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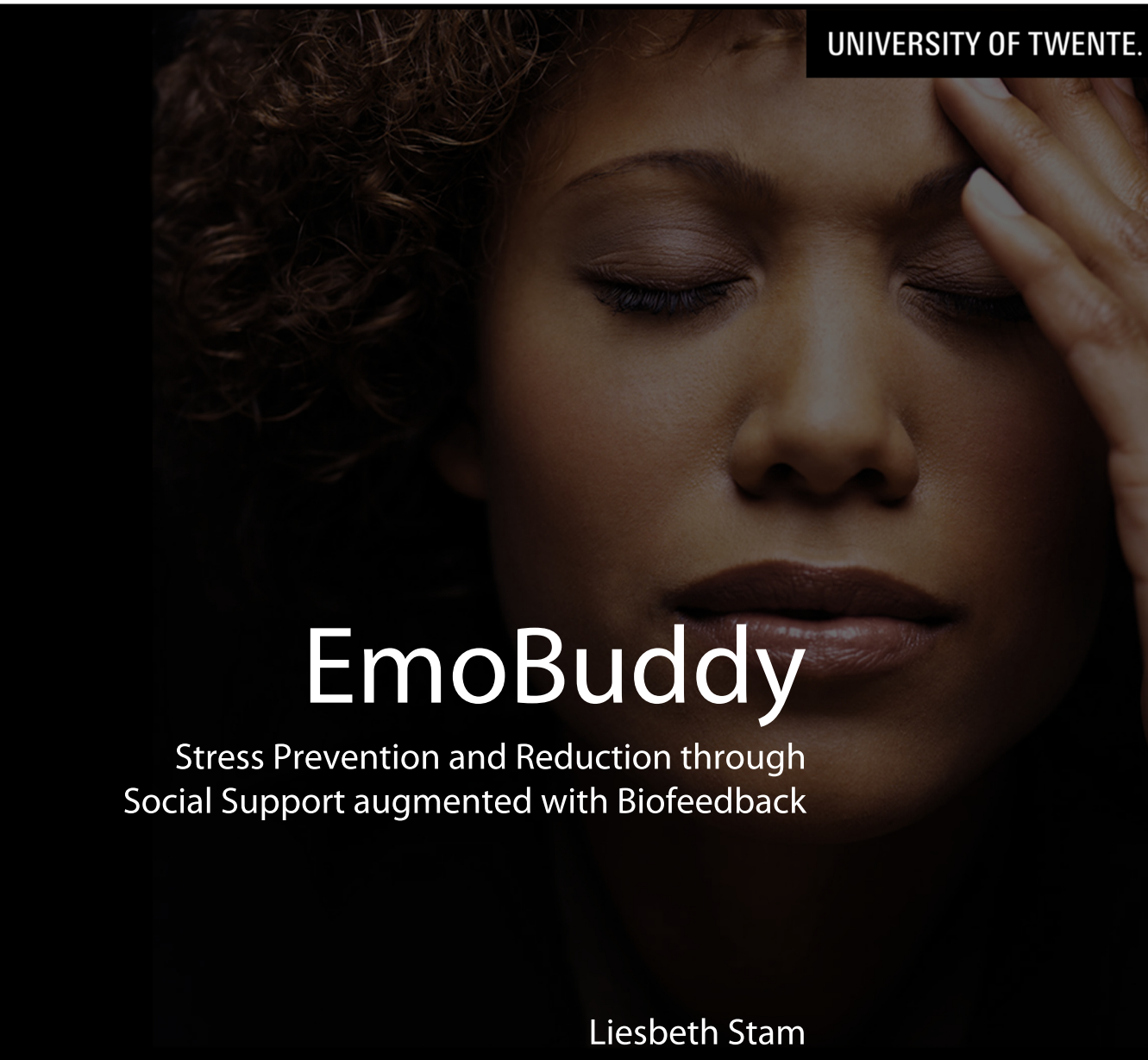

EmoBuddy

Stress Prevention and Reduction through Social Support augmented with Biofeedback

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By
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in partial fulfillment of the requirements for Bachelor degree in Industrial Design at the University of Twente

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Summary

Due to globalization of economy, growing diversity in the workplace and an increased mental workload, occupational stress has become the second biggest source of illness and reduced productivity. EmoBuddy is a concept system that aims to reduce and prevent stress by inducing social support and increase awareness on stress behavior. Central in its design is the role of facilitation of empathy between buddies, by sharing each individual's real time stress level, derived from wireless skin conductance measurements. Whenever stress levels rise, users are encouraged to contact each other and possibly join in a stress reducing activity (e.g., drink a cup of coffee).

This study serves to strengthen the EmoBuddy concept through an iterative design process. In the first part of this study we analyzed the concept thoroughly. We investigated the background from which EmoBuddy commences. We identified two main approaches in handling work-related stress. On the one hand active governance on social support and on the other there are commercially available products which employ biofeedback to monitor stress. EmoBuddy combines the strengths of both approaches. In further analysis of the concept we performed a literature study and conducted 8 expert interviews. This led to the enhancement of the existing prototype.

In the second part of the project this prototype was submitted to an extensive user test. 36 participants used the EmoBuddy system for four workdays in full context. After finishing the test the participants were invited to a thirty minute interview. To analyze test results we developed a model of EmoBuddy's performance. We translated the dependencies depicted in the model into hypothesis. These hypotheses were tested in quest for a proof of principle. Our results showed that EmoBuddy induces desirable behavior: usage induces social support and creates awareness on stress behavior.

In the third and last part of this study we focus on the future. Discussing test results leads to recommendations on testing, research and design. We conclude the study with design propositions for the next generation prototype. The balance between social functionality and awareness functionality is slightly shifted towards awareness functionality. In contrast with awareness functionality, we expect that social functionality will not reach its full potential in a work environment as it demands a high level of intimacy between people. But, social functionality is nevertheless very valuable. To underline this we (superficially) explore the social functionality in a different, more personal context.

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1 | Introduction

Sweeping changes occurred in the organization and composition of paid work in Northern and Western Europe as well as the United States due to globalization of economy, growing diversity in the work place and an increased mental workload [Kompier, 2002; Landsbergis, 1999; EFILWC, 2007]. While overall these changes have resulted in a massive increase in wealth especially in western nations, for many workers it also resulted in a variety of potentially stressful circumstances. Work-related stress is one of the main sources in illness and reduced productivity [EFILWC, 2007], inherently stress related costs are skyrocketing [Milee, 2007]. Employers are aware of the organizational benefits of investing in workplace health and are inclined towards doing so [Zwetsloot, van Scheppingen, Dijkman, Heinrich & den Besten, 2010].

As a respond to this demand a system called EmoBuddy was developed by research scientists Elke Daemen and Gert-Jan de Vries at Philips Research. This system aims to reduce and prevent stress on the work floor by combining the strength of both biofeedback and social support. EmoBuddy is designed as a distributed application for two employees, to which we will refer to as buddies.

Central in its design is the facilitation of empathy between buddies. By sharing each individual's real time stress level, derived from wireless skin conductance measurements, users are stimulated to contact each other whenever stress levels rise and join in a stress reducing activity (e.g. drink a cup of coffee).

In this study we have (re) designed and tested this system called EmoBuddy. We conducted an exhaustive evaluation to both strengthen the EmoBuddy concept and to reach understanding whether or not EmoBuddy holds a sustainable future.

1.1 Thesis Overview

To be able to enhance EmoBuddy concept the second chapter discusses the projects objective and introduces the EmoBuddy concept more elaborately. In Chapter 3 we will provide a theoretical framework and explore subjects concerning occupational stress. For instance we will investigate if and how stress coping mechanisms are influenced by awareness and social support to find whether or not this is fruitful in preventing and reducing stress. Besides, Chapter 3 will glance at the existing anti-stress market. In Chapter 4 we will zoom in even further as we will analyze the EmoBuddy concept leading towards a redesign of the prototype. Chapter 5 concerns the design and execution of the user test and its fundamental analyses. A discussion of the test results will follow in Chapter 6, concluding in recommendations on research, testing and design. Chapter 7 offers more detailed design propositions. And finally we will conclude the project with Chapter 8.

2 | Project objectives

EmoBuddy is a concept in the fuzzy front end of development. The fuzzy front end is often said to be characterized by chaos, unpredictability and lack of structure [Smulders, van den Broek & van der Voort, 2007]. But pre-eminently it is also a phase characterized by creativity and freedom. Bringing new ideas further into the organization is core to this phase. Against the background of an iterative design process, focusing on the social context, we will not only aim for a proof of concept but we want to develop EmoBuddy to the next level.
This chapter will present a more elaborate view of EmoBuddy concept and formulate the project's objective by means of a problem analysis. *Appendix A* offers the original assignment and *Appendix B* offers the project plan, but exclusively the aspects that are not included in this chapter (stakeholder analyses, project planning and method description).

2.1 EmoBuddy

2.1.1 General concept

Generally, roughly two approaches can be distinguished in handling work-related stress. On the one hand we find commercially available products that often employ biofeedback: physiological measurements are presented to the user in varying levels of interpretation. And on the other hand, from behavioral research it is well know that active governance on social support positively moderates the stress process. Both these approaches have advantages and disadvantages. EmoBuddy distinguishes itself from similar products because it combines these two approaches:

- *EmoBuddy deducts the subject's stress level from physiological data(skin conductance (SC))*
- *EmoBuddy deploys (informal) social control as a mechanism to regulate the process of reducing and preventing stress*

EmoBuddy aims to reduce and prevent stress by combining both biofeedback and social support through a system that thrives on computer-mediated-communication (CMC). CMC includes a variety of electronic message systems and electronic conference systems, which can be supplemented with e.g. audio and video [Derks, Fischer & Bos, 2008]. In the case of EmoBuddy we will enrich CMC with physiological data.

EmoBuddy is designed as a distributed application, and is used by multiple users to which we will refer to as buddies. Central in its design is the facilitation of empathy between buddies. By sharing each individual's real time stress level, users are stimulated to contact each other at times when stress has built up and join in a stress reducing activity (e.g. drink a cup of coffee).

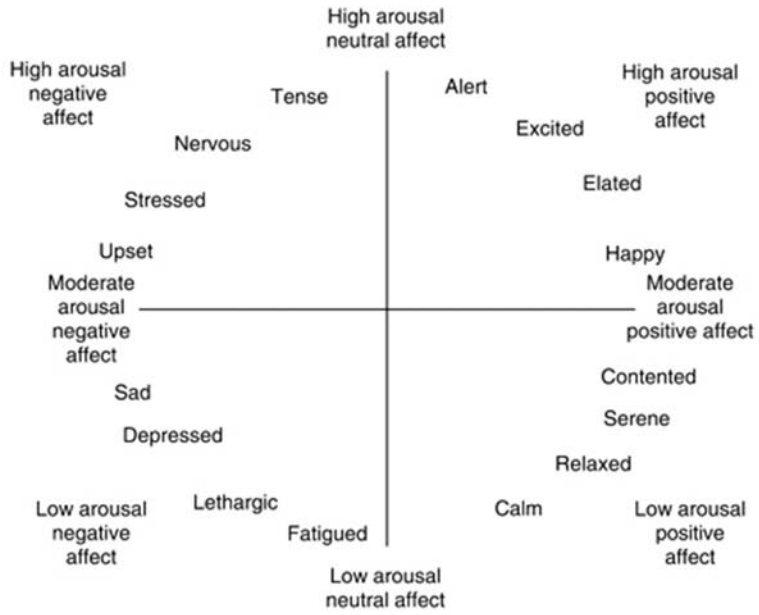
EmoBuddy predisposes that employees are not always able to monitor their own stress; therefore, EmoBuddy monitors its users stress level. Whenever stress levels rise we expect buddies will feel persuaded to contact each other based on a feeling of (informal) social control that is fed by the presence of empathy. It may become clear that EmoBuddy does not propose a direct solution for stress (e.g. provide a coaching function using breathing exercises), but it induces a phenomenon that is known to be stress reducing: social support. This approach will provide the users with insight in their stress coping not only via social reflection but also via individual reflection. Ultimately enabling buddies to change their coping behavior and manage their stress to (keep) a more healthy level.

2.1.2 Technology - operating principles

The system uses the DTI: discrete tension indicator, which is a wrist worn, wireless skin conductance (SC) sensor for daily life use (*Picture 2.1*) and is developed at Philips Research. The skin conductance (SC) is measured at the inside of the wrist by a small DC current between two metal pads.

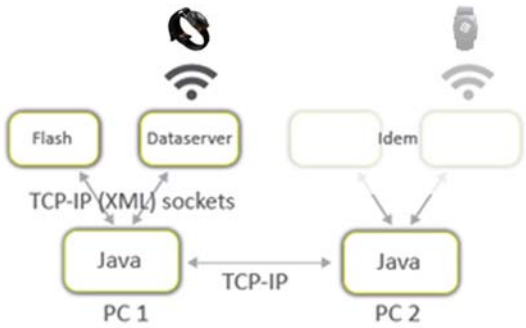
2.1 Discrete Tension Sensor (DTI)

Skin conductance, also referred to as galvanic skin response (GSR) is a direct measure for arousal [Boucsein 1992; Caciopoppo, Tassinary & Bernston 2000]. Within this project we refer to the DTI measurement as a stress measurement. This is however debatable as opinions differ on whether the concept stress only describes the negative emotion (distress) or also the positive emotion (eustress) [Berk et al., 2001]. Concerning this study we are only interested in distress, therefore we are interested in distinguishing positive from negative stress. *Picture 2.2* shows a model that depicts arousal as one of two dimensions in understanding a person's affective state (among which stress) and is deployed in reference to valance [van den Broek & Westerink, 2009]. Arousal is an indication of how intense an affective state is; valence indicates to what extent the affective state is positive or negative. According to this model the DTI is able to detect distress but only among other emotional intense states. It can't exclusively distinguish negative stress as it would need valence in order to discriminate between positive and negative emotion. This could be achieved by adding more features to the measurement. Due to timing restriction this falls outside the scope of this project, besides former research showed that the measuring device is quite able to indicate high levels of emotional intensity. Also this study doesn't focus on the stress measurements (e.g., quality), but focuses on the application that applies these measurements. We expect in the context of EmoBuddy we will achieve intended functionality using the DTI.



2.2 Valence Arousal Model, *source* Van den Broek and Westerink [2009]

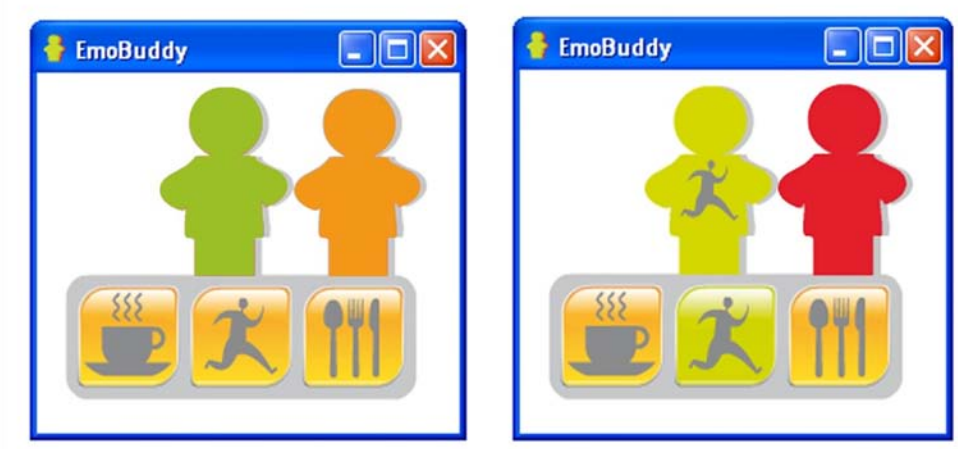
The EmoBuddy application has been developed and tested for a Windows environment, using a combination of Flash and Java. In addition the system consists of a data server to provide GSR data provided by the DTI. Via a network protocol (TCP/IP) buddies' computers can communicate and thus share stress level information via the EmoBuddy application (*Picture 2.3*).



2.3 Communication Protocol EmoBuddy

The application communicates the stress intensity via four different colors: ranging from light green, to dark green to orange and finally red, each indicating a higher stress level. The avatars can also turn gray, this indicates either absence (no data samples coming in) or incoming samples below the threshold of the device. *Picture 2.4* shows the EmoBuddy application, including

the avatars representing the buddies. Below the avatars there are three contact buttons that can be used to invite or answer an invitation; there are three options. Go for coffee, go for a walk or, invite each other for lunch.



2.4 The EmoBuddy Application. The right picture shows an invite from the user to go for a walk.

2.1.3 Target group

'*The service sector in North and Western Europe and the United States*' in answer to which market EmoBuddy will be developed for and who will be using EmoBuddy.

Stress is a universal phenomenon; therefore EmoBuddy could be a universal product. However since stress perception is both individual-related [Thong, 2003] as cultural-related [van Hemert, Poortinga, & van de Vijver, 2007; Vandekerckhove et al., 2008] EmoBuddy should be customizable. Customization can only be realized to a certain extent, reaching universal bandwidth would be assumedly impossible due to the inherent increasing complexity. On the contrary major trends such as globalization increase the scope of EmoBuddy: '*Information and Communication Technology (ICT) has characterized contemporary times - boundaries of place and time are transforming and even dissolving, influencing economical, political and social communication between people and between states. In North and Western Europe states are growing more homogenous and move closer to the United States in terms of their working patterns*' [Perrons et al. 2006, p.3].

2.1.4 Problem analysis

This study revolves around the social component of EmoBuddy: we will address central problems and challenges concerning designing and embedding the social context within the product. Specifying manageable problems relevant

to this project in general will eventually result in specific research questions central in the enhancement of EmoBuddy.

It has become eminent over the years that social support plays an important role in reducing and preventing but also developing occupational stress. Consulting literature we find that the stressful experience is intensified if social support is lacking and in turn a work environment with supportive social relationships contributes to workers' well-being and health [EFIWLC, 2007; van Yperen & Hagedoorn, 2003; Thong & Yap, 2000]. However, actively inducing and guiding behavior (social support) over a distance by deploying a social mechanism through CMC is a very complex task; even more so since multiple people are involved.

As became obvious we expect that by facilitating empathy we can conjure this desired behavior. But we must bear in mind that the inducement of can have negative consequences. The feeling of responsibility for a colleague's well-being is not always justified and can turn in to an emotional burden or an unacceptable distraction from work. So there is a fine line, besides it is rather unpredictable if and if so to what extent social responsibility can be controlled when multiple people are involved. How can we implement these boundaries that are very subjective and dependent on the situation in a product?

The above roughly sketches the general problem. It predisposes that EmoBuddy needs to adapt to individual users and specific situations. The general philosophy is the more variables can be taken into account, while understanding their role and not being burdensome to the users, the more accurate EmoBuddy can act on a specific situation and induce desirable behavior between people. However Emobuddy will not and cannot take into account an endless amount of variables: both due to complexity and costs. And for what is more at some point the functional gain does not nearly weigh against the effort of taking these factors into account. Little aside but nonetheless important we will make one constriction on forehand concerning the social context. Group dynamics are far too complex to fit the scope of this program and must be strongly confined: within this project we will exclusively focus on one-to-one mapping.

We must carefully weigh what variables to take into account. We can identify three levels on which EmoBuddy can be customized: (1) individual level, (2) buddy-level and (3) company level.

Individual characteristics need to be included in a redesign of the current concept. As was emphasized by Thong and Yap (2000), individual traits have been found to influence the perception of stress and moderate the stress-outcome. The optimal way to cope with stress is different per individual and dependent on personality traits [Berber 2001; Vollrath & Torgersen, 2000]. Individual demographics such as age, gender and education have been found to have the same function as individual personalities in the stress process [Thong & Yap, 2000]. If actions intended to relieve stress are not tuned to the

individual it may very well add to the developing of stress. This is a phenomenon significant to EmoBuddy: it seems that individualization is a precondition to EmoBuddy.

The acceptability of Emobuddy is an aspect concerning individual characteristics that we want to accentuate separately. EmoBuddy can be a very invasive product. Not only is the user's mood quantified by data retrieved by sensors, but the system also real time shares its user's emotions with another person. In most communication we have a higher extent of control on what we want to share and when: the user might experience EmoBuddy to be an intrusion on personal space and privacy.

This is where we cross the second level variables; buddy-level. Both the nature of the relationship between buddies is strongly related to this issue of acceptability, as well as the level of intimacy between buddies. It is imaginable that hierarchy or social proximity between colleagues will severely affect the functioning of EmoBuddy. In a relationship with low intimacy employees will not always feel comfortable disclosing real time emotions.

EmoBuddy could eventually also be customized on a higher level; company level. EmoBuddy is a product that will influence the social structures on the work floor. The *how* to this statement is very complex: many variables influence how people will react to EmoBuddy and interact with each other in relation to EmoBuddy. This ranges from company policies, occupational and social organization even to environmental characteristics such as spatial layout [Van den Broek et al, 2006]. For example EmoBuddy will function different if buddies are located in the same room, compared to a situation where buddies work in different buildings.

We discussed three levels on which EmoBuddy could be customized to gain an acceptable extent of control over inducing social support in such a way that users are valued in their personal space and not emotionally burdened by the usage of EmoBuddy.

Customization is however complicated both technically and design-wise. '*To get a user from blank state to fully customized interface or product takes exceptional design skill*', [Nielsen & Norman 2009, p.93]. Product customization will over all make processes more complex; not only the design process but also production and usability. For instance customization often leads to over complex workflows. Anticipating on these aspects is crucially important in the further development of EmoBuddy concept: we have to install an optimum between level of customization and usability. All of these considerations strongly concern redesign and testing of the EmoBuddy concept and are translated in two research questions presented below.

2.1.5 Research Questions

(1) How can social control be deployed through EmoBuddy as a mechanism to guide employees in their stress management and increase social support in the work place?

- *Can deployment of social control through Computer Mediated Communication (CMC) actively induce desirable behavior?*
- *How to embed this behavior inducing phenomenon successfully into EmoBuddy regarding individual while keeping high usability?*
- *Does EmoBuddy facilitate empathy and induce social support when stress has built up?*
- *What conditions need to be satisfied to fulfill the above?*

(2) Is EmoBuddy sustainable, can further investments of time and money be justified?

2.1.6 Project objective

The main objective of this project is to strengthen the EmoBuddy concept and develop it to a higher, more detailed level via an iterative design process. The first part of this study will focus on analyzing the EmoBuddy system based on both literature and interviews with experts. This analysis serves to enhance the existing EmoBuddy prototype so that it facilitates empathy through CMC and induces social support when stress has built up. In the second part of the study we will conduct a large scale user test, aiming for a proof of principle concerning the social functionality of EmoBuddy. Submitting the enhanced prototype to an exhaustive evaluation will besides provide insight in concept sustainability. The third and last part of this study focuses on EmoBuddy's future, handling recommendations and propositions for redesign.

