized in some kind of temporal order, we decided to explore the problem through creating different design concepts where temporality took on different appearances. [Figure.3]

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1\(^{http://www.emwave.com/about_emwave_stress.html}\)  

**Figure 2.** Sketches of the initial three design concepts showing temporal progressing in different forms.
The first concept was built on the idea of pulse and movement vanishing into a time-tunnel where one could trace the past at the end of the tunnel. Our second design concept was inspired by nature and the idea of leaves falling to the ground, building layers of historical data. Our third concept showed time as a colored wave where the bottom of the wave represents what is happening right now and the past floats upwards. In all these design concepts we represented arousal using color following the results presented by Ståhl and colleagues on how to use colors to represent emotional arousal [6]. During the ongoing design process we continually collect feedback from users in different ways, e.g. through a Wizard of Oz study [3] and lo-fi prototyping [7].

In the wizard of Oz study we wanted to find out early in the process, when the system was still incomplete and we had no appropriate sensors, whether a mobile service like Affective Health would possibly help users in decreasing stress levels. We wanted to be sure that the system would not become a stress factor in itself. This study confirmed that our overall ideas for the application would not be contra productive and that the application in fact might inspire changes in everyday behavior.

The lo-fi study was used when choosing which one of the three early temporal concepts to work with in depth. We involved users by presenting 2D paper-models of the basic functions: time, history, heart rate, physical activity, and arousal [Figure. 3]. Six unprepared participants were asked to share their understanding and associations of the models. In this way we aimed at getting a direct reaction to how the different concepts could reflect their experiences. Based on our findings we chose to continue working in depth with the “layers of leaves” - concept since this, proved to evoke most associations with time.

One of the main ideas of Affective Health is for the user to be able to browse back in history to explore patterns and characteristics in their lives and behaviors. In the current implementation of the “layers of leaves” - concept running on a mobile phone, users can scroll back in layers of time segmented into standard units such as minutes, hours and weeks. This is a starting point of a temporal concept, but this solution has turned out to be far to narrow. [Figure.1]

**The problem of visualizing time**

Time is subjective and depending on how we live our lives, it is perceived differently. In the current version of Affective Health we see only one perspective of time; the linear. The linear perspective, by many people understood as something that goes by, (the past-present-future idea) is the one characterizing our western cultures and perception of time today.

However, our perception of time changes continually depending on our activities and memories: You can for example live a slow Saturday afternoon with tea and scones, or fight towards time a busy Monday afternoon. This has to be mirrored in the interface of Affective Health and the way we believe we could design for this is to not follow just one perception of time, but add several perspectives thereby giving a possibility for a subjective perception that can be modeled depending on life pace and life style. The Affective Health application should support reflection on life with e.g. a circular perspective that allows the user to look at her/his life separated from the standard units. One example of cyclic time is the ecclesiastical (church) year that is not a year of moving forward, it is rather
an eternal repetition of certain qualities of time: Expectation, sorrow and sacred hope. Users should be able to scroll between reoccurring behaviors, events, emotions and so on. By exploring radically different alternative perspectives, such as circular time or time as relevant only vis-à-vis certain geographical positions, we have been able to move outside the prevailing perspective of time as linearly progressive in equal portions of time. [Figure. 4]

We also explore how time could be presented in a modified way: People’s lives are continually changing in tempo, intensity and activities. How can “important” events get more focus or space than “unimportant” and how would the user tell the application this? It is not necessarily the case that a slow, uneventful Sunday morning should be given little space in the representation. It might have been the most important part of the week to someone who is trying to remember all the peaceful, restful moments she or he is actually able to get. This perception of time has been found with the “NU” people [1] who during, non-active periods do not have any expressions for time.

This idea of regulating the perception according to the intensity of experiences makes us need to dig deeper into “primitive” time, point time, or moments of time where the future is impossible to imagine and where time is created from the pulse and life of humans. Memories or events that occur are tied to geographical grounds and not to a time frame, as for example, in the life of the Baktaman people in New Guinea [2].

As a part of the design process we have created sketches of a kind of map visualizing geographical and virtual activities.

Different shapes represent different kinds of places/events such as home, work, mum’s place, sister calling, and so on. (There is no such text in these sketches) The top one shows the positions and activities organized in a linear time while the bottom version is presenting the activities organized circular with what is happening right now placed in the middle and the past placed further out from the centre the longer back in history it belongs.

Figure 4. Two different presentations of temporal activities and geographical positions.

A similar conception can be found in early Christian society. For instance in the Middle ages this way of thinking is illustrated in how the Garden of Eden was thought of as existing somewhere far away on earth.
thoughts and further work
We believe that the way we think about time is a core subject in our society that forms people’s lives and a certain kind of living. We find it inspiring to challenge this conception and to design to reach a broader perspective of time.

Our approach has been to explore the time dimension through designing different representation. This has helped us to clarify what it means to create an application where users can compare their subjective experience of stress over time, finding patterns in their own behaviors. So far we have made user feedback studies and a Wizard of Oz study, during the design process of Affective Health. Since we now have a stable system, we are planning to make a user study with the current system implemented on a mobile phone where we want the application to be a part of user’s everyday life and to be used in a variety of situations. The studies aim to give us information of how the system can have impact on people’s experience of their bodily reactions, on their time perception and we also want to know how we should think when designing for wearing sensors attached to the body.

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References

Figure 5. Sketch of a red flag to reinforce an event.

The “flag” (red shape)