1 Introduction
Health is a product of not only physical but also mental well-being. Exposure to high stress levels for too long of time periods endangers health and may not only lead to states such as being ‘burned out’ but also to physical diseases such as obesity, diabetes, or high blood pressure [10]. These kinds of diseases are increasing in both the Western world, but also, recently, in third-world countries. The reason behind this development is complex and multifaceted, but the work-and life styles have changed and are considered to be more stressful and psychosocially endangering [3].
The healthcare systems in the Western world cannot cope, neither financially nor resource wise, with the increasing demands emanating from these kinds of diseases. A more holistic perspective on well-being is needed. People need to learn to listen to their bodies, take control over their lifestyles and change their attitudes towards work and leisure activities. Recently, there has been quite some attention within HCI towards building systems to support behavior change. But the question is how to design such systems which lead to a long-lasting behavior change? Furthermore, how can we do so without infringing on people’s autonomy or adding to their stress levels? Is it even possible to design for a positive, fun, aesthetically pleasing and empowering interaction that not only ‘controls’ users’ behavior but becomes a valued addition to their lifestyle?
These are some of the issues that we needed to answer in our design process towards designing and implementing what we have named the Affective Health system. The idea builds on a previous system, the Affective Diary. That system consists of a software client on the mobile phone, digital diary software and biosensors. It works by capturing sensor data from the user and uploading it to the digital diary installed in a computer, together with other materials from the phone such as text and multimedia messages, photographs, Bluetooth presence, etc. A colorful shape is then formed from the sensor data and is associated with the other collected materials. In a user study of the system, we found that users could identify and
start understanding some of their own stress related situations. They learned, reflected and even trained themselves to behave differently [14].

However, the *Affective Diary* system was not specifically aimed at stress and it did not provide feedback in real-time. In *Affective Health* we would like to provide for such a biofeedback loop through using real-time feedback on a mobile phone. This entailed figuring out how to provide real-time feedback without causing users further stress. It was also crucial that they could identify with the representation and feel empowered rather than controlled by the system.

We needed very practical results in order to continue on the right path in the design process. Here we present a Wizard of Oz study which is aimed at circumventing the technical difficulties, by allowing us to simulate parts of the system’s functionality without the participants being aware of this fact.

We then report on how the participants understood the system, how they related to it, what they liked, what they did not like as much, as well as what they thought on the different aspects of the designs. We also present meta-results on the study method collected from the participants.
2 Background

In 1936 Selye formulated the General Adaptation Syndrome (GAS) theory [13], based on the idea that the body achieved its balance through a process of homeostasis. This concept, first formulated by Cannon [2], has its roots in the Greek words *homeo*, meaning “same”, and *stasis*, which can be translated as “stable” or “stability”. Selye’s idea was that the body achieved stability by remaining constant. He believed that our bodies have internal parameters for heart rate, blood pressure, body temperature, etc. and those parameters have absolute, fixed values which are ideal for a good functioning. The body, according to Selye, responds to external stimuli that might alter these values, with an opposite ‘force’ needed to bring them back to their ideal value.

Up to this point everything seems reasonable. The body adapts and maintains stability, which is good, but we all know how one can only take a certain amount of external stimuli. Selye called this adaptation energy. According to him this “energy” is a finite resource and represents the limit for homeostatic adaptation. If we are exposed to stressors too frequently, we might run out of this energy and start suffering from various health problems. Stress was thus, for the first time, being seen as a potential source of illness.

The way the stressor is perceived, as well as the way a person feels they can cope with it can be either aggravating or attenuating factors for the potential impact on oneself. Despite a general disagreement over the definition of psychological stress [2] there are several generally accepted situations that may lead to chronic stress [10]: Failure to habituate to frequent exposure to the same stressor, inability to shut of the stress response even though stress exposure has terminated, or situations that cause regulatory disturbances of the stress system.
3 The System

There exists today a paucity of tools and devices that empower people to take control over their everyday behaviors and balance their stress levels. This is where a mobile service, like the system we will discuss here, *Affective Health*, could prove useful. By providing users with easy-to-grasp visualizations that enable biofeedback loops, it could be one useful tool in a repertoire of health improving actions.