3 | Backgrounds

This chapter describes the background from which this study commences. The first two paragraphs address the presence of occupational stress in western society and provide a glance at today's anti-stress market. In the paragraphs that follow we will develop a theoretical framework addressing key concepts surrounding EmoBuddy.

3.1 Backgrounds

In the introduction we briefly introduced occupational stress as a widespread and very expensive problem. In this paragraph we will address this somewhat more extensive and highlight causes and consequences and the extent of the problem.

Information and Communication Technology (ICT) has characterized contemporary times. Boundaries of place and time are transforming and dissolving influencing economical, political and social communication between people and between states. New lifestyles, forms and patterns become increasingly apparent towards the end of the 20th century in Northern and Western Europe and the United States. Terms such as 'the risk society', 'knowledge society' and 'new economy' are used to portray the new era [Perrons et al., 2007].

These major changes intensively affect the organization and composition of paid work. Perrons and colleagues [2007] describe how states in North and Western Europe are growing more homogenous and move closer to the United States in terms of their working patterns. The service sector has become dominant: manufacturing jobs continue to decline giving way to service and knowledge work. Liberalized trade regulations and development in ICT have enabled more countries to operate globally, resulting in intensified price and product competition. In addition, product and service demands are shifting rapidly amid pressure for higher quality and customized products [Landbergis, Cahill & Schnall, 1999]. More companies adapt to lean management or other flexible production systems which often result in more time pressure and higher job demands for employees [NIOSH, 2002; Landbergis, Cahill & Schnall, 1999]. In many countries these trends rise against a backdrop of an aging and increasingly diverse workforce and a constricting labor market. Beside an in general higher educated, an older work staff and increased migration, paid work has become more feminized [NIOSH, 2002; EFILCW, 2007].

For many workers these landscape shaping trends have resulted in a variety of potentially stressful or hazardous circumstances such as reduced job stability and increased workload. Stress is one of the main sources in work related health problems; only back pain with 28% seems to be more common [EFILWC, 2007].

Work intensity has been increasing mainly during the first part of the 1990s. The average work year for prime-age couples has increased by nearly 700 hours from 1980 to the year 2000. And high levels of emotional exhaustion at the end of the work day are the norm for 25% to 30% of the workforce [NIOSH, 1998]. Alternatively, increased flexibility, responsibility and learning opportunity in today's workplace may offer workers greater potential for self direction, skill development, and career growth, leading to reduced stress and increased satisfaction and wellbeing. Since the year 2000 the level of work intensity seems to be stabilizing at a constant but high level. Data from a large-scale European survey executed by the European Foundation for the Improvement of Living and Working Conditions (EFILWC) [2007] suggests that over 30% of the workers experience stress on the job. And 60% of European workers report stress over 50% of the workday and 33% of US workforce is stressed 'often' or 'always' on the job [Milee, 2007].

It needs no defending that stress-related costs are immense. Pinning down the exact numbers however is practically impossible since they are strongly depending on the point of view the costs are evaluated and calculated. There are multiple estimates for both Europe and the US. The variables that are generally included in calculations concerning stress-related-costs are: accidents, absenteeism, employee turnover, diminished productivity, substances abuse, direct medical, legal and insurance costs and workers' compensation awards. In this perspective Europe spends around 200 billion dollars every year on stress-related issues and in the US stress-related costs accumulate to over 300 billion dollars a year [Milee, 2007].

3.2 Market

The 'anti-stress' market is a big and varied market; ranging from a simple anti-stress ball[1] to (freely available) medication (e.g. Vitango[2], AntiStress Natura[3]) to complex devices that 'enhance feelings of happiness, gratitude and satisfaction while simultaneously decreasing stress levels' based on brain wave technology (Peak Brain Happiness Trainer[4]).

Within this market we can identify a product group aiming at stress reduction that employs biofeedback. These products present physiological measurements to the user in varying levels of interpretation. As the underlying technologies gradually mature this is still a relatively small, but emerging market. EmoBuddy, using GSR measurement to monitor stress, belongs in this group.

In reviewing this product group we will use a stress product overview recently created by W. van Beek a research scientist at Philips. He uses three categories: (1) professional consumer products, (2) professional business products and, (3) consumer fun/ leisure products. We will introduce several products belonging to each category to sketch an image of this group.

Professional consumer products

Heart Math emWave® [5] is said to be a personal stress reliever. The emWave® employs Heart Rate Variability (HRV; measured by the variation in the beat-to-beat interval) and provides a breath pacer with a LED strip on device (*Picture 3.1*) as well as additional evaluation software. The system costs 390€.

3.1 HeartMath's personal stress reliever emWave®

[1] http://stressbal.nl/
[2] http://www.vitango.nl/minder-stress-meer-succes
[3] http://www.holico-vitamins.com
[4] http://peakachievement.com/Happiness/Peak_Brain_Happiness_Trainer.html
[5] http://www.heartmathbenelux.com

StressEraser® [6] is a pocket size device that also uses HRV which is unobtrusively measured by a finger sensor that measures HRV. The signal is presented as a wave on a small display (*Picture 3.2*). This wave guides you to synchronize your breathing with your heart rate cycle. Costs: 180 €.

3.2 StressEraser®

Professional business products

Omega Wave™ [7] (*Picture 3.3*) is a full physiological monitoring system targeting (professional) sports sector featuring HRV, DiffECG (concerning energy supply analyses), Omega (slow brain waves report), neuromuscular report and sensorimotor report. This system uses very advanced software and is not an end-user product. This system costs 35.000€.

3.3 OmegaWave™

Mind Media B.V. NeXus-10[8] (*Picture 3.4*) is a multi-channel and multi-modal physiological monitoring and feedback platform used for biofeedback and neurofeedback (EEG, ECG, RSP, Blood Volume Pomp (BVP), GSR and temperature). This device is well known and used within Philips Research. The system costs 6000€ and is like the other business products not an end-user product.

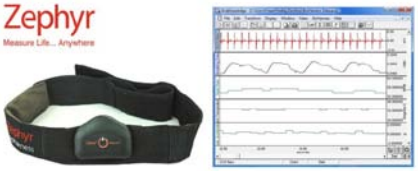
3.4 NeXus-10 by Mind Media bv

Plux ® [9] focuses on sports, health and research and integrates bio-signals processing and miniaturized wireless sensor devices (*Picture 3.5*). The Plux® is like the NeXus-10 a multichannel and multi-modal physiological monitoring and feedback platform. Plux® is available as four different systems: research, motion, clinical and personal. This broadens the product scope to both professional consumer products as professional business products.

3.5 bioPlux®

[6] http://stresseraser.com/
[7] http://www.omegawave.com/
[8] http://www.mindmedia.nl/english/nexus10.php
[9] http://www.plux.info/

Zephyr BioHarnass™ [10] is a device that is worn just below the breast that enables remote monitoring of human performance and condition in the real world (*Picture 3.6*). It measures HRV, ECG, temperature and motion.



3.6 Zephyr™

The BioHarnass can be connected to any smart phone or computer system and offers advanced software to analyze data retrieved from the device. This is also not an end-user product and costs 1500€.

Consumer leisure/fun products

Gavari Stress Watch (concept)[11], is a device resembling a normal wrist watch that measures HR and temperature, via its display it offers biofeedback to the user on his/her stress as well as a breath pacer. This concept has not been developed into a working device (*Picture 3.7*).

3.7 Gavari Stress Watch (concept)

Smart phone applications Breath Pacers[12, 13] are simple applications that do not actually include in this product groups since they usually do not use biofeedback. There are two reasons to mention them, it is likely that in the near future these applications will include bio-signals (e.g., HR) besides these are breathing pacers aiming to reduce stress in the same way as some of the products above (*Picture 3.8*). These applications cost typically between 0€ to 5€.

3.8 Smart Phone applications: Android Breath Pacer Lite, iPhone BreathPacer

[10] http://www.zephyr-technology.com/bioharness-bt
[11] http://www.gavaridesign.com/eng/industrial/stresswatch.html
[12] http://nl.appbrain.com/app/breath-pacer-lite/net.androidresearch.BreathPacerLite
[13] http://download.cnet.com/BreathPacer

EmoBuddy can be counted among the professional consumer products leaning towards consumer leisure/fun products as it for example resembles the concept Stress Watch designed by Gavari. However, generally this product group has one important limitation. Although there is an inherent benefit in terms of increasing health, the long term usage of these devices is limited as their benefit as a motivator declines over time. These applications typically lack the power to convince users to change their behavior permanently. With the introduction of EmoBuddy we aim to enrich the concept by inducing social support as a motivator while also deploying biofeedback.

As we briefly introduced in paragraph 2.1.1, there is a second approach in handling work-related stress besides using commercially available products. Actively influencing social support is a known mechanism in preventing and reducing stress. This approach is usually constrained to governance and therefore it is difficult to see this approach as a concurrent to EmoBuddy. Still employers are inclined to deploy social support in reducing and preventing stress. Ybema and Roozeboom [2009] demonstrated with a longitudinal study how Dutch employers recognize the benefits of encouraging social support and are willing to change organizational structures regarding health in favor of encouraging social support. EmoBuddy is rather exceptional as we translate this approach into a product for this market.

We now have an image of both the presence of stress in the western nations as well as the market relevant to EmoBuddy answering to the problem of occupational stress. The latter part of this chapter as introduced will focus on the theoretical framework. We will explicitly discuss five subjects: occupational stress, stress coping, personality, social support and empathy. These concepts are interwoven to such an extent that a complete semantic representation of these subjects falls outside the scope of this project. Therefore, the concepts are all introduced at the same level and in the order mentioned above.

3.3 Occupational stress

EmoBuddy aims to reduce and prevent stress in the work place. Therefore, it is important to explore the concept of occupational stress and related concepts. This paragraph will address the perspective from which we view occupational stress relevant to this study.

Stress is part of our everyday vocabulary to such an extent that virtually anybody is able to grasp the concept in most contexts without the necessity of a thorough definition. Nevertheless, although many definitions are circulating, there is no universally accepted definition on what stress entails.

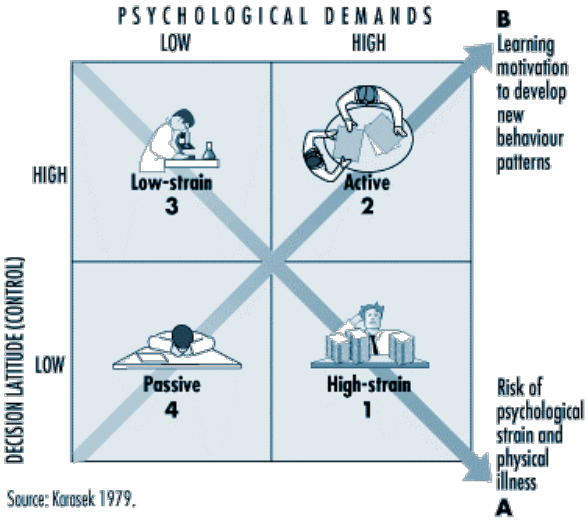
Stress has been researched from sociological, psychological and medical perspective. In the early eighties Ivancevich and Matteson [1980] laid important groundwork in unraveling the concept of stress focusing on work and stress. Their work is up to this day often used and found in current research on occupational stress; this is where we will take off in order to adopt a working definition on occupational stress.

Ivancevich and Matteson [1980] distinguish three categories concerning stress definitions: (1) stimulus definitions, (2) response definitions or, (3) stimulus-response definitions. Simply stated stimulus definitions view stress as the force or stimulus acting upon the individual that results in a response of strain. Response definitions view stress as the physiological or psychological response an individual displays due to stressors. And stimulus-response definitions view stress as the consequence of the interaction between environmental stimulus and the idiosyncratic response of the individual.

To this study the third perspective is the most appropriate: within these three perspectives the stimulus-response view provides the most room for involving personality traits. As Thong and Yap [2000] emphasize individual traits have been found to influence the perception of stress and moderate the stress-outcome. In this vision will adopt their definition:

'Occupational stress also referred to as work-related stress, job stress or stress in organizations is a condition wherein environmental stimulus (stressors) interact with the individual and alter his or her psychological and/ or physiological condition such that the individual's mind and/ or body are forced to deviate from normal functioning' [Thong & Yap, 2000, p.683].

Stress occurs in many different circumstances, but is particularly strong when a person's ability to control the demands of work is threatened. In literature we find different models that interpret the relations between work demands and health complaint. The 'Job Demand-Control model' (JDC) by Karasek (1979) is still one of the leading models in the field of work related stress [Kain & Jex, 2010] (*Picture 3.9*). It combines epidemiological views on the relationship between work demands and health complaints on the one hand, with studies on job satisfaction and motivation on the other. Central in the model is the interaction between job demands and job control. The model assumes two main hypotheses: (1) the combination of high job demands along with low job control precipitates psychological and physical strain ('high strain' jobs); (2) jobs in which both demands and control are high, lead to well-being, learning and personal growth ('active' jobs) [Karasek & Theorell, 1990].



3.9 Karasek's Job Control-Demand Model (1979)

In line with the JDC model the European Foundation for the Improvement of Living and Working Conditions describes a pattern of reactions on occupational stress in the 2007 report [EFILWC, 2007, p.2]. Occupational stress leads to this pattern of reactions occurring when workers are presented with work demands that are not matched to their knowledge, skills or abilities, and which challenge their ability to cope. These demands may be related to time pressure or the amount of work (quantitative demands), or may refer to the difficulty of the work (cognitive demands) or the empathy required (emotional demands), or even to the inability to show one's emotions at work. When the worker perceives an imbalance between demands and environmental or personal resources, this can cause a number of possible reactions that can be divided in (1) individual consequences and (2) organizational consequences.

The individual consequences may include physiological responses (e.g., increase in heart rate, blood pressure, hyperventilation), emotional responses (e.g., feeling nervous or irritated), cognitive responses (e.g., reduced attention and perception, forgetfulness), and behavioral reactions (e.g., aggressive, impulsive behavior, making mistakes). When people are in a state of stress, they often feel concerned, less vigilant and less efficient in performing tasks. Arising out of these individual consequences, high absenteeism, low productivity and high personnel turnover are regarded as organizational consequences.

3.4 Stress coping

Stress coping concerns the way we (chose to) handle and react on stressful situations. Welbourne and colleagues [2007] distinguish four core families of coping based on research by Skinner and associates [2003]. *Problem-solving*

includes both action-oriented (e.g., active coping) and cognitive decision making types of coping strategies (e.g., planning). *Positive cognitive restructuring* involves coping strategies that focus on adjusting one's view or perspective of a stressful event (e.g., acceptance). *Avoidance* coping includes strategies aimed at escaping from or disengaging from a stressful situation, either emotionally or behaviorally. Finally *Support-seeking* includes both problem-focused and emotion-focused support seeking.

Both problem solving, cognitive restructuring and social support have been have been linked with physical well-being and general wellbeing, while avoidance is associated with poorer adjustment and more negative outcomes [Armstrong-Stassen, 2004]. Welbourne and colleagues [2007] translate these findings into a work-related context and state that seeking social support from others may lead to greater satisfaction by providing workers with emotional support in the workplace. Social support seeking may also encourage the other positive coping strategies; problem-solving and cognitive restructuring.

Although a person may use a variety of coping strategies across situations or from one stage to another of a stressful encounter, past research suggests that one's choice of coping strategies can be predicted, in part, by personality characteristics [Welbourne, Eggerth, Hartley, Andrew & Sanchez, 2007]. This is a recurring aspect in this study and an important argument to customize EmoBuddy. We want EmoBuddy to behave individually consistent and provoke the user to seek (and offer) social support as a way to cope with stressful situations. To this effect we will first discuss the influence of personality on coping behavior and stress susceptibility. Next we will address social support as a coping strategy.

3.5 Personality

Research on individual differences concerning coping, mainly emphasizes personality traits as a vulnerable and or resistance factor [Grant & Langan-Fox 2006]. Usually the Big Five are applied in explaining personality, and are viewed as large arenas of human behavior [Bebner, 2000]. The Big Five are neuroticism, extraversion, conscientiousness, openness and agreeableness. In recent years it has been well established that the basic personality factors of neuroticism, extraversion and conscientiousness are associated with stress experience and coping [Vollrath & Torgersen, 2000]. People respond emotionally to events and information or they do not (neuroticism, N). They are careful, organized and ethical in their behavior, or they are not (conscientiousness, C) and they are sociable, or not (extraversion, E). Neuroticism has an overwhelming negative effect on both stress and coping, where as extraversion and conscientiousness have a positive effect on both [Volrath & Torgersen 2000; Grant & Langan-Fox 2006]. In their research Volrath and Torgersen applied typology (based on N, E and C) to map the

combined influence of personality traits on stress coping (Table 3-1). We will shortly discuss their results as these are interesting in adapting EmoBuddy to individual user characteristics.

3-1 Personality types according Vollrath and Torgersen [2000]

BFI-score	Type	Characteristics
Low E, C and N	Spectator	Passive; not social; doesn't take initiative
Low E and N; High C	Skeptic	Emotionally stabile but detached; problem oriented; rigid
Low E and C; High N	Insecure	Self-conscious; depending on what other people think; badly organized
Low E; High C and N	Brooder	Shy and withdrawn; worries about decisions
Low C, High N and E	Impulsive	Pleasure oriented; attention seeking; appears chaotic and changing
High C, E and N	Complicated	Emotionally intense; occasionally bursts and regrets this; dependent on others; orderly
Low N; High E and C	Entrepreneur	Socially secure; independent; dominant; cool-headed; goal oriented
Low N, C; High E	Hedonist	Socially skilled, pleasure oriented; emotionally robust; unreliable

- Types with a high N are more susceptive for stress (insecure, brooder, impulsive and complicated). Hedonist and entrepreneur types are least susceptible for stress followed by the skeptic and spectator types.
- A high score on C and E is an indicator for problem-coping (complicated and entrepreneur), whereas high N and low C are related to reduced problem-coping (impulsive and insecure).
- The impulsive, spectator and skeptic types score lower on cognitive restructuring.
- On the potentially dysfunctional coping scales, the insecure type and the impulsive type (high N, low C) scored high, the complicated type followed. Hedonist and entrepreneur types scored low.

3.6 Social Support

As mentioned we want EmoBuddy to adapt to the behavior of its users and simultaneously structurally induce social support as a coping mechanism for occupational stress. There is general endorsement concerning that social support is an important moderator in the occupational stress process [Ganster et al. (1989); Karasek & Theorell (1990); Sargent & Terry (2000); van Yperen &

Hagedoorn (2003); EFILCW, 2007; Brough & Pears (2008)]. EFILCW (2007) underlines the influence of social support on the stress process, stating that the stressful experience is intensified if no help is available from colleagues or supervisors at work. Therefore, social isolation and lack of cooperation increase the risk of prolonged stress at work.

Etzion(1984) defined social support as an informal social network that provides individuals with expressions of emotional concern or empathy, practical assistance, informational support or appraisal. Johnson and Hall (1988) included a dimension of social support in Karasek's (1979) Job Demand-Control model of occupational stress (Job Demand Control Support Model: JDCS). Johnson and Hall demonstrated that in environments characterized by high demands and low control, workers experienced reduced levels of strain when social support was high. Johnson and Hall suggested that perceived social support influences the stress-strain relationship in a similar manner to the better-established moderating effect of job control.

3.7 Empathy

The last part of this chapter will address empathy. Empathy is a key concept to EmoBuddy, because by facilitating empathy we aim to deploy social control in order to induce social support.

Empathy has been studies for hundreds of years from a large range of disciplines: philosophy, theology, developmental psychology, social and personality psychology, ethology and neuroscience. The field is marked by disagreement and discrepancy [Preston & De Waal, 2002]. Superficially the debate stems from a lack of consensus on the definition. Preston and De Waal [2002] indicate that the preponderance of research theory is directed towards determining if empathy is an emotional or cognitive process and distinguishing empathy from emotional contagion, sympathy and perspective taking. They underline this statement with an extensive list of research [Preston & de Waal, 2002, p.4].

In their quest to articulate the proximate mechanism Preston and De Waal [2002] focus on three levels of empathy: emotional level, cognitive level and empathy in humans that can be linked to empathy in non-human animals. The concept of cognitive empathy is most relevant to EmoBuddy. To clarify we will first outline these concepts:

Empathy refers to situations in which the subject has a similar emotional state to another as a result of perceiving the other's situation. Empathy is thought to preserve the distinction between self and other, with an emotional state that is focused on the other. This may result in prosocial actions to alleviate the distress of the other [Davis, 1994]. As a process, one is empathizing when they understand the state of the other by activating their own representation of the

others state. Cognitive empathy refers to situations when a person arrives at an understanding of the other's state through cognitive processes. It implies that the subject has used cognitive perspective taking to project him or herself into the position of the person to understand, empathize and help [Eysenck, 1981; Preston & De Waal, 2002; De Waal 2009].

4 | Concept Analysis

Chapter 3 offers the basis for an elaborated analysis of EmoBuddy: subject of this chapter. We conducted 8 interviews with experts on several knowledge fields (e.g. interface design, emotion and social psychology). In addition we spoke with group leaders within Philips Research to explore both the usage scenario where EmoBuddy is implemented and the target group. Leading about 50 people in research gives them a profound insight in our target group.

Another tool we used to gain more insight in the concept components is a function deliberation. We mapped EmoBuddy's (desired) functionality in order to find requirements for the redesign of the prototype. Paragraphs 4.1 present results of these processes. Whereas 4.2 and 4.3 apply both these results as the results from the literature study in redesigning the concept in order to enhance the existing prototype for the user tests.

4.1 Interviews and Function Mapping

4.1.1 Interviews

We approached several experts, presented them the EmoBuddy concept and interviewed them on their specialty. These interviews gave a profound insight in the concept and exposed key aspects that must be (re)considered in refining the prototype. This paragraph will highlight the main aspects that emerged in these interviews concerning implementation, composing of couples and functionality.

Implementation

- EmoBuddy should be implemented on a voluntary basis. Outside the fact that a vast majority believes that it is morally not acceptable to force EmoBuddy usage, its functionality is likely to diminish when usage is forced upon employees.
- Both group leaders agreed that EmoBuddy was a suitable and desirable product to deploy amongst their group.
- On the question what would trigger a person to use EmoBuddy we got two different answers: (1) from a request for help and (2) out of curiosity as a 'fun-application to gain insight in your stress behavior'. The first option was usually compared to the program *Workrave*® that assists in the recovery and prevention of Repetitive Strain Injury (RSI). The second was by one person compared to a smart phone application '*the Sleep Cycle Alarm Clock*'; a program that assesses your sleep quality by movement.
- A comment that was often heard is that anonymity should be respected as much as possible. Stress is often socially considered as a sign of weakness.
- Next an important risk was identified. However, most experts agree that well-being and health in the end is everyone's own responsibility, they do recognize the danger in EmoBuddy issuing a suggestion of responsibility for a buddy. This is acceptable as it is interwoven with the working mechanism (the deployment of social control) but only to a certain extent. Especially the company psychologist underlined it to be of great importance to somehow keep track of the possible emotional burden EmoBuddy entails. Although she expects this will not be a major (common) problem, it must be considered a risk.

Composing of couples

- There is consensus on 'a chosen buddy' out of the two options to appoint buddies (e.g. by group leader) or let users be free of choice who their buddy is.
- The relationship between buddies impacts EmoBuddy's performance, both the nature as the level of intimacy. 7 out of 8 experts agree that

hierarchy must be avoided, since EmoBuddy would have a strong influence on the distribution of power between buddies.
- Furthermore the experts deem a friendly relationship to be a condition for being buddies as EmoBuddy discloses very personal information. There must be a basis of mutual trust and openness for EmoBuddy to function optimally.
- On whether buddies should be work related content-wise (e.g. same project) the opinions are divided. Knowing each other's emotional state to such detail might function as leverage on the negotiation of work tasks. This is considered unacceptable. On the contrary some experts do argument that being substantively involved in each other's work enables more efficient help.

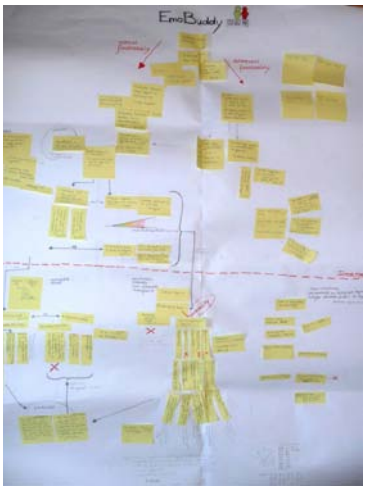
Functionality
- A very obvious advice was to extend the awareness functionality. For example by offering overview graphs (week/day/month/year), or correlating the stress assessment to the outlook agenda. Several experts reasoned social functionality will be less popular to awareness functionality depending on individual traits.
- Related to the previous point we asked whether the user should also receive overview (week/day/month/year) information on his/her buddy. This was answered negatively, with the argument that this would cross boundaries of privacy and personal space. It would be an option if the buddy is asked for consent. But this function is deemed not to add much value to the concept.
- We also asked if EmoBuddy would benefit from a coaching function. The majority answered to appreciate the fact that EmoBuddy does not dictate a solution but leaves it free to interpret for buddies themselves.

4.1.2 Function Deliberation

To gain insight in EmoBuddy we literally got down to hands and knees; took an enormous amount of post-its and a giant sheet of paper and we started structuring EmoBuddy's functionality (*Picture 1*). We identified two main functionalities; social functionality and awareness functionality. *Appendix C* contains an overview of functions and requirements.

Social functionality concerns all functionality that involves buddies (CMC). The objective of this functionality is to actively induce social support. As been said before we aim to persuade contact by facilitating empathy. This is achieved by exposing buddies to each other's emotional intense moments. In the interface design we can anticipate on how the contact is supported by EmoBuddy leading to the following question as an important driver in redesign: '*how do we support the contact between buddies?*'

In answer to this question we introduced a scale of coerciveness concerning *directing attention* and *directing action*. Accordingly the presence of the application can range from low attendance to quite pushy. The same goes for directing action: if we want to force the user to act, we can take coercive measures (e.g., locking a computer) until the user invites his/her buddy or we can leave the initiation of contact free to decide for the user. The optimal presence of EmoBuddy will be individually different as stress-coping is dependent on individual characteristics (personality and demographics) [Thong & Yap, 2000]. We chose to set the optimum according different personality types based on theories of Vollrath and Torgersen [2000] discussed in Chapter 3. Demographics are far more difficult to take into account, because they are much more diverse. We chose to solely focus on different personality types in customizing the social functionality.



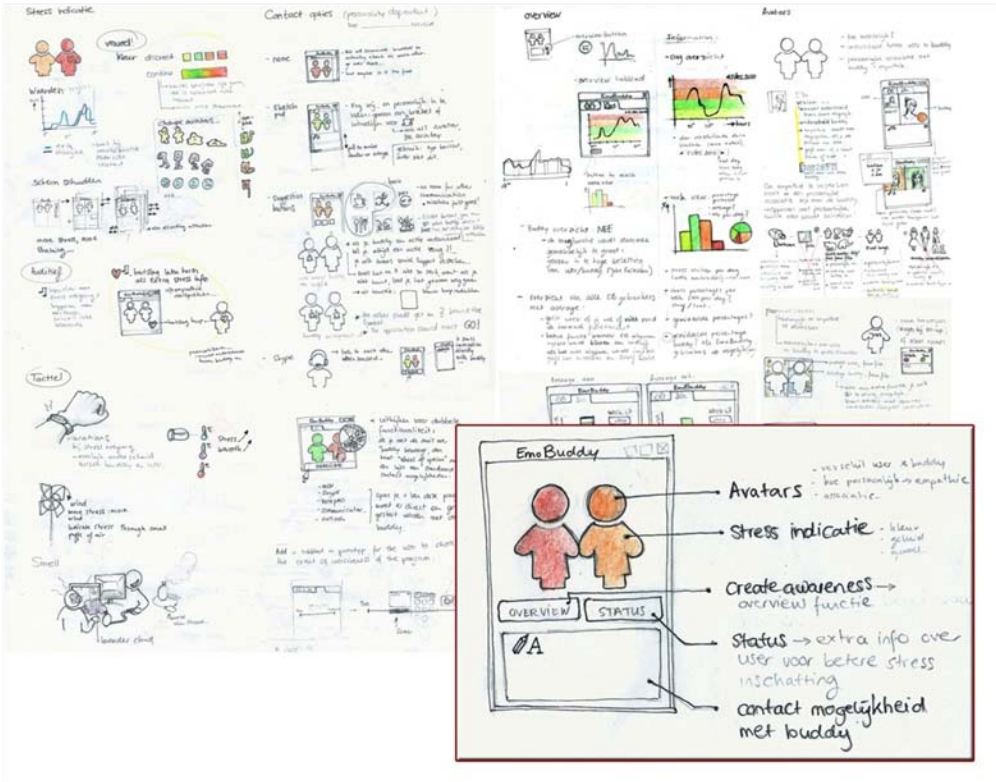
4.1 Function deliberation post-it feast.

Awareness functionality concerns the individual route in changing stress coping; concerning human-computer interaction instead of CMC. We expect that by learning about ones stress behavior users to greater or lesser extent will be enabled to positively influence their stress coping (with a deeper understanding of one's own mechanisms, one can maybe choose to avoid certain situations etc.). This functionality is submissively adjacent to social functionality: the user is not only exposed to his buddy's stress level but receives continuous feedback on his own.

As the interviews point out this functionality should be more prominently present. A function that could be added is to give the user insight in his stress development (e.g. present him overviews over certain amount of time).

4.1.3 EmoBuddy components

The Interview provided helpful guidelines in redesigning the prototype and the function deliberation concluded in a plea to carefully balance coerciveness (to what extent a user action is forced) and attention direction (the presence of EmoBuddy) based on personality traits. The following paragraphs address implementation, the interface components (avatars, stress indication, create awareness, contact possibilities and status, *Picture 4.2*) and application behavior as a proposition for redesigning the prototype.



4.2 Overview interface components

4.1.4 Implementation

Implementation has been discussed extensively in the interviews. As we strongly value these opinions we will adopt them in the social context design. In brief: EmoBuddy should be implemented on a voluntary basis. In line with this we want buddy's to be chosen, because the relationship that exists between buddies needs to be positive and already established.

We hope EmoBuddy is used neither from a serious request for help nor as a mere 'fun application' but something in between. It is very important that it is obvious to its users that EmoBuddy can't be a replacement for professional healthcare, even more so to protect the buddy from emotional burden.

4.1.5 Avatars

Avatars are a representation of both user and his/her buddy. The avatars carry the stress indication by color deducted from GSR. In analyzing the avatars for redesign one question was central:

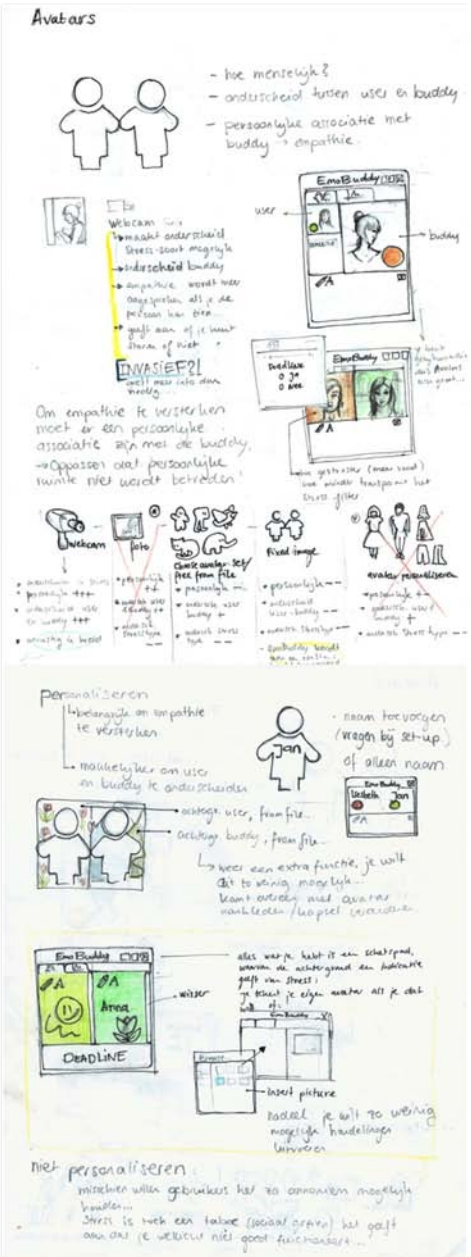
How much should an avatar resemble an actual, specific person?

A high level of identification reinforces empathy [De Waal, 2009, p.110] which is expected to be a catalyst in inducing social support. Opposite anonymity is also desired. Stress is socially a sensitive issue, as it is often described as a weakness. It is well imaginable that knowledge on a person's stress level could place this person in an unfair bargaining position regarding (e.g., task division). Translating this to avatar design there is a trade off to be made (*Picture 4.3*): from one extreme to the other avatars could be simple geometric shapes (e.g. circle) or we could use a webcam to represent the user and his/her buddy. On this scale we identified:

- Webcam
- Photograph
- Browse an image or choose an avatar from a pre-programmed set
- Personalizing a fixed shape (e.g., choosing clothing, or hairdo)
- (Fixed) human shape
- (Fixed) geometric shape

Factors that were used in finding an optimum on this scale are: (1) level of identification with user/ buddy, (2) how distracting (restlessness of the image) the image is, (3) if it can hold extra information on stress, (4) whether it distinguishes user form buddy.

Using a webcam offers many benefits: e.g. it reinforces empathy, offers extra information on stress and it shows for instance whether interrupting is appropriate. But all of these pros are countered with the fact that it is a very invasive method. We consider it too invasive.



4.3 Avatars

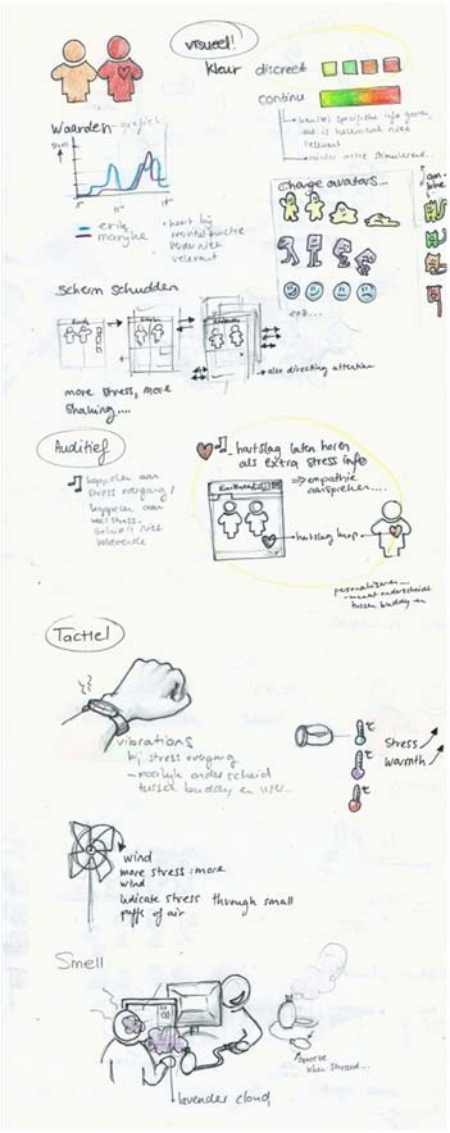
A photograph shares the same benefits as a webcam, except for that it offers no extra information on stress. But it also shares the disadvantages. It could put the user at unease, for the chances of EmoBuddy disclosing too much personal information to passersby are rather large.

Browsing an image seems an option that closes in on an optimum. The drawback is that it possibly results in a busy image while stress level information should be transmissible in a mere glance. Thus in the redesign we intended to keep the simple human shapes, but to transform it in a sketch pad. If the mouse pointer is placed inside the avatar contours, it changes in a one pixel black pencil tool. The user can only change his/her avatar, the changes he/she makes are also presented to both user and buddy. In this way the user can give a personal touch if desired and therefore decides the level of anonymity for him/her self.

4.1.6 Stress indication

Stress indication is offered according the DTI. EmoBuddy identifies four stress levels displayed by four different colors (*Picture 4.4*). In assessing this component we identified several ways to identify stress besides color, for example numeric values, avatar posture, tactile (vibration or warmth), audio, etc.

Especially adding audio, in the sense of adding a heartbeat sound, was considered worth implementing. The idea sprouted from research on the effect of heartbeat on personal space by Janssen and colleagues [2010]. This research showed that being exposed to a heartbeat of a random person generally increases personal distance that is experienced as comfortable. By giving the user the opportunity to hear his/her buddy's heartbeat the connection between possibly intensifies and hopefully stimulates empathy. Side benefits are that the avatars would remain anonymous for bystanders, but become very personal between the two connected people. However, this providing heartbeat sounds can be considered very invasive. Besides the experiment shows that by increasing intimacy by one modality (heartbeat sound), the other modality must (personal distance) make up this difference. We, therefore, chose to not implement a



4.4 Stress indication

heartbeat sound and deemed color the most appropriate way to indicate stress.

We will keep discrete color coding of stress levels opposite to continuous stress levels. The discrete levels are more likely to stimulate action than the stress level changing according a gradient; besides a gradient probably holds more nuanced information than is relevant according the measurements.

4.1.7 Create Awareness

EmoBuddy intends to reduce and prevent stress in two ways: by inducing social support and secondly to create awareness on stress. In the light of creating awareness the prototype gives the user real-time feedback on his/her stress level through which we expect he/she shall become more aware of his/her stress behavior. The interviews indicated a wish to expand this functionality.

In this assessment we explored how we could extend this functionality by offering a data overview (*Picture 4.5*). We intended to add another tab to the EmoBuddy application providing overview graphs: 1 week graph and a day graph. The week graph presents the percentage of samples of each separate color, with the possibility to show an average. The day graph presents the stress levels across the day. It would be possible to browse through past days up to 5 days.

4.5 Creating Awareness

4.1.8 Status

EmoBuddy can be an unwelcome disruption from work. As is well imaginable, in some cases of stress it is very undesirable to be disrupted (e.g., in case of an approaching deadline). Besides literature points out that stress is not always a negative thing but can also function as performance enhancement. [Wickens & Hollands, 20001, p. 485]. Therefore we decided there must be a way to avoid the risk of EmoBuddy interrupting work while someone wishes not to be disrupted. However, we don't want to discourage contact and actively disable contact between buddies. EmoBuddy is designed to

interrupt a person from his work to renew (mental) energy or vent so he/she can proceed with a lighter mind. Therefore we don't want to send out the message to the buddy to 'not interact'. We always want to stimulate this behavior.

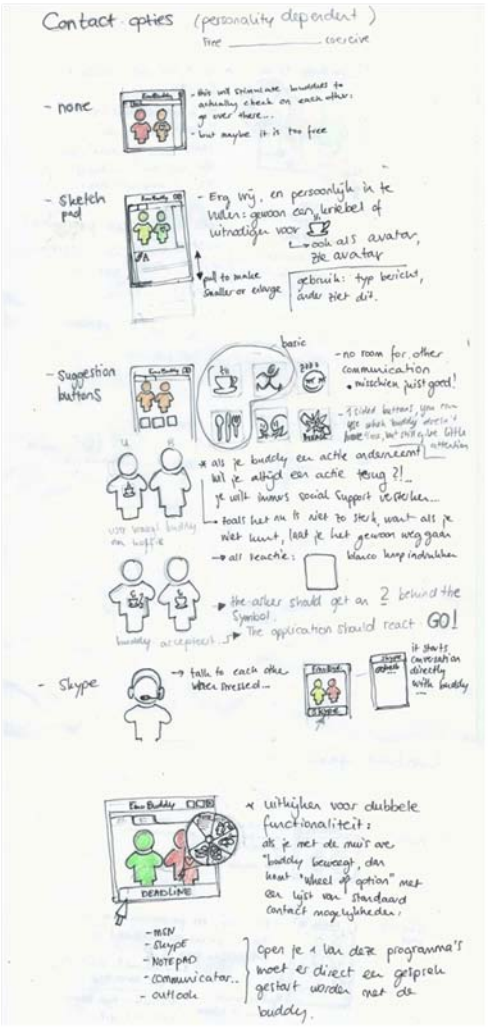
The balance is delicate: EmoBuddy is meant to disrupt in case of stress, only we recognize that to a certain extent stress can also be a positive thing as it is known to enhance performance. A status indication should be able to give extra information on desirable program behavior. The solution was found in implementing a deadline button. This toggle button can be used in case the user is very busy (e.g., in case of a deadline). The behavior of EmoBuddy will tone down: he/she will not receive an alarm when his/her buddy turns red or when he/she himself/ herself turns red. Besides his/her buddy will not receive an alarm when the user turns red. While all contact possibilities will remain fully functioning. It the deadline button is on, this is not visible for the buddy.

4.1.9 Contact Options

In line with the idea to customize program behavior based on the user's personality traits, the behavior should differentiate in such a way that it changes on the scale of coerciveness (from free to coercive). Effectively, this means that the program behavior should be customized on directing action and directing attention in a more or less obtrusive way. This paragraph will discuss the consequences for contact possibilities.

We chose 2 different contact options and 4 different ways of implementing these (according personality type) ranging from very free to more coercive. The implementation of contact option will be discussed in paragraph 4.2.7.

The first contact option is a sketch pad with an option to type a message and have a conversation. This offers a very free way for the user to express him/her self. He/she can choose to send an invitation or just draw a smiley to keep spirits high. The second option is invitation buttons. This functionality remains from the primary prototype consisting of three contact buttons: '*coffee*'-button, a '*go for a walk*'-button and '*lunch*'-



4.6 Contact possibilities

button. In addition to these buttons a second and third set of buttons will be used that appear at set moments if the application is set to more coercive behavior.

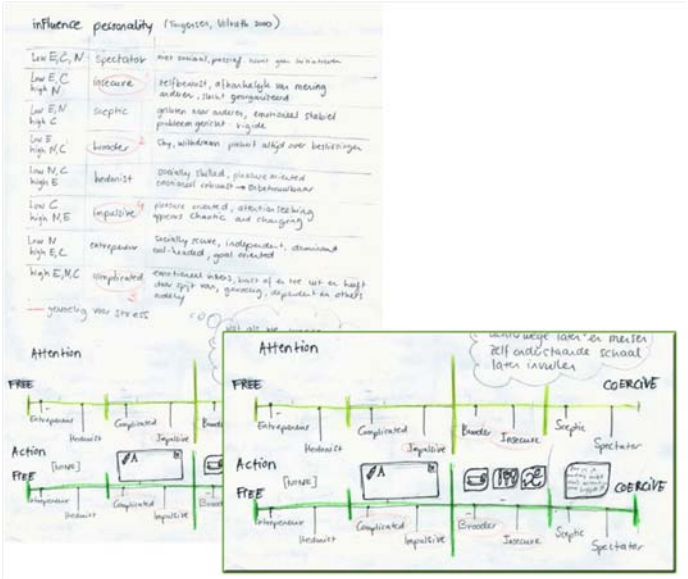
To invite a buddy simply press the button containing the icon of the desired activity. The icon will then appear on both user ends in the belly of the inviting avatar. An invitation can be answered by pressing the button with the same activity. If an appointment is made, EmoBuddy shows an animation encouraging the buddies to go.

4.1.10 Program behavior

Customization prototype

As introduced we aim to differentiate the application behavior according to personality based on theories of Torgensen and Volrath [2000]. They indicate 8 different personality types based on three traits (N,E and C) resulting from the Big Five Inventory (see § 3.5). Literature points out that N, C and E three traits are indicative for stress coping preference. We used these personality traits to identify the optimum on a scale of coerciveness on directing attention and directing action.

We abided three rules: (1) Emotional instability makes a person more susceptible for stress. Emotional instability to some extent holds unpredictability in how a person reacts to (similar) situations. Therefore slight compellingness is desired while keeping some degree of freedom. (2) Extravert people need less convincing to disclose to others. They will accept EmoBuddy more easily. People who score low on extraversion need more coercive measures to engage in personal contact. (3) People who score high on conscientiousness are very orderly and often problem oriented; they tend to approach stress more systematically. We expect this group needs less convincing to deal with stress and are more likely to act on their own account. These rules lead to the following classification (*Picture 4.7*)



4.7 Personality types classification

This classification is leading in how to implement the contact options. Implementing the contact options we only include two most important traits in this context; N and E. While discussing the contact possibilities we introduced there were four ways of implementing the 2 options:

- We expect the entrepreneur and hedonist to be well capable of handling stress, and appreciate to be free in deciding how they want to use the information EmoBuddy offers. Therefore this group doesn't feature specific contact options.
- The complicated and insecure type will generally likely benefit more from EmoBuddy as they are more susceptible to stress, like the brooder and insecure type. The complicated and impulsive types are more extravert and we expect them to need higher degree of freedom thus we offer these groups a sketchpad which can be used for both drawing and writing.
- The brooder and insecure group will be offered buttons with action suggestions, like the old prototype.
- The latter group, skeptic and spectator types we expect need most compelling measures to engage in contact. The interface features buttons, but when a buddy turns red the application does a specific suggestion (e.g., '*do you want to invite your buddy for coffee*?')