The idea behind the *Affective Health* mobile system builds upon physiological reactions common to all people, regardless of race, sex, age, creed or culture [2]. These fundamental human reactions emanate from the autonomic nervous system: they are essential survival reactions. These reactions are not consciously controlled by us, but are instead indirect reactions to what our senses perceive and how we act in the world [2]. If mirrored back to the user, the relationship between activities in the world and how their bodies respond to them might become one starting point for users to begin building meaningful relationships between what they are exposed to and how that affects their bodies. This in turn empowers them to take control and avoid stressful activities, increase activities that promote their well-being, or simply change their attitudes about certain aspects of their lives, thereby reducing its impact on their stress levels [9].

Stress reactions are related to a range of factors in our lives which trigger various emotions. These in turn trigger our bodily reactions [2, 10]. Emotions, such as fear or anger, make our autonomic nervous system react, changing the hormonal levels in our body, altering our facial expressions and the focus of our senses and cognition, thus preparing us for flight or fight behavior [7]. Other emotional processes, such as shame or pride, which are crucial to our ability to maintain social relationships, also have associated corporeal processes affecting similar factors [7]. If there are many threatening stimuli in a person’s life, paired with little or no control for how to deal with them, their bodies can stand on full-alert for too long and the normal, adaptive coping mechanisms that the body uses to restore its capacity, such as rest, sleep, and ways of reducing stress levels, will have little effect [5].

The body can lose its ability to adapt to higher and lower levels of activity – it becomes stiff/rigid in its reactions to the world [10].

But we do not make sense of our emotional and stress reactions solely as biological processes nor are we predetermined to react in only one way to a particular circumstance. Emotional and stress reactions are social and dynamic communication mechanisms. We learn how and when certain emotions are appropriate to display and we learn what in our lives constitutes a threat and what is good for us. A life with no stress at all is not necessarily good either. A
healthy life includes both highs and lows, but foremost, it is a life where our bodies cope with the changes and are capable of adapting to them.

The way we make sense of our own emotional and stress reactions is a combination of the experiential processes in our bodies and how emotions arise and are expressed in specific situations in the world, in interaction with others, colored by cultural practices that we have learned. We can teach ourselves to deal with threatening stimuli without alerting our entire, bodily and emotional reaction system [6].

In considering the design of IT-applications that reflect emotional and stress-related processes, Boehner and her colleagues [1] have drawn on what might be called a socially situated perspective of emotion. These provide a set of requirements for systems that engage users in a reflective, empowering process which they named the interactional approach. Their ontological view on emotion is that it is “culturally grounded, dynamically experienced, and to some degree constructed in action and interaction”. Emotions are created in a co-constructed, co-interpreted fashion between people in social situations. Hence, in designing for emotional experiences Boehner et al. contends that the focus should be moved “from helping computers to better understand human emotion to helping people to understand and experience their own emotions” [1].

The aim of the Affective Health system is to provide a holistic approach towards health by enabling users to make a connection between their daily activities and their own memories and subjective experiences. This construction is based upon values detected from certain bodily reactions that are then visualized on a mobile phone.
4 Study Setup

To answer the questions above and to get as much feedback as possible in this early phase of the project, we conducted a Wizard of Oz study. The guiding principle of such a study is that a human, called the wizard, is between the system and the actual user. The user is led to believe that their interaction with the system is direct while in reality, the wizard is simulating the system.

This kind of study setup, widely used in natural language processing and the development of intelligent agents [4], has also been used previously in Affective Interaction studies [11], providing us the means to circumvent the practical difficulties and test the system.

The aim for the study was to attempt to put the user in a stressful situation and see if different ways of presenting the feedback affected the user differently, particularly in their reflection and interpretation of the real-time data.

Hence, we started to design the study by conducting a first phase with three participants which also are involved in the project at our lab. There were two reasons for this. First, we wanted to make sure that our Wizard of Oz study set-up was realistic enough and that we could place the participants in both a stressful and relaxed situation so that we could properly test the system. Therefore we needed some space to define such situations and identify the important qualities in them. Second, we believe that it is important that we would experience the system ourselves. Additionally, we wanted to make certain that future participants could get involved with the system and not feel deceived by this approach.

After testing the system and user study method on ourselves, we recruited seven participants to the final stage of our study. They were recruited through mailing lists at companies and educational institutions in the area of Kista, Sweden. In the invitation we explained that we wanted to get feedback on a lifestyle stress management application and were seeking people who were interested in self-reflection. Most of the answers we received expressed either a concern over stress in their lives or a willingness to learn more about themselves. We avoided bringing in users with real stress-related illnesses; this was due both for ethical reasons and because our application is aimed for personal reflection and interpretation, rather than replacing professional medicine.