Traits can be identified through a Big Five Inventory (BFI). There are numerous variants mainly differing in the amount of items ranging from 10 to over a 100 items. Since we do not want to burden the user with endless lists of questions we selected the ultimately compact 10 item variant (BFI-10). A research which compared the well established and validated BFI-44 to the 10 item variant concluded that: reducing the items of the BFI-44 to less than a fourth yielded effect sizes that were lower than those for the full BFI-44 but still sufficient for research settings with truly limited time constraints [Rammstedt & John, 2007, p.203]. Users are asked during setup of the program to once fill out this test, so the EmoBuddy interface can be set accordingly.

Directing attention and action

The application will alert user and buddy when the stress level rises to the fourth state (red). EmoBuddy will pop up and set itself on top in the downright corner of the screen. According the classification a user is increasingly (severely) hindered in his/her computer work until he/she contacts his/her buddy. Conscientiousness will be taken into account as a time factor; a high score on conscientiousness will result in less coercive behavior to persuade contact. For the full behavior flow diagram consult *Appendix D* (Prototype; under 'action – attention' path).

There are two different possibilities: (1) the user turns red and (2) his/her buddy turns red. These are considered separate events; an event can occur with a maximum of once per 30 min. In contrary to when the user turns red, if the buddy reaches the fourth state the application will show increasingly coercive behavior to induce contact.

The interface starts in the variant based on the user's personality. When his/her buddy turns red and he/she does not react to this event. The interface will increase 1 step on the scale of coerciveness. For example if you are an impulsive type, and you fail to contact your buddy after multiple alerts you will eventually reach the skeptic state in which EmoBuddy will propose a specific action (e.g., invite buddy for a walk). If the user reacts to his/her buddy's state, the interface will be reset to its natural position (*Picture 4.8*).

4.2 Prototype Development

We designed the prototype according the given design propositions. The existing prototype used a combination of flash (front end) and java (back end). We decided to exclude flash and develop the prototype fully with java. We would have to change the behavior of the application so dramatically that apart from the communication protocol (server-client) we chose to start from scratch. Unfortunately this turned out to be far more complicated and time consuming than expected. It proved impossible to finish the prototype in time for the user test. Therefore we switched to plan B and had to severely cut the design propositions. We enhanced the existing prototype and implemented the most important recommendation deducted from the expert interviews. *Picture 4.8 -4.11* show the EmoBuddy prototype.

These are the changes we made:

- We excluded the customization based on personality.
- A maximum was introduced to the amount of alarms. When either buddy or the user turns red EmoBuddy alarms the user by popping up and setting the application on top of other programs that are in use. Buddy turning red and user turning red are considered separate events and an event can occur max once every 30 minutes.
- The contact buttons remained intact but were extended with a texting function. In this way users are not solely bound to face to face contact via EmoBuddy but can chose for instance to send an uplifting message when too busy to meet in person. Inviting a buddy and answering an invite remained the same.

- Instead of an overview tab, we introduced an overview button; giving access to an overview of the user's stress level across the day.
- A deadline button is inserted according the propositions made in paragraph 4.2.5

4.8 EmoBuddy application: normal presence

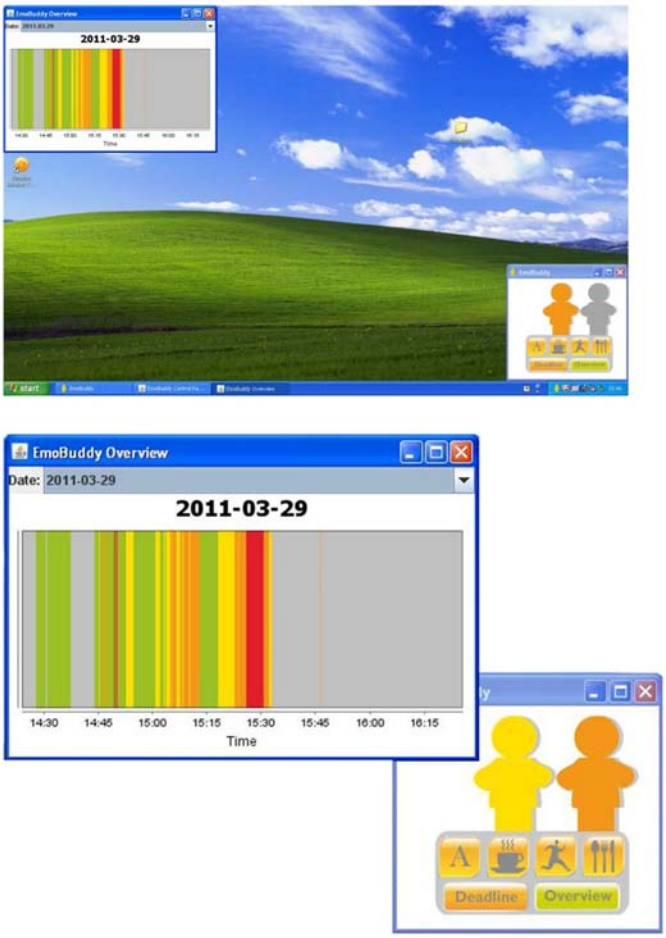
To test this prototype we conducted a pilot with two couples. The pilot resulted in some last minor changes in the prototype:

- The colors indicating different stress level heights were changed. 3 out of the 4 subjects ought the order of these colors illogical. They expected the light green to be the second level in between dark green and orange instead of the first level, because light green tends towards yellow. Upon these results we conducted a small test in which we asked ten people independently what color range they thought was logical to indicate an increasing stress level. We offered them 5 choices. According to the outcome of this test we changed the color range to (dark) green, yellow, orange and red (*Picture 4.12*).
- The subjects also indicated some ambiguity in inviting a buddy as they expected that the icon would appear in the belly of the avatar who was invited instead of the avatar who was the inviter. To clarify we introduced a question mark: if a user invites his/her buddy the activity icon and a question mark appear in the avatar of the inviter.

4.9 Color distribution stress indication

4.10 EmoBuddy application: invite and accept

4.11 EmoBuddy application: sending and receiving a text message



4.12 EmoBuddy application: overview

5 | User Test

We immersed in *How to embed empathy as a behavior inducing phenomenon successfully into EmoBuddy regarding individual characteristics.* With enhancing the prototype we ended the first phase of this project. The second part regards executing a large-scale user test. This chapter will involve both the set-up (§5.1) and analysis (§5.2).

5.1 User test design

Reverting to the research questions an extensive user test was designed: the first research question finds an answer in this chapter.

How can the mechanism of social control be deployed through EmoBuddy as a mechanism to guide the employees in their stress management and increase social support in the work place?

This research question was approached from the following sub questions serving as the test objective:

- *Can deployment of social control through Computer Mediated Communication (CMC) actively induce desirable behavior?*
- *Does EmoBuddy facilitate empathy and induce social support when stress has built up?*
- *What conditions need to be satisfied to fulfill the above?*

We will summarize the user test setup addressing participant criteria, procedure and data collection.

5.1.1 Participants

We selected participants on four criteria: profession, buddy relationship, gender and SC level. EmoBuddy is intended for employees. More specific: knowledge work employees in western countries, accordingly we approached Philips Research employees to participate.

Secondly participants needed to join as couples, so called *buddies*. We demanded the relationship between buddies to be positive and already established. Therefore we asked participants who already agreed into participating to indicate an appropriate buddy.

Gender was also a factor in composing the couples to determine whether it influences EmoBuddy functioning. Consequently we tried to find an equal number of same-sex (male and female) couples and mixed couples.

Last criterion is SC level; for EmoBuddy to function as intended the GSR must be higher than the threshold value .015*mS*. Therefore the SC level was sampled in advance.

- 36 participants completed the test with an average age of 32.5 (*stand. dev.*8.5) among which 19 females and 17 males.

5.1.2 Procedure

The aim was to test 20 couples. With hardware being the limiting factor, 5 couples could participate at the same time. Before starting the actual user test, we ran a pilot study with four participants to test the experiment and implement final changes.

The user test took five workdays to complete. Participants were asked to use EmoBuddy during four full work days. We considered this as an optimum between minimizing novelty aspects and invasiveness on the participants. The fifth day was reserved for logistics. In the first place to gather material and collect data from couples who finished he test. Secondly to hand out EmoBuddy material to new couples and give a 30 minute introduction on the test. The user test took place in their own workspace so the participants could, and were encouraged to proceed with all of their planned activities. After the

introduction the participants were asked to sign a consent form and fill out a one-time questionnaire mainly on demographic data.

The actual test would start the next day. Subjects were asked every day for four days as they arrived at work to fill out a start-up questionnaire and start up EmoBuddy as was explained during the introduction. Next they could start their normal work day. When participants were ready to go home they were asked to close down EmoBuddy according to the manual and fill out the daily questionnaire. In the week after using EmoBuddy subjects were invited to an individual, 30 minute interview. The test materials (handout booklet, questionnaires, and interview) are provided in *Appendix E*.

5.1.3 Data Collection

Data was gathered in three ways; an EmoBuddy log was kept recording user data (e.g. number of button presses, session duration, sample distribution over the 4 stress levels, etc.); as mentioned via several questionnaires; and a 30 minute interview. A complete list of variables can be found in *Appendix F*.

Among the questionnaire we used two validated tests: 21 item Depression Anxiety Stress Scales (DASS-21) [Lovibond & Lovibond, 1995] and the 44 item Big Five Inventory (BFI-44). To map personality traits the BFI-44 was chosen as most suitable [John & Srivastatava, 1999]. This test provides an indication on each of the five trait scales (neuroticism, extraversion, conscientiousness, openness and agreeableness). The DASS-21 was selected to indicate the subjects subjective stress level as a comparative measure for the EmoBuddy algorithm. In the first place it was selected for its compactness. Although the original DASS consists of 42 items and is developed as a clinical inquiry, research validated the 21 item variant [Szabo, 2010] and literature promises it has been elaborately tested and validated in relation to occupational stress [Nieuwenhuijsen et al., 2003].

5.1.4 Data loss

36 participants completed the test; 18 buddy pairs. We lost one couple due to one of the participants suffering from nickel allergy; the sensors are nickel coated and cause a serious rash. The other couple aborted the test for no obvious reasons and unfortunately without informing us.

Out of the 18 couples who completed the test, two couples were composed of students due to difficulty finding enough employees. Two of these students were soon to be employed PhD students at Philips Research.

The main source however of data loss was malfunctioning hardware. Almost all wristbands showed signs of a short circuit once and some even twice over the four weeks of testing. This was by all means an unexpected problem especially to occur on such a large scale. Before handing out the wristbands

they were checked and repaired when necessary. Unfortunately participants didn't recognize the signal behavior of a malfunctioning wristband. Consequently they often completed the test with a defect wristband, unless we could intercept a defect wristband during a check-up.

A total of 10 participants completed the test with a malfunctioning wristband. Another 4 participants suffered from an invalid signal due to other reasons (low SC level, mall fitting and misuse). Leaving 22 participants with a valid signal and 6 couples in which both subject's had a valid signal. We do have subjective (questionnaires and interview) data of the 36 participants.

5.1.5 Process

The user test we designed is very extensive at quite an early product stage. Some may argue (e.g. based on data loss) that it was too premature to conduct such an extensive test. But it fully suited our intention to exhaustively explore the EmoBuddy concept in all its facets.

We knew we took a risk to suffer more data loss than usually is acceptable. Mainly because the test took place in full context; consequently we were depending on many variables and we had hardly any control over the environment. In addition, social and technological functionality are firmly interwoven and hard to unravel with a test that has such a broad scope (e.g. the noise on the algorithm performance functioned for some subject's as a buffer on personal space).

Unfortunately we did suffer a lot of data loss (objective data). This will affect the possibility to generalize results. But we deem it acceptable as we received a very broad understanding of EmoBuddy as a product. Besides, the test revealed a clear future path for both testing and (re)design.

In retrospect the main restriction that adversely influenced the test was time. Either testing fewer couples over a longer period of time or deploying more man-hours, would have benefitted the test results.

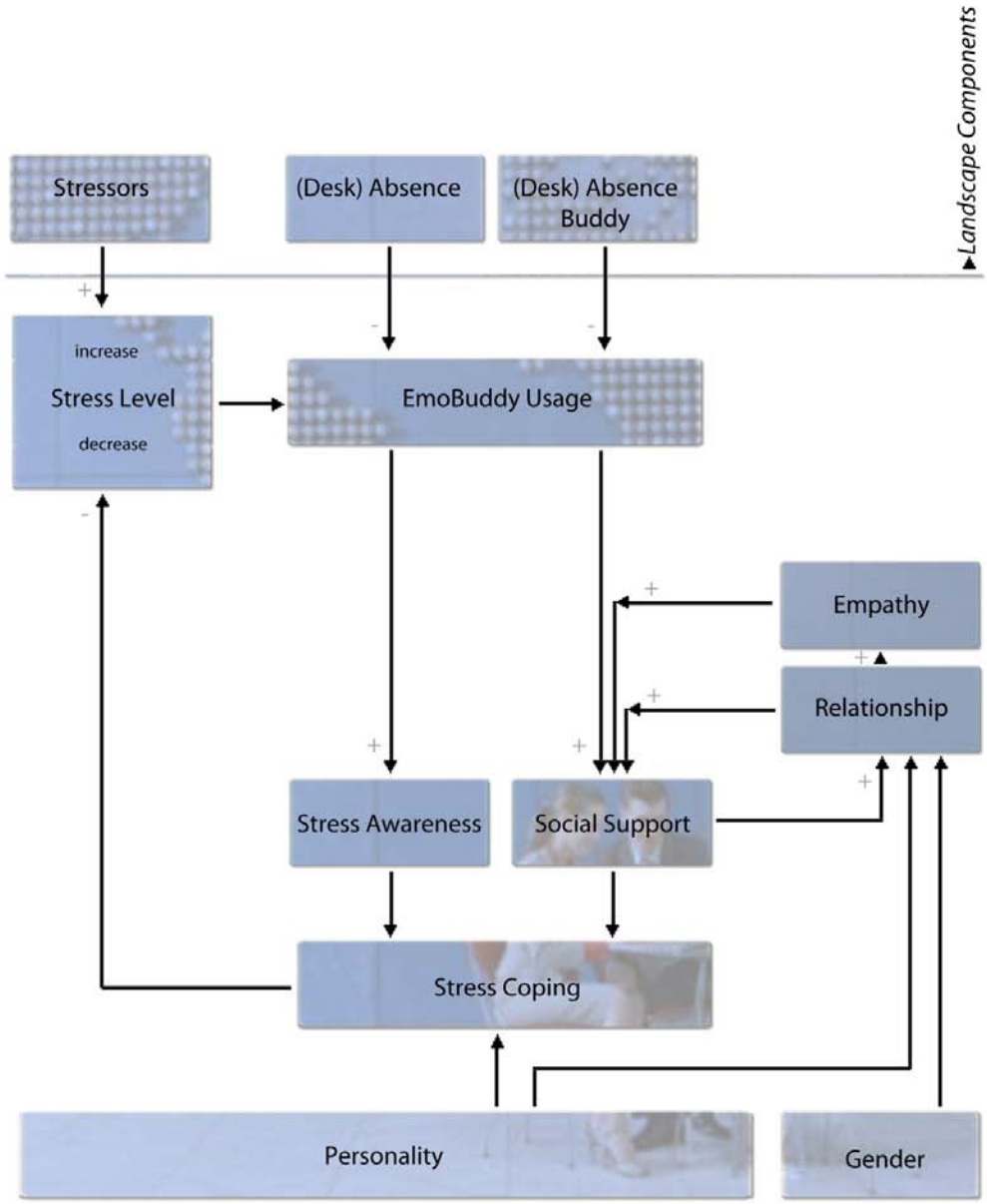
5.2 Test analysis

The next step is to analyze the data. The results are organized as followed: a model of dependencies is presented (§ 5.4.2.1) and explained. Paragraph 5.4.2.2 contains the actual analyses results validating the hypotheses following from the dependencies model.

5.2.1 Dependencies

To gain insight in EmoBuddy's performance dependencies between sub factors have been mapped and structured as a flow diagram (*Picture 5.1*). We do not presume this diagram to be a complete and irrefutable model of EmoBuddy's functioning. We rather see it as a tool to gain more understanding in EmoBuddy's subcomponents and how they relate to each other; as well as a

tool to structurally test EmoBuddy's performance.



5.1 EmoBuddy's performance: Dependencies model

The diagram shows both awareness and social functionality. These will be addressed as we will go through the chart to indicate expectancies that are translated to hypotheses. Starting on the upper left:

Stress Level represents (a subjective or objective measure of) the users stress. His/her stress level is expected to increase as the amount or severity of stressors increase (e.g. resource deficiency, pressure to perform, low job control). Stressors are considered as landscape variables and are not mapped. Stress Level variables are:

- DASS score on stress[14]
- Daily stress indication (7 Likert)
- Interview questions (4) (see algorithm performance)
- GSR sample distribution over four levels; green/ yellow/ orange/ red

Consistency within these variables, between subjective and objective measures, can be expected (1, 2).

Following the diagram to the right, it can be considered a fact that the stress level influences **EmoBuddy Usage**; a higher stress level correlates to more EmoBuddy usage. This is inherent to the behavior of the application; if either the user or his/her buddy turns red EmoBuddy pops up and forces itself on top. On the other hand EmoBuddy usage is dependent on (desk) absence of both user and buddy. Desk absence can't be controlled and is like stressors considered a landscape variable. Variables concerning EmoBuddy usage are:

- Number of GSR samples
- Coverage duration; percentage of samples user coming in over total duration EmoBuddy sessions
- Coverage both; percentage of samples user coming in over total duration EmoBuddy, while also samples buddy are coming in
- Overview button presses

If we follow the first downward arrow we will reach **Stress Awareness**; containing information on the user's awareness on his/her stress. We expect this arrow to describe a positive relation (3). The more time the user spends behind his desktop, the more he/she is confronted with real time feedback of his/her stress level. Also frequent usage of the overview functionality is indicative of a positive relation between usage and creating awareness. Variables on stress awareness:

- Interview questions (5) (see: stress awareness)

Further down we find **Stress Coping** to be influenced by stress awareness. Stress coping describes how the user reacts to and copes with stress. Apart

[14] Only the stress component of DASS-21 test is interpreted, concerning 7 questions on a 3 point Likert scale resulting in a maximum of 42 points. The outcome is doubled; the original test consists of 42 items. Rating: 0-14 Normal/ 15-18 Mild/ 19- 25 Moderate/ 26-33 Severe/ 34+ Extremely Severe. The severity labels are used to describe the full range of scores in the population, so 'mild' for example means that the person is above the population mean but probably still way below the typical severity of someone seeking help (i.e. it does not mean a mild level of disorder).

from personality traits obtained with a BFI-44 there is no specific information on stress coping and whether coping changes due to EmoBuddy usage. However based on literature research we do expect that increasing awareness on stress behavior leads to enhancement of stress coping (4).

To fulfill the circle, enhanced stress coping supposedly leads to stress reduction (5). Contradictive, we do not expect to find this in the test results (e.g., a downward trend in any of the four stress level variables). The user test lasted four work days, which is too short to find any reliable correlation. Literature however supports these expectations.

The right half of the diagram concerns the more complicated social functionality. The second downward arrow from EmoBuddy usage leads to **Social Support**: representing contact between buddies via EmoBuddy. More usage is expected to lead to more contact between buddies (6). Variables concerning social support are:

- Number of EmoBuddy dates per day (subjective and objective)
- Number of EmoBuddy invites
- Messaging: number of conversation starts
- Number of daily contact moment apart from EmoBuddy
- Before/ after contact indication
- Interview questions (2) (see: contact)

Furthermore based on literature and Johnson and Hall's (1988) stress JCDS model it is expected that social support influence stress coping in a positive manner (8) and therefore reduces and prevents stress (5).

Social support is influenced by two very important factors in the social functionality of EmoBuddy: **Empathy**, and **Relationship Intimacy**.

In this context empathy contains whether the user experiences emotional empathy towards his/her buddy. Empathy functions as a catalyst for inducing social support (9); if the user sympathizes with the person on the other end of the application he/she is more likely to engage in contact. Variables concerning empathy are:

- Interview questions (5) (see: empathy)

Secondly relationship intimacy is expected to positively influence social support; the more intimate a relationship, the more contact between buddies there will be and vice versa (10, 11). This means that we expect EmoBuddy will induce a more intimate relationship between buddies (12). For what is more it is also expected that the level of intimacy influences the presence of empathy (13): if buddies keep an intimate relationship it is more likely they will sympathize with each other. Variables concerning relationship intimacy are:

- Before/ after test on how personal their work relationship is on a 10 point scale
- Interview questions (8) (see: relationship)

The last two factors to be mentioned that influence EmoBuddy's performance are **Gender** and **Personality**. Literature predisposes both gender and personality has an effect on the route to intimacy [Mashek & Aron, 2004]. Besides, personality is a known factor in stress coping as can be deducted from the third chapter. Therefore we expected different types of EmoBuddy users based on gender (14) and personality (15).

Hypotheses

The dependencies and expectancies are translated in hypotheses:

System performance

(1) EmoBuddy's interpretation is consistent with the subjective measures of stress
(2) The subjective measures of stress are mutually consistent

Awareness functionality

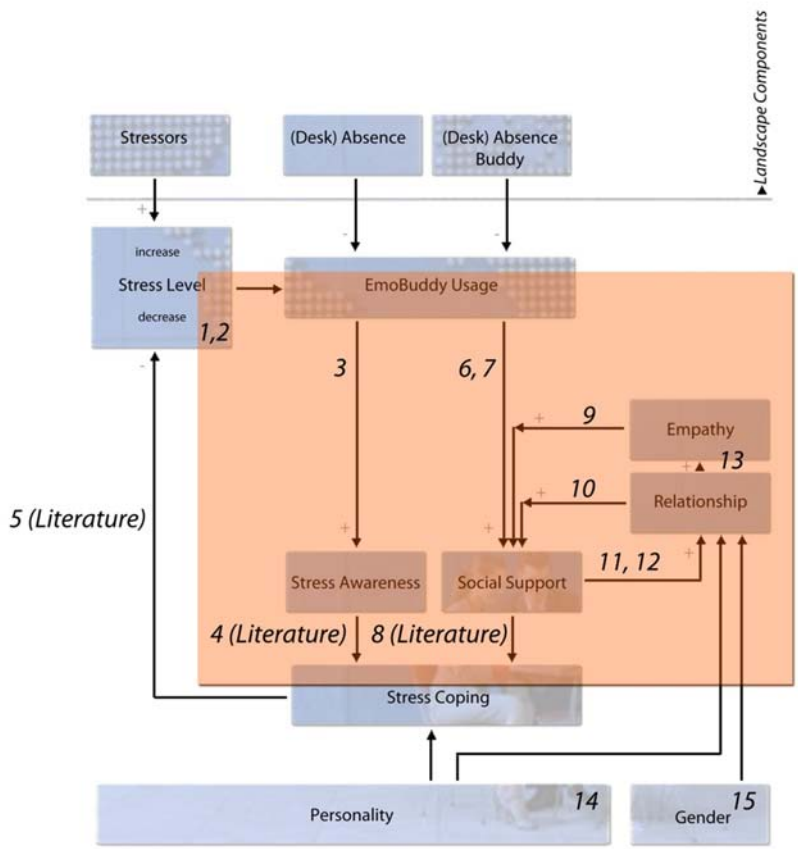
(3) More active EmoBuddy usage increases the user's awareness on stress
(4) Stress awareness enhances stress coping
(5) Stress coping enhancement reduces and prevents stress

Social functionality

(6) More active (mutual) EmoBuddy usage correlates to more contact between buddies via EmoBuddy.
(7) There will be more contact when either of the subjects is more stressed.
(8) Increase in social support will positively change stress coping.
(9) Empathy functions as a catalyst in inducing social support
(10) The more intimate a relationship is between buddies, the more they will engage in contact.
(11) If a couple has more contact their relationship will grow more intimate.
(12) Using EmoBuddy will reflect in a more intimate relationship between user and buddy.
(13) Presence of empathy is an indicator for a higher level of intimacy
(14) Gender reveals two types of EmoBuddy users
(15) Based on personality differences on the scales E, N and C, there are different types of EmoBuddy users.

5.2.2 Statistical Analyses

To validate this model of EmoBuddy's performance the hypotheses are tested. We performed statistical analysis methods (MANOVA and correlations). *Picture 5.2* shows a variant of the diagram in which the hypotheses are included. The orange area indicates the scope of the user test (1, 2, 3, 6, 8, 9, 11, 11 and 12). Hypotheses 4, 5 and 9 fall outside the scope of the user test and are solely supported by literature mainly discussed in Chapter 3.



5.2 EmoBuddy's performance: user test scope

We will briefly discuss these latter hypotheses first. EmoBuddy aims to reduce and prevent stress via encouraging social support and creating awareness. However the user test can't validate this, only whether or not users feel more awareness on stress and whether or not there is more social support. Again, Chapter 3 offers literature background. There is general endorsement on the fact that a person is not exclusively bound to one coping strategy, but can apply different strategies by choice to handle stressful situations (§ 3.3). This choice is affected by individual characteristics such as personality, but is nevertheless a choice. Awareness on stress behavior enables a person to choose more aware (4).

Furthermore, paragraph 3.3 and 3.6 consult work on social support relevant to the ninth hypothesis. Social support is indicated in itself as a positive coping mechanism which stimulates problem-solving and cognitive reconstruction (the other positive coping strategies) (8). Positive coping strategies may lead workers to find tangible solutions to stressful workplace problems or to view stressful situations more positive (5) [Welbourne et al., 200, p.316].

We will now proceed to the actual statistical analyses to test the hypotheses in the orange area. Correlations are considered significant if $p \leq .05$, and a trend if $p \leq .1$ higher values for p are considered not significant.

Before addressing the hypotheses we first performed a set of *t*-test to find what variables are influenced by invalid data (e.g. due to malfunctioning wristband). We found three variables to be significant: namely whether or not the subject could recognize EmoBuddy's interpretation to be stress related ($t(33) = -2.063$, $p=.047$, N33); the trust in the signal ($t(30)=-2.744$, $p=.010$, N33); and whether or not the participant felt more stress aware due to EmoBuddy ($t(33)=-2.063$, $p=.047$).

Hypothesis (1) EmoBuddy's interpretation is consistent with the subjective measures of stress
Hypothesis (2) The subjective measure of stress are mutually consistent
To test the first hypothesis the group of participants with a valid signal was selected (N22). Against expectations, there were no correlation found between the percentage of red samples, representing an objective measure of stress and subjective measures of stress (DASS-21, daily stress indication and an indication of how busy a subject's work week was). Implicating the algorithm is not a reliable indicator of the subject's stress level.

Whereas the subjective measures of stress do show consistency. Testing the DASS reliability shows a correlation to both the daily stress indication ($r=.367$, $p=.027$, N36) and to the indication how busy a subject's work week was ($r=.391$, $p=.018$, N36). Meaning we can trust the DASS to be a reliable measure for the stress level (Annex B shows SPSS output on the hypotheses).

In contrary to the results above 68% of the participants (N22) indicated during the interview they could relate EmoBuddy's interpretation to stress. However the recognition refers back to very specific moments in time (e.g., talking about upcoming fatherhood or boss stepping in to the office). Subjects also indicated that they recognized these moments an intense moments rather than stressful moments. An explanation to these results is that EmoBuddy represents acute stress or rather emotional intense moments, and does not represent an overall stress level.

Still on these grounds we could expect a correlation between subjective measures and the algorithm since it is a known effect that if a person is suffering from prolonged stress he/she will react more extreme to stressors. However this is a small effect and due to for instance artifacts on the measurement this effect is likely not to be observable. Besides, interpreting these results we must bear in mind that there was only little evidence of stress among the subjects. This could be harmful in judging the algorithm performance.

Hypothesis (3) More use of Emobuddy overview increases the user's awareness on stress

The third hypothesis is supported by the user test as a significant correlation was found between the number of times subject's used the overview (# overview button presses) and the number of interview questions (out of 4) concerning stress awareness they answered positively during the interview (r=.466, p=.011, N29). Moreover 58% of the participants indicated to feel more stress aware.

Subjects who used the overview actively also tried to relate this graph to their activities during the day (r=.687 p=.001, N36). This behavior supposedly leads to a greater understanding of stress coping and ultimately enables a person to enhance his/her choice of a coping strategy to handle stressful situations.

Hypothesis (6) More active (mutual) EmoBuddy usage correlates to more contact between buddies

Hypothesis (7) There will be more contact when either the user of buddy is more stressed

We tested hypothesis 6 and found a correlation as expected between the amount of samples recorded and the amount of contact (r=.556, p=.001, N31) (contact being the cumulative amount of (neglected) invitations, dates and texting conversations). The correlation stands as well for the separate contact components and also hold if we take in to account the time both buddies are active (r=.594, p=.005, N21).

Through a t-test we can support that participants indicate in the before/ after test to have more contact during than before using EmoBuddy. This test shows an average increase of one meeting each per workday. (before: *mean*.38 ~ *stand. dev.(*2.372), after: *mean*9.06, *stand. dev.*(3.63)). These results do not at all match to the user data extracted from the log where we found an average of 1.556 dates via EmoBuddy over 4 days with a standard deviation of 1.65. Of course it is very possible buddies met due to EmoBuddy but not via EmoBuddy.

The seventh hypothesis is more important as it describes the most prominent objective of EmoBuddy's social functionality; to induce more contact when either the user or his buddy feels stressed. Translated to a test we expect the experiment to show that the higher the DASS score or the more stressful a subject indicated to be, or the more red samples recorded would relate to more invites, dates and messaging conversations.

Respectively we found that the DASS and the daily stress indication do not show any significant correlation to the amount of contact. But that contact is significant for the number of red samples and dates (r=.422, p=.018, N31), also we found a trend for red samples and the number of invites (r=.345, p=.057, N31). On number of conversations however nothing was found.

Combining these results with the tests on hypothesis 1 and 2, we can conclude that contact is maybe not so much induced by actual stress, but by the application's behavior itself. This is not necessarily a bad thing; especially when one bears in mind that there was only little stress recorded. It shows clearly that the objective of the social functionality is supported as we can assume that the illusion of stress induces more contact.

Hypothesis (9) Empathy functions as a catalyst in inducing social support
There is a significant correlation between whether or not people score positively on presence of empathy during the interview and the amount of contact. Executing a one sided ANOVA delivered significance on invites and dates (respectively: F(1.34)= 11.919, p=.002 and F(1.34)= 7.428, p=.010). And a trend on messaging (F1.34)= 3.745, p=.061). Meaning that if empathy is present, there is more contact between buddies.

Hypothesis (10)The more intimate a relation between buddies, the more they engage in contact
Hypothesis (11) If a couple has more contact their relation grows more intimate
The eleventh hypothesis is underlined by the correlations on both invites(r=.465, p=.004, N36) and dates (r=.579, p=.001, N36). The eleventh hypothesis states that having more contact will result in a more personal relationship. This was tested with a Pearson correlation and was also found significant for both invites (r=.406, p=.004, N36) and dates (r=.403, p=.015, N36).

In both cases texting is an exception: no correlations are found. It is starting to become obvious that messaging has another function in contact between buddy and user. An explanation could be that especially when buddies do not have an intimate relationship texting is much more accessible.

Hypothesis (12) Using EmoBuddy will reflect in a more intimate relationship between user and buddy
A paired samples t-test on a before and after indication on how personal the work relation with the participants buddy was, validated this hypothesis (t(35)=-5.089, p=.001).

Hypothesis (13) Presence of empathy is an indicator for a higher level of intimacy
Empathy and intimacy growth do not show any significant correlation (r=.264, p=.119, N36). But what we did find as a confirmation to this hypothesis is that while at the start of the test empathy does not significantly relate to a more personal relationship; after using EmoBuddy for a week we recognize a trend between presence of empathy and how personal the relation between buddies was (r=.290, p=.86, N36). It is not by all means any strong evidence of this

hypothesis to be true, but it reveals there is something to be further investigated.

Hypothesis (14) Gender reveals different types of EmoBuddy users
Although we expected gender to influence EmoBuddy's performance based on literature, apart from the fact that the user test indicated that females feel less obligated to react to their buddy then men, there were no significant correlations found. But to truly investigate this hypothesis the amount of samples was too small.

Hypothesis (15) Based on personality differences on the scale E, N and C, there are different types of EmoBuddy users.
To understand more about the relation between personality and stress coping we consulted Vollrath's and Torgersen's work [2000] (§ 3.5) and expected to find result that are in line with their theories on stress coping and personality. We didn't find eight different user groups according to the eight personality types he described. But we did as expected find a set of trends and significant correlations that are in line with their theories. These results can be important guidelines in future redesign of EmoBuddy concerning for instance target group decisions.

We could point out two types of users based on personality trait extraversion. A significant relation was found between a higher score on extraversion and a preference for social functionality (r=.375, p=.24, N36), opposite to awareness functionality relating negatively to a high score on extraversion (r=-.397, p=.017, N36).

Furthermore people who score high on neuroticism, a measure for emotional (un)stability, expressed they think red is an unacceptable state of being (r=.379, p=.023, N36). In line the data shows a trend on the amount of dates (r=.328, p=.051, N36). Also emotionally less stable subjects expressed contact felt different using EmoBuddy (r=.465, p=.004, N36).

Participants who scored high on conscientiousness tend to feel more responsible towards their buddy (r=.345, p=.040, N36). And felt more aware of their stress using EmoBuddy. Also subjects with a high score on conscientiousness were less eager to actually meet their buddy (r=.-291, p=.085, N36). Important guidelines for future development are drawn here. However, it is important to point out that the amount of samples was too small to come to full understanding of this hypothesis.

5.3 Conclusion

The hypothesis formulated according the EmoBuddy performance model have been tested, and thus we closed in on answering the research questions.

- *Can deployment of social control through Computer Mediated Communication (CMC) actively induce desirable behavior?*

We deployed social control by facilitating empathy, hypothesis 6, 7, 9 and 12 underline that Emobuddy induces more contact between buddies and thus answers the first sub question positively. Besides, by hypothesis 3 we can conclude that using Emobuddy stimulates stress awareness.

The second question remains on more questionable grounds:

- *Does EmoBuddy facilitate empathy and induce social support when stress has built up?*

EmoBuddy does induce more contact and by hypothesis 8 even more contact takes place under the impression that either buddy or user feels stress (when user or buddy is represented red). However we found no proof that the algorithm is a reliable measure for stress, where as the DASS according to this user test is a reliable measure for stress (hypothesis 3). This means that a higher DASS score should relate to more contact, which it did not. Important to not is that there was only very little evidence of stress; meaning this effect is probably not observable. And not less important likely harms the possibility to judge the algorithms performance.

Still, EmoBuddy does seem to induce desirable behavior (inducing social support and creating awareness on stress). But the user test does not deliver any evidence that this actually affects stress coping in a positive way and thereby reduces stress. Hypotheses 4, 5 and 8 are all exclusively based on literature. We must be careful, therefore, to be jumping to conclusions and state EmoBuddy reduces and prevents stress. Further research on these hypothesis is desirable.

The third sub question:

- *What conditions need to be satisfied to fulfill the above?*

The user test showed that there are conditions to be met to satisfy the encouragement of social support and the stimulating of awareness on stress behavior: The following aspects must be carefully considered and optimized:

- Trust in the signal,
- Relationship intimacy between buddies,
- Presence of empathy,

- And functionality according to personality: distinguishing two groups based on extraversion.

In conclusion, in this chapter we presented a rather objective image of the user test results. The following chapter will provide recommendations and a discussion on these results: answering the research question even more thoroughly and more balanced.

6 | Recommendations

The primary goal of this thesis is to understand if and how EmoBuddy can be a guide in stress-management by on the one hand increasing stress awareness and on the other hand by increasing social support. This was assessed by conducting a large scale user test. Arising from the user test results we found a number of keys subjects which can insight in the second research question:

Is the EmoBuddy sustainable, can further investments of time and money be justified?

To reach a verdict on this question this part of the study will discuss and investigate these key subjects. And conclude in both design recommendations and recommendations for future testing. The following paragraphs will address: hardware and algorithm performance, empathy, social functionality and awareness functionality.

6.1 Hardware and algorithm performance

The interview proved that with an average of 5.5 out of 10 the overall trust in the performance of the algorithm is low (N22; participants with a valid signal). It speaks for itself that the value of EmoBuddy is depending on the technology that is underlying EmoBuddy.

These trust issues find root in both hardware malfunctioning and the performance of the algorithm that is often in discrepancy with the participant's stress-experience. These issues must be addressed as a priority in further developing EmoBuddy.

6.1.1 Hardware

Hardware malfunctioning concerns that a number of wristbands suffered from a short circuit, causing he signal to be over 80% invalid. It needs no explanation that participants who were using these wristbands could hardly correlate their stress experience to EmoBuddy's interpretation of their stress level. Less obvious is how this influenced their buddy's experience of the performance of the system (who had a working device). It is most likely this had a negative influence and the form the interview we can deduct it influenced empathy.

The participants also recognized movement artifacts in the signal (e.g., typing or arm movements underlining conversation). Typing constantly changes the pressure of the sensors on the skin, causing the avatar to flicker. On the other hand users recognized physical activity. After engaging in some physical activity (e.g., going out for lunch) Emobuddy would typically indicate a higher stress level, mostly red. Physical activity normally results in a higher conductance due to more sweat production. This raise in GSR is not related to emotion, making the participants doubt the reliability of the signal. Another phenomenon mentioned by participants was a trend throughout the day: the interpretation starting out more green and the end of the day it would overall tend towards red. This was another aspect that subjects recognized and could not relate to stress.

These hardware issues are the first to be improved. A prototype redesign would be appropriate before entering a next testing phase. Besides measurement quality, aspects such as ergonomics, usability should be taken into account in redesign. 62% (N36) indicated that the wristband was uncomfortable to wear and that it was difficult to reload the battery, place the module and to turn it on or off. Also in redesign the allocation of the sensors to the wrist need to be more precise on all size wrists. As the wristband is designed now, people with small wrist have difficulty to get a good signal, because the sensors can't be placed correctly. They should be allocated on the patch of skin were there are the most eccrine sweat glands. Another aspect that

desirably is included in redesign is improving measurement by changing sensor material. Research has been done to this effect and should be held.

Secondly, movement artifacts should be dissected from the interpretation of stress. The GSR modules are already equipped with an x, y, z – accelerometer. Efforts have been made to exclude data where too much movement is recorded. More research on this subject is recommendable.

Eliminating movement is quite a realistic goal that goes well together with an often made remark by the participants during the final interview: making the measurements more mobile (e.g. by integrating a memory cell or investigation of applicability of other communication technologies). Adding mobility means that physical activity can be recognized and compensated for. Another reason for adding mobility is that stressful moments occur maybe even more often outside the office then inside. Adding mobility is not recommended for real time sharing with their buddy, but 33% indicated they would appreciate to be able to contemplate this data later for increasing their stress awareness.

6.1.2 Algorithm performance

Excluding the participants with a bad signal, 68% (N22) indicates to have experienced a correlation with stress. Good news. However as mentioned before this concerns mostly single events of recognition: very specific moments such as *boss stepping into the office*, *receiving a tense email* or *frustration triggered by a slow computer*. Within this group these kinds of moments occurred maybe once and if lucky twice over four days of testing. The participants found it much more difficult to find an overall correlation to their stress experience. They indicated that independently of the movement artifacts they felt there was still a lot of noise and they could often not understand the representation: impairing their trust in the algorithm.

This taps into a more unstable issue that comes down to '*what is actually measured?*' versus '*what do the users expect to be measured?*' The final interview showed there is a discrepancy between both. It is of utter importance that this is solved.

What we measure is the Galvanic Skin Response (GSR), this is a direct measure for arousal [Boucsein, 1992]. As was discussed in paragraph 2.1.1, arousal is a measure of emotional intensity including stress rather than a sole measure for stress. The participants however expected that their stress would be measured. Important to note is that within this study 'stress' always refers to distress which is the negative component of stress, and does not include eustress (see §2.1.1).

Besides although stress is such a common understanding that everyone has a perception of stress it remains an elusive concept. During the final interview participants were asked to explain events where EmoBuddy indicated a higher stress level and it became clear that there are definite

individual differences in the perception of stress. Where as one person would only describe stress when suffering a deficiency of resources to fulfill a task (e.g. time pressure) the other would explain stress also as social pressure or as (constant) worry (e.g. about ones abilities). For instance being engaged in a heated debate, or receiving a sensitive email are events that were not by far unanimously indicated as stressful, although these are typical events where EmoBuddy would indicate a high stress level. Participants did agree on experiencing the concept stress as something negative.

There is also the issue of prolonged stress. For a part of the participants this is a solemn part of their concept of stress. This leads to a certain mismatch between the algorithms representation of stress and their experience. The algorithm is not designed to measure long lasting stress; it shows the difference in emotional state over a short period of time. This could be an explanation to why people experience very specific moments of recognition, but miss the overall correlation to their state of being. We do suppose long-term stress and acute stress are related to each other in the sense that if a person is stressed he/she will perceive more stimuli as stressors and will react more intense to stimuli. Consequently EmoBuddy will indicate stress often, since there are more acute stress situations. But to experience this relation using EmoBuddy, four days is probably too short.

To counter balance only 3 out of 22 participants with a valid signal (14%) indicated to have had a busy work week; the rest experienced a normal (55%) or even a quiet (31%) workweek. There was probably too little evidence of stress to fairly judge the algorithm, also underlined by the DASS scores. Only 1 participant scored moderate stress, the rest scored in the normal range.

This is in line with only 2 people indicating that they experienced a moment where they expected EmoBuddy to show a higher stress level than it presented; where all participants indicated to have experienced a moment where they expected EmoBuddy to indicate a lower level of stress than it presented. Overall 77% (N22) indicated that they experienced the representation as too red, 23% as suiting their experience and 0 people indicated that the representation was overall too green.

From this user test it is not possible to deduct how much the user experience is affected by the distribution of the stress levels. And for what part by the false expectations on what is actually measured. But it is very clear that the algorithm should be adjusted more green. This will definitely influence how EmoBuddy's representation will match the level of stress the user experiences. It will probably even make the discrepancy between expectation and performance smaller. However it is not likely to fully solve the problem: since the performance of the system is not in line with their concept of stress.

In conclusion, we must bear in mind that this study does not aim to study the algorithm's performance, but we studied the application using it. Inherent, by conducting this study we do not have the proper tools to judge the algorithm

performance. What we do find is that performance and expectations do not match each other on 'what is measured' and 'what users expect to be measured'. There are two solutions for future development. (1) Change the user's expectation; build the application around emotional intensity instead of negative stress. And (2) expand measurement with more features so that positive and negative stress can be distinguished.

6.2 Empathy

Facilitating empathy is one of the main functions of EmoBuddy. Test results explained empathy as a catalyst for inducing social support. Even to such an extent that it probably should be a condition for EmoBuddy's social functionality to work sufficiently.

From the analyses we can deduct there is a strong correlation (r=.598, p=.001, N36) between empathy and whether or not the participant could correlate EmoBuddy's interpretation to his or her perceived stress level. Well imaginable: if EmoBuddy often presents a color that doesn't suit your stress experience at that specific time, it is very likely you are not as much interested, or touched by the representation of your buddy's emotional state.

Due to hardware malfunctioning, as been discussed in paragraph 6.1.1, there were 10 couples using 1 working and 1 defect wristband (they were not aware of this information). And there were 3 couples of which one participant had a GSR below the threshold (0.015mS). How this affected EmoBuddy's social functionality isn't obvious. It is reasonable to expect that it affects both subjects of a couple. Their trust will be called into question if on the one hand a subject sees his/her own signal not matching his perceived stress, while his/her buddy does recognize the interpretation regarding his/her state of being. Or vice versa, when the subject does feel a correlation between his/her stress level and EmoBuddy's interpretation, while his/her buddy indicates he or she can't relate to the signal at all.

During the interviews it became clear that with losing trust in the interpretation, participants also lost interest in their buddy. This is underlined in the correlation found between trust in the algorithm performance and outreach effort as in # button presses (r=.410, p=.018, N36).

One could debate that the social functionality should still stand even if it is not technically supported. Especially, because people with a bad signal due to a short circuit were not aware of the fact that their wristband was malfunctioning. Besides, the participants with a good signal were also exposed to noise (e.g. movement artifacts). Another argument why the couples with 1 bad signal should be taken into account in social functionality issues; is that contact seems not so much motivated out of a raised stress level of one of the buddies. It seems to be simply triggered by the application itself.

The analyses shows a correlation between contact (# button presses (trend) and # equal items) for people with a valid signal, respectively (r=.406, p=.061, N22), (r=.471, p=.027, N22). While no correlation is found between either the DASS-test or the stress indication participants noted down every morning. If the subjects with an invalid signal are included we find a trend on percentage of red samples and # button presses (r=.345, p=.57, N36) and between percentage of red samples and # equal items (r=.422, p=.018, N36). Still no correlation is found between contact and DASS-score or the daily stress indication.

However, even though there are good arguments to take all participants into account in social functionality issues, to bring the understanding of the social functionality to a higher level it is strongly recommendable to perform more tests.

The second issue of this paragraph concerns the negative effects of facilitating empathy. The fourth chapter this risk was already identified, and is now underlined by the user test. 67% (N36) show emotional empathy (e.g. curiosity about their buddy's state, or worry/ apprehension). 64% (N36) of the participants feel a responsibility towards their buddy. Participants commented: '*if you choose to use the EmoBuddy system, you agree to be someone's buddy. You should be there to support your buddy when needed.*' Buddies are involved with each other; this can be reckoned as a positive and successful aspect of EmoBuddy's social functionality. However there is a danger. 36% indicated they feel obligated to react if their buddy turns red, the highest stress level. During the user test only 4.5% experienced this as a burden, but 45% aught it possible to experience being a buddy as a burden in the future if their buddy would become needy.