The participants in the first phase were one female professor, one female researcher, and one male researcher. In the second phase we had seven participants; three women and four men. The participants were given two cinema tickets in return for participating in the study.

In total, we studied ten participants using and interacting with the system. The first phase, with three fellow colleagues as participants, provided useful data as well as opportunities to
alter details and fine tune the Wizard of Oz study for the second phase. The objectives and structural set-up for the study remained unchanged throughout the entire study period.

The first preparatory study consisted of three colleagues. After the introduction and preparations, the users were asked to give a presentation to a live audience. They had not been given any time for preparation, but the presentations were their own, typically given several times before in other contexts. The idea was to stage a realistic situation that might put them under some stress, as talking in front of an audience can be, even for experienced researchers. We felt that by doing this we would simulate a commonly experienced real-life situation in the participants professional lives, an activity that is still stress inducing even after years of practice. This situation was both realistic to simulate in lab environment as well as relating to their lives.

After the first phase of our study, we chose to change the stressful situation to a role playing job interview where each participant was the applicant for a job and we as researchers acted as jury of three people (among which was the wizard). This idea was adapted from the Trier Social Stress Test [8] which is a validated stress inducing situation. This test has a component in which the subject is asked to talk for five minutes, to a jury of three people, about themselves. The jury has instructions to provide as little feedback as possible, i.e. avoiding nodding and smiling, as this reassures the subject. We adapted this test by substituting the discourse about oneself for a job interview, to make it resemble a real life situation that most people have experienced. Role playing was chosen as it has been proven to generate very realistic experiences for the persons involved.

Following the stressful scenario we proceeded to the coffee room, where we offered the participant some coffee or tea, engaged in small talk to get everyone to relax a bit before we proceeded with the questions.
5 Results

Some of the results obtained can be summarized as follows:

**Need for interactivity.** Overall, the participants related more to, and were more positive toward, the dot representation. For example, P1 compared the two graphical designs in terms of the connection she felt from her experience with both:

**Representation of stress trends.** Another difference between the representations was the fact that the dots, by remaining on the screen for a period of time after popping up and then slowly fading away, were a visual representation of recent history. The background representation did not offer such a history. Most of the users found representing history to be useful in order to get a quick perspective over the recent evolution.

**Open for Interpretation.** Our design aim is to leave the representation ‘open’ for interpretation so that our users can read their own embodied physical, emotional and social experiences into what the system shows them. To make user identification possible, we need to provide enough openness to allow for their own interpretation while still showing real and concrete data.

**Contextual information.** All of the users noted that in order to make sense of the data *a posteriori*, it should be associated with data taken from the environment.

**Scrolling for reflection.** The two representations tested in this study did not allow for scrolling back further in time. The dot

**The need for training.** Following the identified necessity of having a scroll back feature in the system, a new question arose: can reflecting on past stressful events help people to deal with new situations of stress? When asked about the prospect of using the system to achieve this goal, participants almost unanimously replied that a continued interaction with the interface would give them the possibility to learn more about their lives and train themselves to deal with stress more effectively.

**No increase of stress.** After analyzing all the transcripts we could not find any observation made by the users that indicated becoming more stressed because of the system. We asked several leading questions about this, like “If you think back to a stressful period in your life, would you have become more stressed by having a system like the one presented here?” But our users consistently claimed that this would not be the case, especially as they could not see themselves actually looking at the interface when in the middle of a stressful situation. And if they would see stress reac
6 Design implications

From the results, we gained important input for the continuation of designing and developing the Affective Health Project. Some of the most interesting ones were:

**Identification and interpretation**

The fact that the participants generally requested contextual information as a means of complementing their physical data shows that, by itself, the data collected is of little value in lifestyle applications. In fact, they needed to know what was happening around them in order to assert if those reactions were positive or negative.

**Bits of the past**

A representation of a short-term history (or trend) in real-time usage portrayed in the dot cloud was considered useful by most of the participants. The extra information carried by this design, not only what is happening now but also what happened just before, allows users to more easily grasp the meaning of their own state in the present.

**Reflection and training**

We have not yet tried the system in everyday life, which will be the next step. However, the willingness of users to train themselves for the future by reflecting on their past experiences is encouraging.

**Real-time is not a problem as it enhances empowerment**

Contrary to what we had feared in the beginning, that users of such a system might dislike or even feel scared by constant updates, the users reacted differently. Some mentioned they wanted to have control, to see what was happening, as it was happening in order to be able to do something about it. They did not want us to censor information for them.
7 References