We do find a negative trend on how personal the relationship between buddies is, and if someone would expect EmoBuddy to become a burden (r=-.305, p=0.07, N36). The more personal relationship exists between buddies, the smaller the chance that they will experience being a buddy as a burden. Intimacy is overall a very important factor in EmoBuddy and might be the key to the problem presented above.

A second prospect in handling this problem could be how the EmoBuddy (social) functionality is implemented; bluntly there are two main routes to take: the more serious way or the fun/leisure route. In the serious way EmoBuddy is deployed from a request for help, focusing on stress reduction. A more light way, focusing mainly on stress prevention, could be a solution to the risk of emotionally burdening buddies with each other.

A factor which we also need to mention in this discussion, since it is likely to contribute to the feeling of obligation, is the way a stress level is indicated. Participants indicated with a vast majority the orange level as the point where someone would start to feel stressed. 56% states that a red stress level is

unacceptable and something must change; heightening the social pressure to contact your buddy. It is recommendable to reconsider this way to indicate stress. Red comes on too strong. Color perception is strongly cultural related [Van den Broek, Schouten & Kisters, 2008], red is often associated with for instance 'passion', but also with 'danger'. In the context of EmoBuddy this associations is more likely to occur, explaining the results presented above. Partly this can be solved by changing the parameter of the algorithm and use a different color distribution (more green), as was discussed before. Another option would be to choose a different approach by using for instance one hue over (continuous) different levels of saturation and brightness.

In conclusion it is positive and perfectly acceptable that a user feels some responsibility towards his or her buddy, and social pressure to contact their buddy when he or she shows abnormal stress-behavior. However there is a line, it should be by all means avoided that users become too needy and emotionally depending on EmoBuddy; on their buddy. This scenario is especially a risk when a user suffers from prolonged stress. EmoBuddy is not and can't ever be a replacement for professional (psychological) help. It must be prevented that a user is emotionally burdened with their buddy. This issue should be taken into account when redesigning the application. Some serious thought has to put into how to define the line between acceptable social pressure and unacceptable social pressure.

6.3 Social Support

6.3.1 Intimacy

The relationship between buddies turned out to be the most important factor in the functioning of the social aspect of EmoBuddy; this was underscored by 94% of the participants. This influence was deemed far more important that personality trait which we expected to have a more prominent role. Simply put it comes down to the question '*Who is willing to share what, when and with who?*' This question belongs to the field of intimacy; a core theme in relationship science. The experiment clearly pointed out that this question needs more attention in both research and design and must be carefully answered in further development.

EmoBuddy shares emotion real time between its users. Therefore relationships must meet a certain level of intimacy. If this level isn't reached, Emobuddy forces unnatural intimacy by disclosing personal information, refraining users from any control. The perspective adopted in this study is based on the assumption that intimacy is developed through responsive, personal self-disclosure [Reis & Patrick, 1996; Mashek & Aron, 2004]. Feigning intimacy makes relationship expectations very unclear.

Individuals' expectations about interactions between intimate related persons tend to take an "if–then" form and can involve predictions about reactions of the partner to one's own behavior, reactions of the self to the partner's behavior, and outcomes of a joint event [Baucom, Epstein, Sayers, and Sher (1989, p. 33), via Mashek & Aron 2004, p.9].

The interaction patterns '*if I reveal personal information to my friend, she will listen attentively*' and *'if I tell a joke, my friend will laugh'* may both be indicative of an expectation of intimacy in a friendship. In an extensive experiment on relationship expectations relating to intimacy, the pattern '*If I need to talk, my friend will listen*' was most frequently listed, indicating that self-disclosure is seen as important in creating intimacy expectations. Patterns portraying emotional support also were listed frequently (e.g., '*If I'm sad or depressed, my friend will cheer me up*') and ranked second [Mashek & Aron, 2004, p.13].

Ambiguity in relationship expectations and prototype patterns is prelude to feelings of insecurity, as several participants said to have experienced. They described vulnerability in initiating contact; afraid to be rejected by the other or afraid to violate their buddy's personal space.

At the start of the test participants answered how personal they experienced their work relation with their buddy to be on a 10 point scale (*mean*1.02, *stand. dev.* (1.13), N36); afterwards they were asked to answer the same question (*mean*1.99, *stand*. *dev*. (1.82), N36). During the interview they were asked to score what level of intimacy a relation must have in order to use the social functionality of EmoBuddy: this question scored an average of 3.8 points. This is 2.6 points higher than the participants indicated their relationship to be at the start of the test. Only two subjects indicated their relationship was intimate enough to real time share their stress level. And after the test the level of intimacy is still 1.7 points lower than the desirable level of intimacy. These results stand in contrast with only very few participants indicating they experienced violation of their personal space and 58% of the participants indicating to being willing to use EmoBuddy in the future.

An explanation to these results can be found in the malfunctioning of the system. Due to the distrust in the signal the contact becomes less intimate. Several participants described the noise on the interpretation functions as a buffer on personal space. If someone wasn't willing to share intimate information, he or she could hide behind the measurement insecurity (e.g., movement artifacts). This was experienced as pleasant. It is therefore important to perform more tests when the algorithm and measurements are freed from artifacts, to truly understand what impact the intimacy factor has. It is unquestionable this aspect must be addressed in a redesign.

Intimacy can be reliably measured with the Relationship Closeness Inventory (RCI) [Mashek & Aron, 2004, p. 81–117; O'Brien & DeLongis 1996; Berscheid & Schnyder, 1989]. Here lies an opportunity for EmoBuddy to adapt

to the level of intimacy between buddies and regulate the amount of personal disclosure accordingly.

6.3.2 Reducing stress

A second very important issue concerning the social functionality is that it approaches EmoBuddy's main objective - reducing and preventing stress – in an indirect manner. The essential goal of the social functionality is to provide an opening for personal conversation if something is the matter; thus it should induce social support. This means that the level of intimacy in a specific work relation is enabled to grow by the means of EmoBuddy. With empathy as a catalyst, sharing each others' stress level should lead to more contact on stressful moments.

A before- after test showed that people answered their relationship to be more personal when they used EmoBuddy. A paired-sample *t*-test gave $t(35)=-5.089$, $p=.001$). One can question if a relationship can actually change over such a short period of time. We do know for sure that during the user test most buddy pairs had more contact than they usually had (70%). 44% indicated during the interview that the content of contact was more personal. The before-after questionnaire showed face to face contact increased with an average of 1 time per day. Finally from user data we can deduct that 28 meetings took place on account of EmoBuddy, meaning an average of 1.6 times over 4 days per couple.

In all possible ways the user test shows that during the test there was more (personal) contact between buddies. For what is more 78% of the participants indicated that they would like to have a more personal relation with a colleague. And 8 subjects believe personal relationships do not belong in a work environment. 75% believes EmoBuddy does induce social support.

The final objective of EmoBuddy is to reduce and prevent stress in the work place. Both in literature and several elaborated field studies (see § 3.3 -3.6) we find that social support is an important factor in reducing and the prevention of stress. Closing the circle the analyses show that EmoBuddy does induce social support. However claiming EmoBuddy reduces or prevents stress would be jumping to conclusions. The user test doesn't in any way show that users felt less stressed.

For instance the interview question '*did you feel more relaxed after contact with your buddy'* got answered only four times, because almost all participants stated there wasn't any stress worth mentioning and deemed the question not applicable. DASS, the daily stress indication, or the GSR data do not provide enough ground to draw conclusions on decrease, stabilization or increase of stress. This issue has been discussed before. To understand if EmoBuddy truly reduces or prevents stress there was too little evidence of stress and testing should be done over a longer period of time. It is

recommendable that in future testing stress should be a criterion in selecting subjects (e.g. work with a control group).

Another argument for more extensive testing is the questionable factor that participants had more contact simply because they both participated in the same test and were curious about each other's opinion on the system. Several subjects commented that after four days the novelty hasn't worn off yet. Four days is too short to understand what the novelty aspect is, and what the actual social functionality does.

6.3.3 Unused functionality

Last to discuss in paragraph 6.3, with a more practical nature is unused functionality (concerning the contact possibilities and the deadline button).

The prototype was equipped with four contact buttons for respectively texting, a coffee break, a walk break and a lunch break. From the 28 appointments made 3 were lunch breaks and 25 were coffee breaks. This means nobody used the walk button. Texting was used 67 times per couple. This was generally supported in the interviews; indicating they appreciated the coffee button and text button the most.

During the interviews there were a lot of negative comments regarding the texting function. Users generally expected it to be a normal chat function. However it was a very user unfriendly one; designed more like a texting function on a mobile phone. This should be revised in redesign.

The prototype has two more buttons: a deadline button to tone down alarming behavior and the overview button. The last one was used many times, but the deadline button remained untouched. Meaning none of the participants felt the application was asking too much attention, and was distracting from work tasks. This is underlined by 100% of the participants indicating during the interview that Emobuddy did not constrain their work activities.

These results give quite clear recommendations for redesign; eliminate unused buttons and revise the chat functionality.

6.4 Create Awareness

EmoBuddy's awareness functionality was praised most by the participants. 75% is interested to use the stress awareness functionality: concerning both real time feedback and the overview callbacks of their GSR history. Opposite 25% of the participants did not use or see any benefits in this functionality. Their argument was that they do not need technology to indicate how they feel: they describe to be sufficient aware of stress in their body. Among this latter group 6 persons indicated that they would like to use EmoBuddy social functionality, 3 participants would not use EmoBuddy at all.

As described before we found two types of users, depending on their score on extraversion (BFI-44). Subjects who scored high on extraversion tend towards the social functionality (r=.344, p=.040, N36). And people who prefer overview functionality tend to have a lower score on Extraversion (r=.-397, p=.017, N36). Up 33% of the participants proposed that creating awareness should be the sole functionality of EmoBuddy. A group of 15 subjects (42%) says to be interested in both the social functionality and the awareness functionality. Several participants suggested focusing on awareness functionality, with the option to invite a buddy: making the social functionality subordinate.

We must bear in mind however that the subjects who participated in this user test are all employees at Philips Research some overlapping in personality traits therefore can be expected.
In Western Europe and North America extraversion is distributed with a mean of 49.16 and a standard deviation of 9.38 (Distribution of Extraversion in the Netherlands: mean 49.25 and a standard deviation of 9.22) [Schmitt et al., 2011]. This user test had a distribution of mean 66.25 and a standard deviation of 14.89. To strengthen the results a user test among a more differentiated group of people is desirable. It is important to understand more about this correlation. Favorably, especially on personality traits distribution in knowledge work throughout western countries.

The results from this user test make the possibility to divide the concept into two different products very attractive: one that focuses on awareness functionality and one that offers both or just social functionality.

Furthermore, comments on the overview functionality were focused around its current low usability. This function is still very shallow. It should be further developed, better integrated in the application and could be elaborated with some extra features such as offering an average, or other review tools. Most participants were negative towards a coaching functionality and glorified simplicity. The participants used the overview with an overall average of two times a day. The real time representation of the subjects stress level is also part of the awareness functionality. As commented earlier participants indicated they would like this feature to be more present.

6.5 Conclusions Recommendations

The user test from this study was quite a bold and risky test since we chose to test EmoBuddy in full context at such an early product phase. This broad scope did give us an extensive understanding of the product and its possible future. But also, consequently we were depending on many uncontrollable environmental factors.

Although we should pursue an iterative design process, the recommendations are twofold: on the one hand they regard performing more research and tests and on the other hand they regard design. Chapter 7 holds

detailed propositions for a concept redesign. First a short summary of both is provided.

6.5.1 Testing

To optimize more understanding must be gained separately on functioning of the algorithm and on social and awareness functioning. Testing should be done more gradually. If emobuddy will get a more serious chance on a future the first aspect to be revised and tested is technology that underlies EmoBuddy; the algorithm. Proper functioning of the algorithm is bedrock for EmoBuddy success. Besides it is important to recognize this technology holds more futures than EmoBuddy.

Required

- The algorithm should be tested in a controlled environment (e.g. using Subjective Unit of Distress SUD [Horowitz, Wilner & Alvarez, 1979]) aiming at artifact reduction. This will give more pure understanding of the performance of the algorithm, without social aspects interfering.

If the algorithm is optimized effort needs to be put in to gaining more insight in the social and awareness functionality. An extensive experiment is recommendable.

Required

- Stress should be a criterion in selecting participants, to understand if EmoBuddy actually reduces/ prevents stress
- Duration ~ 3 weeks; to minimize novelty aspects and give the participants time to re-settle in the relationship with their buddy.

Desirable

- Subjects with a more differentiated background will likely give more insight in personality factors.

6.5.2 Research & Design

The user test results also lead to direct design recommendations: hardware related and software related. Hardware revision will be shortly mentioned, but any serious depth on this subject is beyond the scope of this study. Recommendations specific to the software application will be thoroughly discussed in Chapter 7, and will be briefly summarized here.

Hardware revision is important. Before any more testing, the current prototypes need to be improved, and desirably replaced with a redesigned prototype. The following aspects should be taken into account in redesign:

Required

- Improve measurement; e.g. change sensor material for better conductance, allocation sensors on all size wrists.

Desirable

- Adding mobility to the measurement to increase awareness value.
- Ergonomics; the 'rough edges' need to be taken off so that the influence of wearing an uncomfortable device will strongly diminish.
- Usability; aspects such as placing the module in the wristband, charging and turning on and off should be addressed.

Important aspects in algorithm revision before testing

Required

- The level distribution should be adjusted to less sensitive (more green).
- Movement artifacts need to be dissected from measurement.

Desirable

- Research the possibility to individually characterize algorithm. For instance implement a calibration period based on SUD.
- Research (cost and benefit of) the possibility to combine GSR with other physiology features (e.g. heartbeat variability) to improve recognition of stress level (distinguish distress and eustress).

Secondly several recommendations can be translated to EmoBuddy application redesign

Required

- EmoBuddy should adjust personal disclosure to intimacy level between buddies (e.g., via RCI).
- Stress indication should be altered so that the user doesn't feel obliged to contact buddy.
- The emotional burden on the user should be monitored.
- Unused functionality should be removed; walk button, lunch button and deadline button.
- Overview functionality needs to be explored and developed to a higher level. Product differentiation on awareness functionality needs to be considered.

Desirable

- Consider a 'buddy-summary' representation
- Continuous presence of the application while working, but not in a disruptive manner

7 | Propositions Redesign

In the paragraphs subordinate to this chapter redesign propositions are made for redesigning the EmoBuddy software. These propositions arise from the recommendations and should strongly be considered to be implemented in the next generation EmoBuddy prototypes. Paragraph 7.1 contains propositions to enhance the current EmoBuddy prototype, whereas paragraph 7.2 takes a glimpse at possible EmoBuddy futures.

7.1 Redesign interface components

Most participants prefer and deem awareness functionality most promising, but also like social functionality. The intention is to keep still both in the next generation prototype. But the balance is slightly shifted towards the awareness functionality, with the option to 'invite a buddy'. This serves another goal as well: it must be by all means avoided that users feel emotionally burdened due to EmoBuddy therefore we will choose a more light-hearted approach. We want

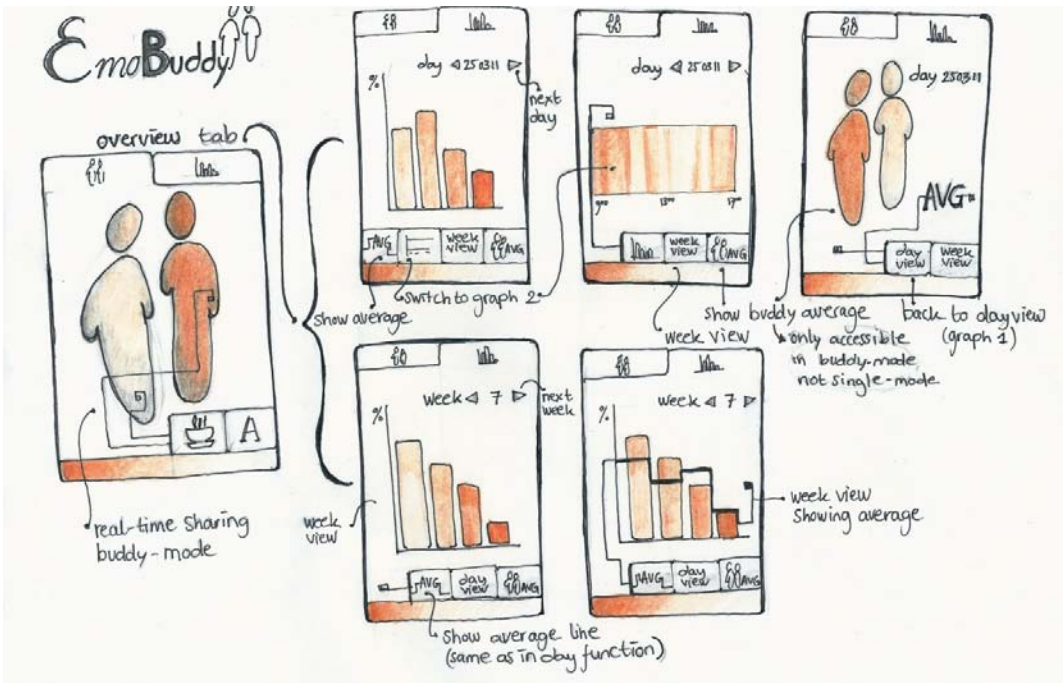
employees to use the social functionality out of curiosity instead of the *need* to reduce stress. A buddy can provide an opening to talk about personal subjects, and can in that way be a relieve of tension. The awareness functionality will be more central in reducing and preventing stress by altering coping mechanisms through awareness.

We will address the redesign following the same structure as in chapter 4, but change the order; first we'll discuss the awareness functionality, secondly the avatars, then contact possibilities, followed by status and finely we will discuss application behavior. These EmoBuddy components are accompanied with a few simple sketches to help the reader form an image of what is proposed.

7.1.1 Create Awareness

The awareness functionality will fulfill a more prominent role in the next prototype: the user can even choose to exclusively use this functionality by not inviting a buddy. This functionality is both deepened and far better integrated than in the former prototype: the overview button that gave access to the overviews in the old prototype will be replaced with a tab that accesses different types of overviews. *Picture 7.1* shows a summary of the overview tab.

Awareness functionality consists of two components: real-time sharing stress information based on GSR and secondly day and week overviews. If a user chooses to use EmoBuddy in the single-mode (exclusively awareness functionality) he will see 1 avatar representing him/her that will change color



7.1 Awareness functionality

according his/her stress level. Apart from the contact option and the second avatar this frame is basically the same as when social functionality is included.

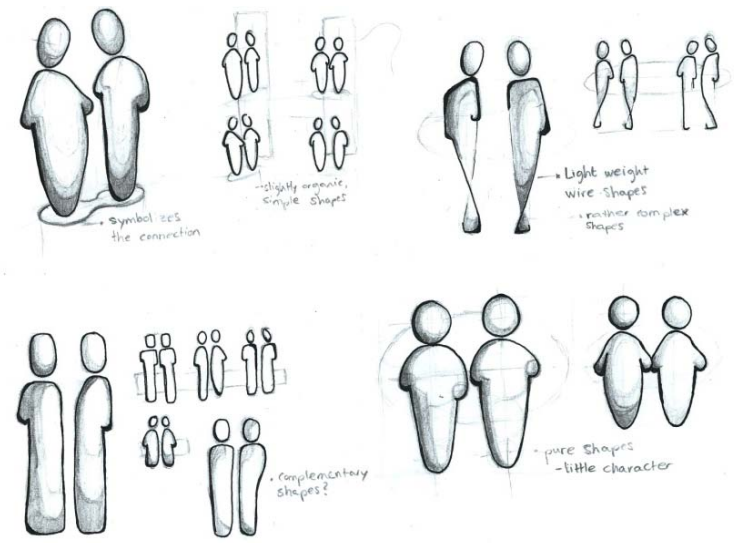
Via a tab the user can reach the overview graphs. We chose to work with a tab function to keep the information density low. This is especially important in the avatar tab in which the information should be transmissible at a mere glance. The overview tab can be a little more complex since we want to stimulate the user to really think about his stress patterns and his stress coping and thus become more aware.

The overview tab contains information per day and a week view. It opens on the day view. This screen shows the day-graph according to time; a day chooser (up to 5 days can be recalled); a button that switches the graph in to a day-graph according to percentage samples per (quadrant) stress level; a button that switches to the week view. And if the social functionality is active there is also a button to show buddy average. Participants indicated to appreciate a (summarily) overview of their buddy's day. This is adopted: the buddy's average stress level of that day is presented.

If the screen is switched to the week view it contains a week-graph according to percentage samples per (quadrant) stress level; a button that shows the average stress recordings; and a button that switches back to day-view. Again if the social functionality is active it holds a button to present the buddy's average stress level that week.

7.1.2 Avatars

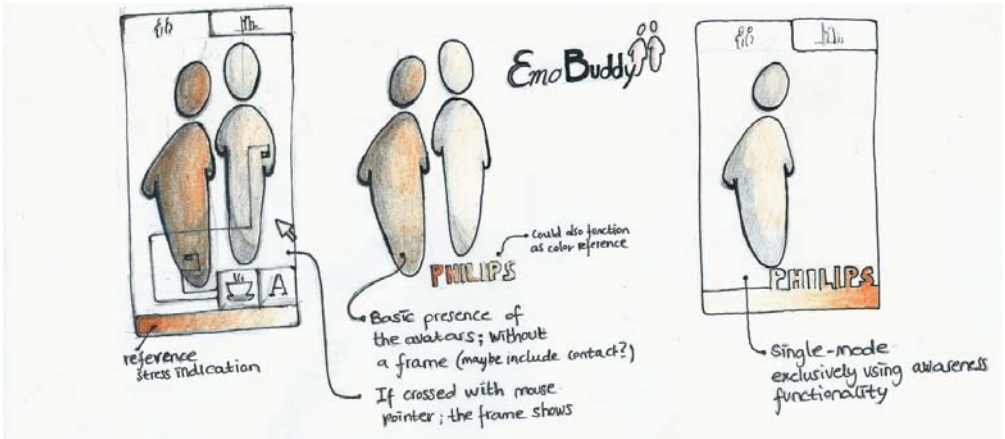
Avatars are used as a representation of the user and his/her buddy. The color of the avatars changes according the GSR samples and represents the user's or buddy's stress level. The main trade-off in designing the avatar shape is how much it should resemble an actual person. At one extreme we could use webcam imaging, whereas the other extreme would be a pure geometrical representation (e.g., rectangle). This trade-off has already been discussed in paragraph 4.2.2. The user test supported the outcome of the avatar analysis made in 4.2.2: keep the human shape as a stepping stone for empathy, while it abstractness ensures a degree of anonymity (for passersby EmoBuddy should not reveal too specific information) (*Picture 7.2*). For the same reason there is no distinction between buddy (presented right) and user (presented left) other than their position. The user test proved that users easily enough understand which avatar is theirs and which is their buddy's.



7.2 Shape study avatars

The avatars are placed in the EmoBuddy frame and have their own tab. It is important to keep low information density, especially concerning real-time sharing the stress level information. A short glance should be enough to interpret the situation. This is why when the application is opened but not actively used, the frame will disappear and only the avatar(s) will be visible. When the user crosses the EmoBuddy frame with the mouse pointer, the frame with contact options and overview tab will appear.

Further more the first steps are taken in redesigning the graphic style, with the goal '*to make it more Philips-style'*. The Philips brand has a very clean and pure style and is all but exuberant in use of color. We choose pure and lightweight shapes, only slightly organic to provide character and with subtle coloring and light effects (*Picture 7.3)*.



7.3 Avatars

7.1.3 Stress indication

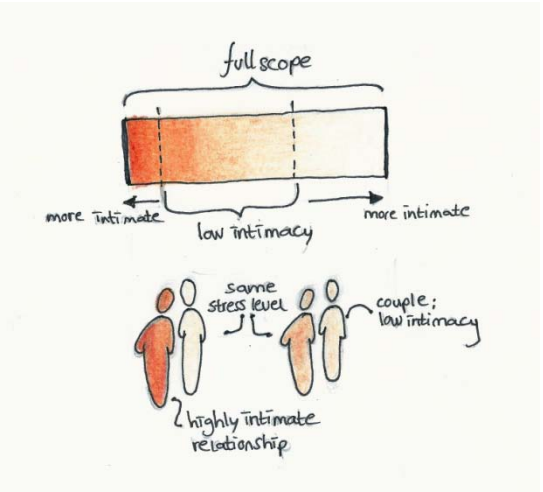
In the prototype used for this study stress was indicated with four color levels: green, yellow, orange and red. The recommendations following from the user test clearly indicate this approach has a number of very negative consequences. And therefore recommends switch to 1 hue over several levels of brightness instead of four different colors.

This will largely alleviate the feeling of obligation and therefore reduce the likelihood to (emotionally) burden user or buddy. On the other hand 'red' as a color functions as an extra trigger to contact each other; red triggers social support. But, as we rather see contact as a result from an actual feeling of stress it is not such a negative side effect that social support is no longer triggered by the 'red' color. Another side advantage is that using one hue suits the graphic style.

The second aspect concerning stress indication is the intimacy level between buddy and user. As proposed EmoBuddy should adapt the amount of information it discloses on the level of intimacy between buddies. If buddies do not have an intimate relationship they probably won't always like to real-time share their emotion. In the former prototype the noise on the measurement was positively experienced as a buffer on personal space: users could easily deny something was the matter. With optimizing the measurements it is important to find a replacing buffer.

By adjusting the amount of color levels according the level of intimacy we gain some control on the depth of personal information that is disclosed. By using only part of the full brightness scope 1 specific color holds less information on the stress level. Meaning it is easier to decline there is something the matter if the subject is not ready yet to share; leaving their personal space intact (*Picture 7.4*).

Then there is the issue of continuous or discrete color coding. Continuous color coding of stress levels would be more appropriate for real time sharing. Besides participants indicated that they felt the representation of emotion in only four colors was to abstract; they would like to see more nuance. But to create overviews with high usability discrete stress levels are more desirable. Therefore we'll chop the continuous color bar in to four quadrants. The borders can be used for alarming the



7.4 Adjustment on level of intimacy between buddies

user and composition of the graphs.

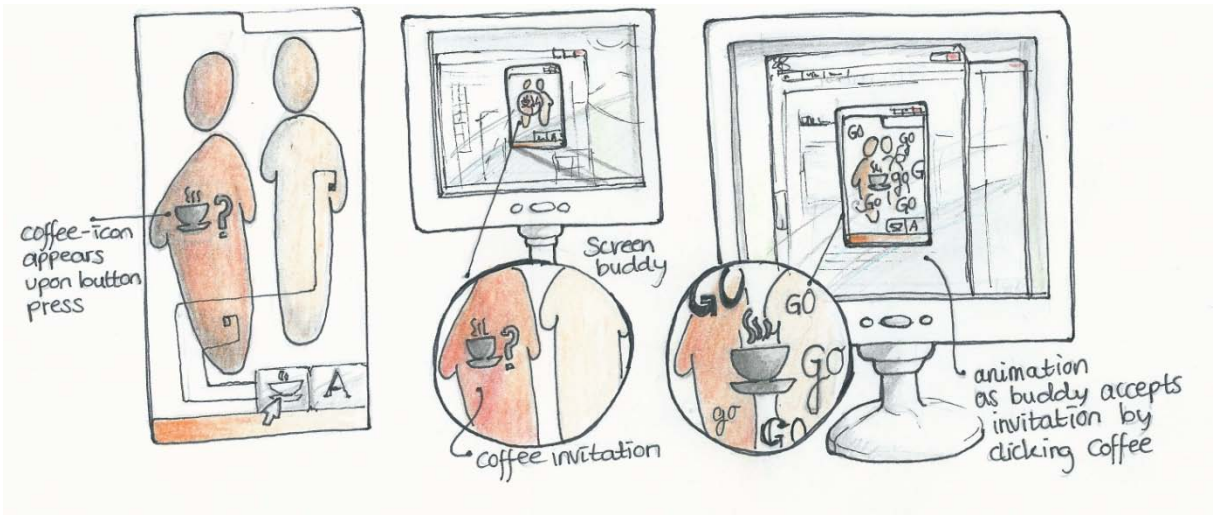
7.1.4 Contact options

In the light of removing unused functionality the contact options are altered. Based on user data the walk and lunch button are removed; whereas the coffee and conversation button will stay. This will benefit the simplicity we are searching for.

The '*let's go for coffee'* functionality will remain nearly the same as in the former prototype (*Picture 7.5*). If a user feels like drinking coffee with his buddy he/she can invite his/her buddy by pressing the coffee button. As feedback on the invitation the coffee-icon will appear in his avatar's belly.

The buddy receives an alarm; the avatars will pop-up in the middle of his/her screen, so the invitation can't remain unnoticed. The buddy has two choices: (1) decline the invitation by waiting until the invitation will disappear after 1 minute and EmoBuddy will resume usual behavior; (2) accept the invitation by also clicking the coffee button.

Upon the answering button press EmoBuddy will pop-up in the middle of the screen and show an animation to encourage the buddies to go for coffee. This happens on both user ends. EmoBuddy will resume normal behavior if the buddies have left their desks.



7.5 An EmoBuddy date

The messaging function will be extended to a full chat dialog (e.g. like office communicator). If the user clicks the 'A' button a dialog frame will open and he/she can start a conversation with his/her buddy. To refrain from double functionality it might be an option to link the button to the actual office communicator, or another chat-box that is already available.

7.1.5 Status

Status concerns the deadline button which toned down the alarming behavior of EmoBuddy so that it would only alarmed in case of an invitation or a message from the buddy. This functionality was implemented to prevent EmoBuddy from becoming annoying occurring when the user would feel interrupted from his/ her work. This functionality was not used and the participants indicated EmoBuddy did not keep them from their work in a negative way. Therefore this functionality shall be removed from EmoBuddy completely.

7.1.6 Application behavior

If a user starts EmoBuddy for the first time he/she will be asked to choose a username. The next time he/she can log in with this username which is used (if desired) to connect with a buddy. In the old prototype this was done based on computer name.

Next screen the user will see contains the question: "*Do you want to invite a buddy?*" Here he/she can check the '*yes*' or *'no'* box. If the user chooses not to invite a buddy EmoBuddy will start up in the single mode. Meaning it will show the single avatar, changing real time according to the GSR measurement. This screen (visible in picture 1) has no buttons.

If the user does invite a buddy, he is asked for the buddy's username. The application always suggests the last chosen buddy. So that if he/she invited this buddy before the user only has to click *'ok'* and the application starts directly. On the other end it works in the same way.

If it is the first time the user invites this buddy, there will be a short questionnaire to determine the level of intimacy between the buddies based on RCI (see §6.1.4). The application will start working, but until the buddy has accepted it will not reveal any data on the buddy. If the buddy accepted and has filled out the intimacy questionnaire; buddies will be able to see each other (buddies can indicate a different level of intimacy, this is respected: they can work with a different brightness scope). The avatar screen in buddy-mode contains two avatars (user left, buddy right); a coffee button to invite for a cup of coffee; and a conversation button that opens a chat box (for instance office communicator) (see *Picture 7.3*).

Via a tab the user can reach the overview graphs. Here they can visit three day-views including a presentation of the buddy's average stress-level over that specific day. And a week view, with the possibility to show your average recordings.

The applications normal behavior when opened will show in the down-right corner of the screen and fall back behind other programs when these are opened (normal windows policy). The tray-icon is always visible and can be used to re-open EmoBuddy on top.

EmoBuddy can be closed with the cross in the right-upper corner. This opens a screen which asks for an affirmation to close down, different from the old prototype. We recommend implementing this since several participants 'accidently' closed the application when they merely wanted it to be minimized without noticing.

Also the presence of EmoBuddy was commented in the user test as the users expressed they would appreciate Emobuddy to be more prominent in view. A suggestion we heard during the interview and that was already on the wish-list in designing the former prototype was to use an active tray-icon. The tray-icon will represent the avatars colors.

EmoBuddy will alarm the user when either he/she or his/her buddy turns to the highest stress level quadrant. Such an alarm event can only occur once every 30 minutes to prevent flickering behavior to become a nuisance (the user turning red and buddy turning red are considered separate alarm events). In case of an alarm EmoBuddy is set on the avatar tab, will pop-up and is set on top in the middle of the screen. The user can actively remove the application from this position or wait till it resumes former behavior after 1 minute.

In the pull-down menu, the user can select '*always on top'* function. Selecting this function will make EmoBuddy visible all times. In case of an alarm EmoBuddy will show in the middle of the screen; demanding the user's attention. In the former prototype the user would often not notice an alarm if the application was already opened and visibly present in their computer screen.

If the user is making use of the social functionality there is another case in which EmoBuddy alarms: when his/ her buddy does an invite or answers the user's invite. EmoBuddy will follow the same behavior as with an alarm due to stress and show up in the middle of the screen forcing attention. Since with the old prototype invites sometimes remained unnoticed and we want outreach effort to be strongly supported. If buddies agree to meet via EmoBuddy, the application will remain in the middle of the screen, encouraging the user to go, and remain in this position until the user left his office.

7.2 Optional Product directions

So, *is it justified to invest further time and money into EmoBuddy?* Presenting the redesign recommendations already holds the answer. With an iterative design process in mind of the ever alternating testing, developing, testing, and developing: for now it is yes.

Emotion recognition is a very young, new and promising market. Technology bedrock for EmoBuddy holds many futures. If EmoBuddy as presented here will be one of them is still very early to say. There is too much yet to be researched before it is confirmable whether or not EmoBuddy will develop to a successful product. But further research and especially further development of the algorithm is very desirable.

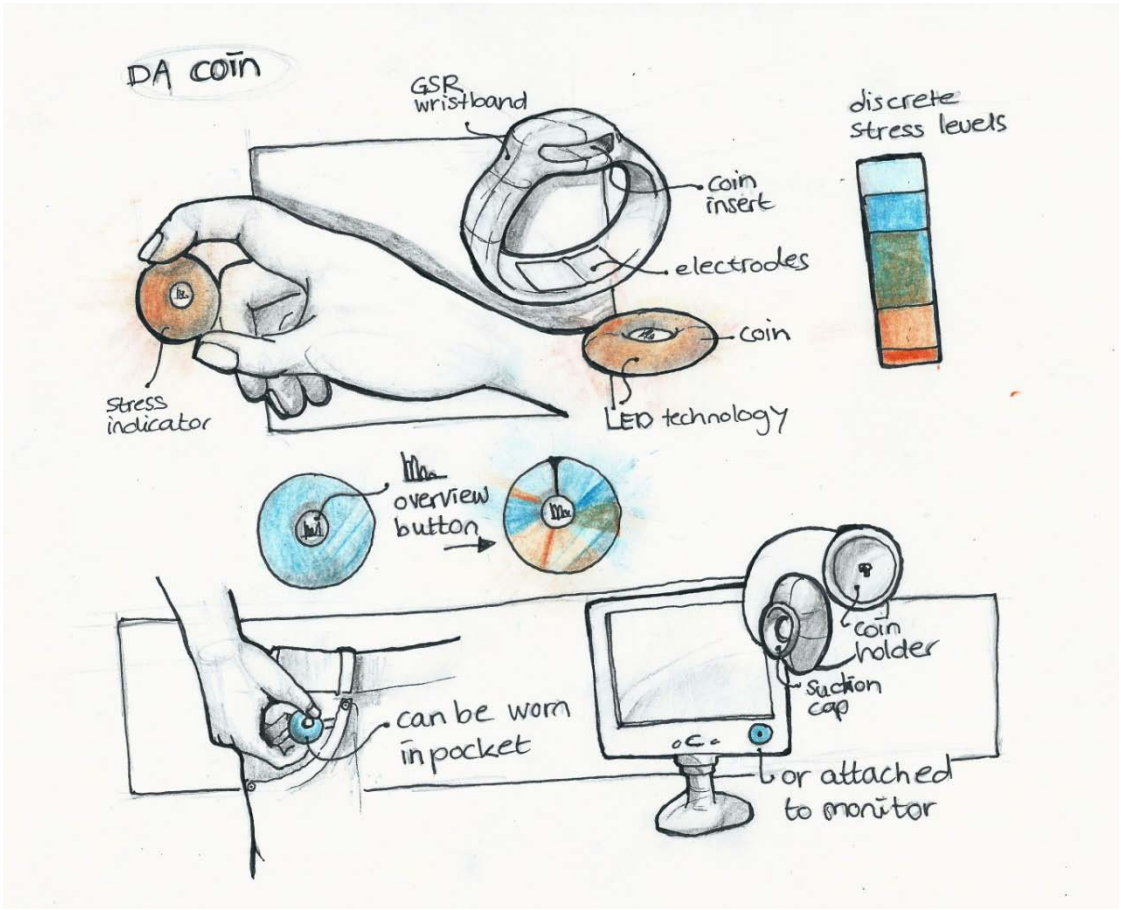
The test divided EmoBuddy even more convincing in two parts: awareness functionality and social functionality. Awareness functionally proves most promising especially in the knowledge work context. The social functionality did not always feel properly placed in this context; it probably will not reach its full potential as it will be submissive to awareness functionality. But we did detect a working mechanism inducing social support. It would be rather interesting for instance to leave the office floors and see if a more personal setting allows this concept to bloom. Take for instance elderly care, or patients who are hospitalized: these context's offer very interesting futures for social functionality.

Next we will present a short glance into the future, simply to stimulate fantasy and creativity for the ones who will maybe run away with the concept of EmoBuddy.

The first concept drawing displays the '*DA coin*' (P*icture 7.6*). The awareness functionality is fully integrated in to a product. There is no need for external software, although it could be a valuable addition.

The product consist of two parts; to measure GSR the wristband is equipped with electrodes, and to indicate the user's stress level a light emitting coin. The coin can be worn in a pocket so that other employees have no access to the information it presents. Or it can be attached to a monitor (or any surface) with a coin holder. The two parts can be assembled when not in use as one for e.g. charging or connecting to a computer.

The strength of the concept is its simplicity. The coin will emit colored light, with its brightness being a measure for the amount of stress. In the middle on one side it has a button that will show an overview according to time. Some extra software could be included to elaborate on the recorded data (e.g., to see week overviews and averages or to offer other tools to analyze the data).

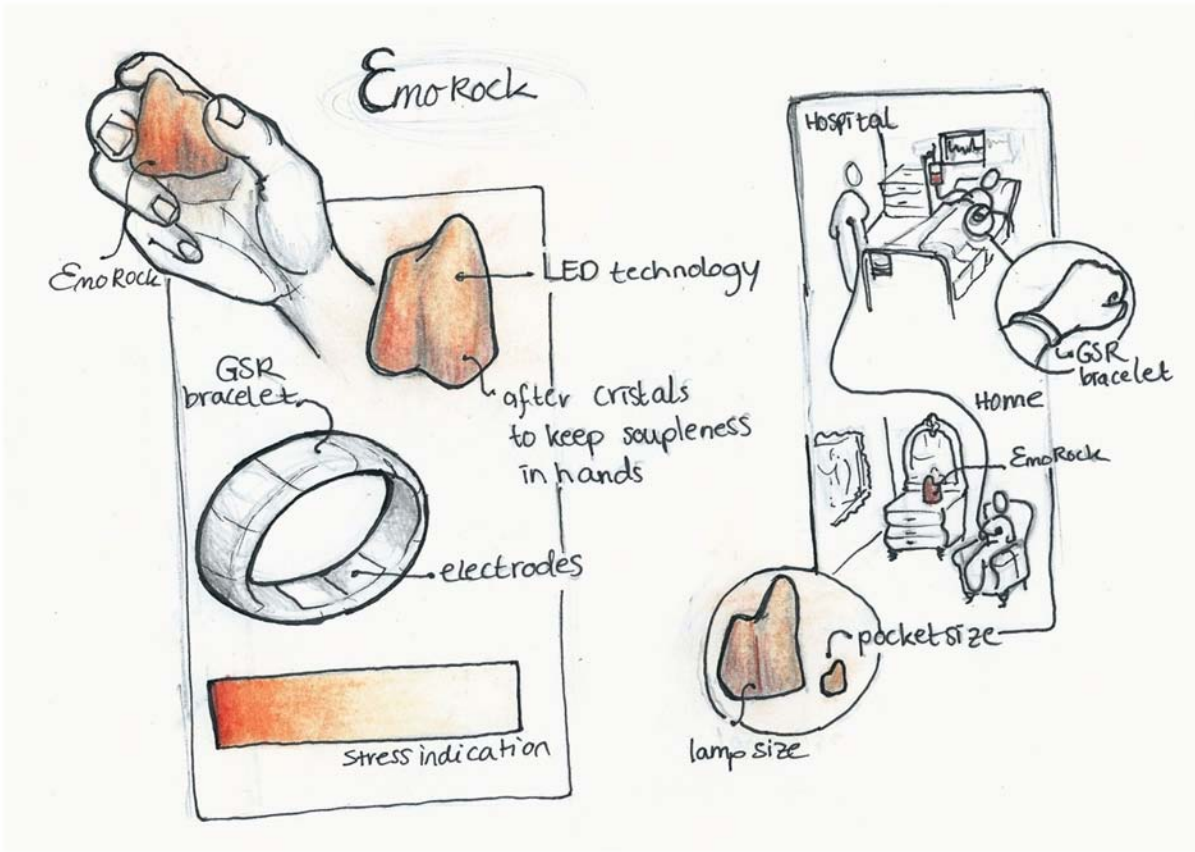


7.6 'DA Coin' Concept

The second concept (Picture 7.7) resembles the first but purely focuses on the social functionality. It is meant to be used to increase the emotional involvement in relationship with for instance related elderly or hospitalized patients when distant. When a loved one suffers from poor health it and lives distant this can give a lot of concerns especially since time does not always allow to be as close as desired. This concept presents a product that offers emotional involvement and bridges distance.

It also consists of a GSR recording device, and a stress indicator. The elderly wears the wristband to measure GSR while the loved one possesses the '*emorock'*. The rock shaped light emitting artifact changes color according to emotional status of the bearer of the GSR device. The rock can have different sizes, (small) lamp size so that it is placed in a home, or pocket size so it can be carried. Therefore it would be valuable to design the communication technology in such a way that the whole system is mobile.

Finally we described a monitoring system; however it could also be deployed on mutual basis.



7.7 'EmoRock' concept

8 | Conclusions

The primary goal of this study was to strengthen the EmoBuddy concept. To this objective we thoroughly analyzed the concept. Literature study as well as expert interviews gave us extensive insight in EmoBuddy and its components. Building on these newly won insights the first phase of this project led to an enhanced prototype.

During the second phase of this project this prototype was submitted to an exhaustive evaluation for a proof of principal. We conducted a large scale user test in which 36 Philips employees participated. The test took place in full context. This meant some drawbacks as we were not always in control due to the enormous amount of variables, but this also led to profound insight in EmoBuddy as a product.

Our results showed that EmoBuddy facilitates empathy and induces desirable behavior. Using EmoBuddy stimulates the user to seek and offer social support to and from his/her buddy. EmoBuddy also increases awareness on stress behavior. These are very positive results. However the test does not reach far enough to validate whether stress is actually reduced or prevented. Although literature supports these assumptions, more research is desirable. We suggested for example to test EmoBuddy for a longer period of time. Above all

the user test gave us a very broad understanding of EmoBuddy's performance and revealed a clear future path for both testing and (re)design.

The third and last part of this study was aimed at the future. This part concerned recommendations for testing and research as well as detailed design propositions for the next generation prototype.

We proposed awareness functionality to take over the leading role from social functionality. Awareness is encouraged via offering overviews and real time stress level feedback, with the option to invite a Buddy. As preference of functionality type proved to be dependent on personality, more specifically extraversion, the user can fill in him/her self whether a relation is intimate enough to share stress information using CMC.

In the future we think it is very well possible that these functionalities will separately grow into different products. The social functionality is maybe subordinate to awareness functionality in a work environment, but is a very interesting and valuable concept in the context of healthcare.

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Annex A | Original Assignment

Student project – Emotions Contacts:
Gert-Jan de Vries (gj.de.vries@philips.com) &
Elke Daemen (elke.daemen@philips.com)

Organization Description:
Philips Research is the source of many advanced developments in Healthcare, Lifestyle and Technology.
Building on 90 years' experience in industrial research and our world-leading patent position, we're dedicated to meaningful innovations. This student project is placed at Philips Research in Eindhoven, in the research department Brain, Body and Behavior and the research department Human interaction and experiences. The student will benefit from supervision in all subject areas by experienced researchers.

Background assignment:
Stress at work is becoming a big problem. The workplace has changed dramatically due to globalization of the economy, use of new information and

communications technology, growing diversity in the workplace and an increased mental workload. Here in Philips Research we developed a desktop application, called the EmoBuddy that connects you and your buddy. It shows the stress level of the both of you, measured through skin conductance, and provides you with the option to indicate the need for a break. The goal is to motivate people to take a break at the moments they should, i.e. in moments where their stress has build up. Social control is deployed as mechanism to regulate the process of taking a break. There are four different stress states: green, dark green, orange and red. You and your buddy can decide at any moment that it is time to take a break, e.g., go for a coffee, for a walk or have lunch together. When you are in the fourth state (red) the application will start to annoy you, i.e., you are forced to take a break. When you walk away from your computer it is detected, and your icon will turn grey. Skin conductance is measured at the inside of the wrist by means of a wrist worn sensor, suitable for daily life use. The application has been developed and tested for the Windows environment, using a combination of flash and java.

Assignment:
The aim of this student-project is to assess usability and acceptability of this system, the EmoBuddy, by conducting user research. The outcomes of the user tests should provide requirements and recommendations and through an iterative process these should be used to enhance (and re-evaluate) the system. There are various aspects of the device to be taken into account in the user study (e.g., (perceived) system performance, graphical design, interaction options, ...). However, the main focus of the study will be decided upon jointly.

Duration: about 6 months.

Your Profile:
- Have experience in performing user research
- Have experience with iterative design processes
- Are familiar with the basics of flash (and optionally java)
- Are fluent in oral and written English
- Are motivated and able to execute a research project independently

Annex B | Project Plan

This appendix contains a selection of the project plan that is not included in Chapter 2: Involved parties, Project objective, results, methods and planning.

B.1 Involved Parties

Industrial design Engineering |Twente University

This project is to be the completion of the bachelor program Industrial Design Engineering, part of the faculty of Engineering Technology at Twente University. The foundations of Industrial Engineering are provided in this program, by graduating this project the student shows he or she has the ability to design new processes and products. Core to this education program is integration and converging of knowledge from different fields into a single product or service.

Philips Research |Human Interaction & Experience

This assignment is commissioned by Philips Research, more specific the research group Human Interaction & Experience (HI&E). Philips Research is one of the world's largest corporate research organizations within Philips and is the source of many advanced developments in Healthcare, Lifestyle and Technology. Philips Research is dedicated to meaningful innovation, dedicated to improve the quality of people's lives. Understanding what drives people, what dilemmas they face and bring to light the best possible way to help them is essential at Philips Research. HI&E performs research on interaction and experiences between users and technology and design user interaction technology for novel applications and context of use.

This project exists on the border of the research topics currently executed in both the HI&E and Body Brain & Behavior group (BB&B) (the other research group this project is closely related to). Attempts will be made to strengthen the current concept and gain insight in the sustainability of the EmoBuddy project and determine whether investing more time and money is profitable.

B.2 Project objective

The main objective of this project is to strengthen the EmoBuddy concept and develop it to a higher, more detailed level via an iterative design process. The first part of this study will focus on analyzing the EmoBuddy system based on both literature and interviews with experts. This analysis serves to enhance the existing EmoBuddy prototype so that it facilitates empathy through CMC and induces social support when stress has built up. In the second part of the study we will conduct a large scale user test, aiming for a proof of principle concerning the social functionality of EmoBuddy. Submitting the enhanced prototype to an exhaustive evaluation will besides provide insight in concept sustainability. The third and last part of this study focuses on EmoBuddy's future, handling recommendations and propositions for redesign.

Results

The results will be threefold:

- *a scientific paper on the deployment of social control through CMC in a stress-aware application to induce specific behavior*
- *a working Emobuddy prototype (with the minimal requirement that it is suitable to conduct user tests for a proof of principle)*
- *recommendations on the further development of EmoBuddy*

B.3 Phasing and Methods

This paragraph serves to provide the sub goals to this study categorized and globally set out in time. The dates coupled to the main goals represent deadlines. A more elaborated planning can be found in annex B where the sub goals are included in a visual representation. Graduation will take place on **Wednesday 30 March 2011** at Philips High Tech Campus.

EmoBuddy Concept Design – 24 December 2010
Understand the mechanism of social control in the context of work environment

- How do companies address the issue of stress currently? Specifically, are there policies on (the stimulation of) social support? **Conduct Interviews**
- What is social control? Can it be deployed to strengthen social support in EmoBuddy context? **Social Psychology Literature**
- How do different types of relationship in a working environment influence social support? **Occupational Behavior Literature**
- What is desirable behavior when someone is stressed? **Occupational Behavior and Social Psychology Literature**

Understand EmoBuddy technology

- Gain *basic* understanding in subjects relevant to EmoBuddy; emotion, mood and physiological measurement by Galvanic Skin Response. **Literature on Cognitive Science and Psychology**
- Define/ understand when action should be taken corresponding to what values are measured. **Cooperation with Gert-Jan de Vries**

Develop enhanced EmoBuddy concept

- Which individual characteristics will be used to create a personal context within EmoBuddy, and how? **Concept Design**
- Decide on what type of relationships EmoBuddy will anticipate. **Concept Design**
- Brainstorm with a group of people **Concept Design**
- Find a way to facilitate empathy: how to use the created context in order to stimulate social support. **Concept Design**
- Develop Emobuddy prototype. **Detailed Design**

Experiment Design – 24 December 2010
Design an experiment to measure the '*willingness to help*', '*acceptability*' and '*user experience*'.

- Define *what* the experiment should indicate. **Experiment Design**
- Get approval for the experiment by the Philips' Ethical Committee. **Organizational**
- Arrange facilities for pilot and gather subjects. **Organizational**

Execute pilot

- Execute pilot and analyze pilot results. **Experiment Design**
- Redesign experiment according to results from the pilot. **Experiment Design**
- Arrange facilities for experiment and gather subjects. **Organizational**

Conduct experiment – 10 February 2011
Execute experiment EmoBuddy

- Execute user tests to define if EmoBuddy stimulates social support concerning stress. **Conduct Experiment**

Analyze experiment results

- Analyze data from experiments. **Analysis**
- Assess Acceptability. **Analysis**
- Assess viability, sustainability EmoBuddy. **Analysis**

Evaluate EmoBuddy Concept – 18 March 2011

Documentation EmoBuddy project

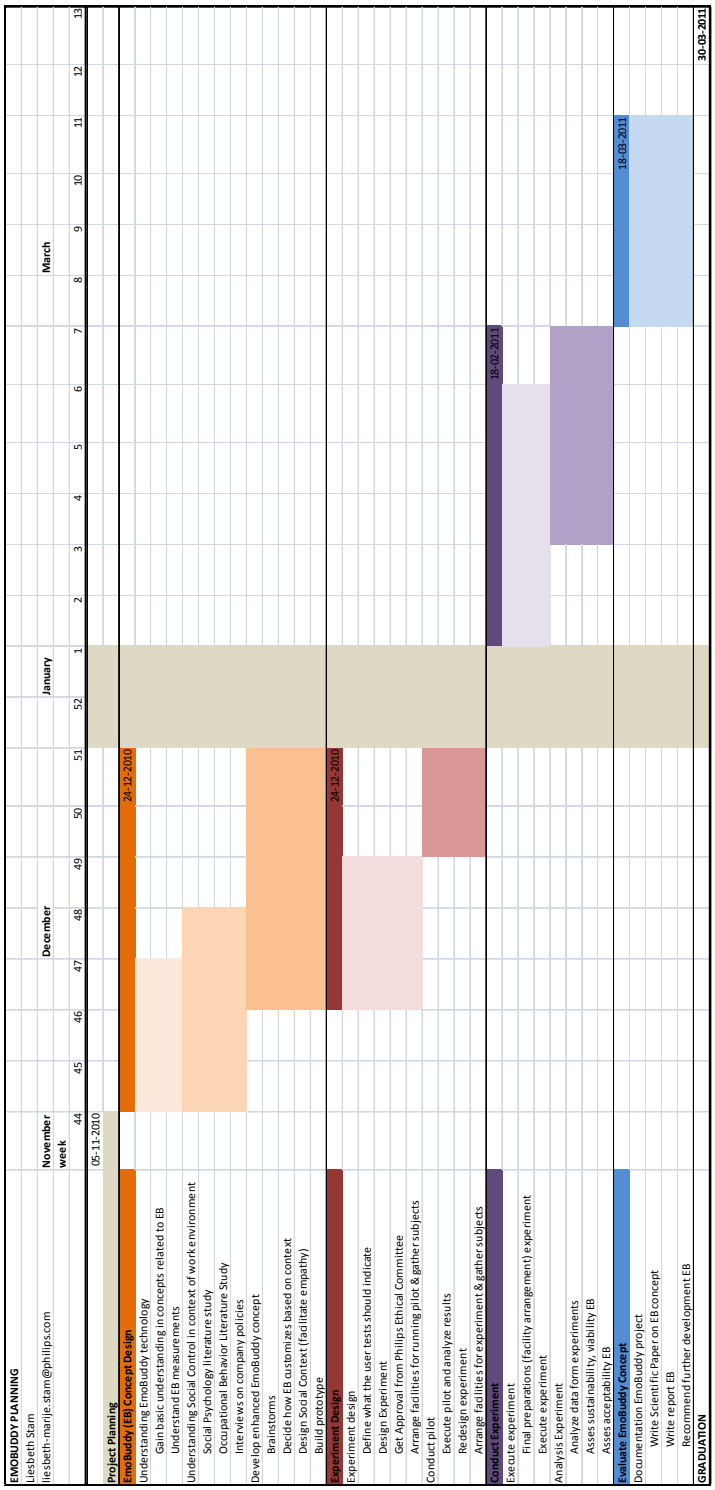
- Write Scientific Paper on EmoBuddy concept. **Document**
- Write report. **Document**
- Recommend further development EmoBuddy. **Document**
-

Process Management - Methods

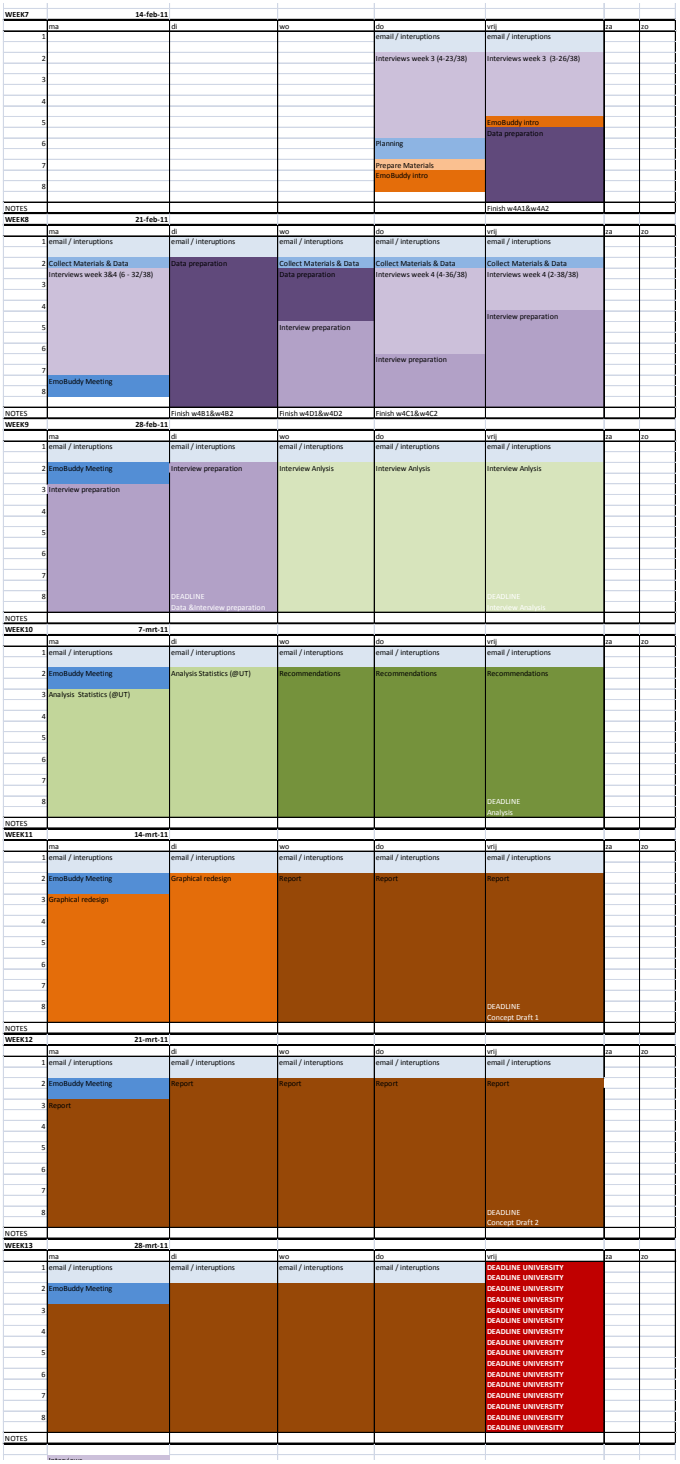
As can be deduced from the sub goals provided above the first part of this study will mainly include a literature study focusing on the fields of Social Psychology, Cognition and Occupational Behavior. Beside literature study interviews will be conducted with experts, such as company doctors or psychologists, researchers in relevant fields, employees and employers, to gain insight in current company policies concerning stress and social support.

During the concept and experiment design phase an iterative design loop [figure 2] will be applied on designing new EmoBuddy concepts. This methodology is offered as a framework and is very much driven by the product itself. W. Luton [2010] shows that the role of the designer becomes quite concrete. This unique fact makes it perfect for small teams working without external pressure in short timeframes to realize products.

B.4 Planning November 2010 – March 2011



B.5 Planning Final Phase February 2011 – March 2011



WEEK7	14-feb-11						
	ma	di	wo	do	vrij	za	zo
1				email / interuptions	email / interuptions		
2				Interviews week 3 (4-23/38)	Interviews week 3 (3-26/38)		
3							
4							
5					EmoBuddy intro		
6				Planning	Data preparation		
7				Prepare Materials			
8				EmoBuddy intro			
NOTES					Finish w4A1&w4A2		

WEEK8	21-feb-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	email / interuptions		
2	Collect Materials & Data	Data preparation	Collect Materials & Data	Collect Materials & Data	Collect Materials & Data		
3	Interviews week 3&4 (6 - 32/38)		Data preparation	Interviews week 4 (4-36/38)	Interviews week 4 (2-38/38)		
4							
5			Interview preparation		Interview preparation		
6							
7				Interview preparation			
8	EmoBuddy Meeting						
NOTES		Finish w4B1&w4B2	Finish w4D1&w4D2	Finish w4C1&w4C2			

WEEK9	28-feb-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	email / interuptions		
2	EmoBuddy Meeting	Interview preparation	Interview Anlysis	Interview Anlysis	Interview Anlysis		
3	Interview preparation						
4							
5							
6							
7							
8		DEADLINE Data & Interview preparation			DEADLINE Interview Anlysis		
NOTES							

WEEK10	7-mrt-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	email / interuptions		
2	EmoBuddy Meeting	Analysis Statistics (@UT)	Recommendations	Recommendations	Recommendations		
3	Analysis Statistics (@UT)						
4							
5							
6							
7							
8					DEADLINE Analysis		
NOTES							

WEEK11	14-mrt-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	email / interuptions		
2	EmoBuddy Meeting	Graphical redesign	Report	Report	Report		
3	Graphical redesign						
4							
5							
6							
7							
8					DEADLINE Concept Draft 1		
NOTES							

WEEK12	21-mrt-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	email / interuptions		
2	EmoBuddy Meeting	Report	Report	Report	Report		
3	Report						
4							
5							
6							
7							
8					DEADLINE Concept Draft 2		
NOTES							

WEEK13	28-mrt-11						
	ma	di	wo	do	vrij	za	zo
1	email / interuptions	email / interuptions	email / interuptions	email / interuptions	DEADLINE UNIVERSITY		
2	EmoBuddy Meeting				DEADLINE UNIVERSITY		
3					DEADLINE UNIVERSITY		
4					DEADLINE UNIVERSITY		
5					DEADLINE UNIVERSITY		
6					DEADLINE UNIVERSITY		
7					DEADLINE UNIVERSITY		
8					DEADLINE UNIVERSITY		
NOTES							

Annex C | Functionality & Requirements

C.1 Functionality

Improve (work) performance
Reduce health problems due to stress

Visualize stress [15]

- Measure stress: GSR measurement via DTI
- Interpret stress: algorithm Gert-Jan (light green, dark green, orange and red)
- Discriminate different types of stress (positive/ negative)
    - Stress due to time pressure
    - Stress due to social pressure
    - Stress due to worrying
-

[15] The First three points will not be addressed extensively in discussion or in redesign since they fall outside the scope of this project.

- Give graphic representation of the user's and buddy's stress
- Give continuous stress information on user and buddy

Guide employee in stress management

Enhance social support in the work environment

- Facilitate empathy
- Trigger feedback between user and buddy (CMC)
- Alert user when stress buddy has build up
- Alert user when stress user has build up
- Enable contact (initiation)
- Offer solutions to stress relieving
    - Free----------coercive (e.g. sketchpad, dialog box, buttons)
        - Direct attention (user to buddy)
            - Free----------coercive
        - Direct action (user to buddy)
            - Free----------coercive

Create awareness on stress development

- Alert user when the user's stress has build up
    - Direct attention (user to buddy)
        - Free----------coercive
    - Direct action (user to buddy)
        - Free ----------coercive
- Give insight in stress development user
    - Create overview user data (day/ week/ month)
    - Graphical representation of stress development user
        - Superficial----------detailed
- Give insight in stress development buddy
    - Create overview buddy data (day/ week/ month)
    - Graphical representation of stress development buddy
        - Superficial----------detailed

The functions that are italic highlight specific points that indicate choices regarding the functioning of EmoBuddy. These choices are depending on how persuasive, coercive or free EmoBuddy needs to be in direction of behavior and attention. Dependent on the individual using EmoBuddy the optimum on this scale of coerciveness can be set. Variables that can be considered are personality traits and demographics as they are an indicator of stress coping mechanisms.

C.2 Requirements

Function	Demand	Verification
Improve (work) performance	Improve work performance[16]*	Less time to complete projects
	Reduce abuse of substance*	Decrease in substance usage
Reduce health problems due to stress	Reduce stress experience	Questionnaires on affective state (DASS)
	Reduce company doctor/ psychologist visits*	Decrease in stress-related doctor/psychologist visits
	Reduce absence*	Decrease in absence
Making stress visible	Measure stress: GSR	
	Interpret stress	Questionnaire algorithm performance
	Discriminate between different types of stress* • Positive / negative • Time pressure • Social pressure • Worries	
	Give graphic representation stress user and buddy	
	Offer continuous stress information to user about user and buddy	Questionnaires usability and log user data to check (in)proper use
	Interface high usability	
Guide employee in stress management	Create insight in stress coping/ positively influence stress coping*	
Enhance Social support	Increase in contact Increase in how personal	Before – after questionnaires; measure

[16] The demands with an asterix * will likely not find verification during this project. To verify these demands EmoBuddy should be used over a long period of time (in terms of month); the scope of this project does not allow this and shall therefore focus on literature concerning the validation on these subjects.

	the buddies work relation is	# contact moments via EmoBuddy
	Facilitate empathy	Questionnaire presence empathy
	Trigger feedback on stress management between user and buddy	Questionnaire content contact
	Alert user when stress buddy has build up	
	Offer solutions to relieve stress Free----------coercive	Personality test; questionnaire coping mechanism
	Direct attention (user to buddy) Free----------coercive	
Create Awareness		Questionnaire stress awareness; log amount of use overview functionality
	Direct action (user to buddy) Suggestive----------coercive	
	Alert user when user's stress has build up	
	Direct attention (to self) Free----------coercive	
	Direct action (to self) Free----------coercive	
	Give insight in stress development user: offer overview user data (day/ week/ month) and give graphical representation Superficial----------detailed	
	Give insight in stress development buddy: over overview (day/ week/ month) and give graphical representation Superficial----------detailed	

Annex D| Prototype Development

D.1 Application Interface

EmoBuddy Interface components

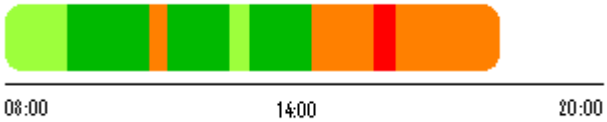
- Frame & panel, Overview tab, Interface choice tab, Avatars, Stress indication, Contact, Status, Personality indication

Overview tab

- 'Day view' button [switch to day view]
- 'Week view' button [switch to week view]

Day view (=standard setting to overview tab):

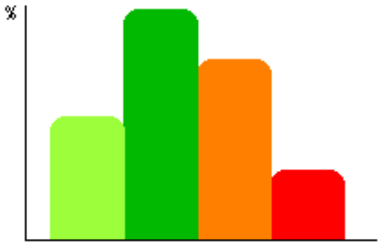
- Day overview graph:



- Next & Previous day button [show day graph previous days: array=5 days]

Week view

- Week overview graph (existing)



- 'Average' button [displaying the average week value of all the EB-users in the graph (fake)]

Interface Choice tab

- Display a scale where user can change the extent of coerciveness of the program
- Slider Scale [changes action/attention path according to slider position: correlated to personality] // Free(Entrepreneur, *Hedonist)*, Semi-Free(*Complicated, Impulsive*), Semi-Coercive (*Brooder, Insecure*), Coercive (*Skeptic, Spectator*)

Avatars

- Fixed Image
- 'Heartbeat' button [plays buddy's heartbeat sound (fake) for 30sec.]

Or

- Fixed Image - During *Setup* you can browse and upload a picture of choice as a background

Or

- Fixed image = sketch pad

Stress Indication

- [Color the avatars according to the algorithm]

Contact components

- 'Suggestion' buttons [see **appointment**] //used for both *Brooder, Insecure* and *Skeptic, Spectator* personality's
    - 3 basic – 9 additional //double if necessary
        - Coffee, Lunch, Walk, Sleep, Break, Talk, Origami, Eat, Lift Weights, etc.
- Sketch Pad
    - Pencil
    - Wiper //renew the field
    - Typing?

Status

- 'Deadline' Button [set personality type to *Entrepreneur/ Hedonist*]

Personality Indication *(different program?)*
Separate Frame containing a 20-item questionnaire

- Text fields + 5 option boxes per question [calculate personality] [communicate with EmoBuddy: select attention/action path, set slider accordingly]

D.2 Action/ Attention Path (main function)

Basic program behavior (Always start here)
Task plane shows EmoBuddy icon

- Pressing on this icon opens the full application. Hiding all but the avatars. If the pointer touched the avatars, the frame, tabs and contact options – according to personality- appear.
- [check status| buddy, user] //it only follows the personality path when buddy turns red, if the user turns red it will only pop up in his user screen and it does not stimulate to take action (this is the buddy's task). Asking for help is not stimulated, as advised by Joke Fastenau!
    - If buddy/user turns is not red [check status]
    - If buddy/ user is red → [EmoBuddy pops up: showing only the avatars][set timer 30 min. then check status]
        - If buddy is not red →[check status]
        - If buddy is red →go to specific personality path

If (personality Entrepreneur, Hedonist)
Emobuddy contains no contact options

- Basic program behavior //Emobuddy pops up when buddy is red, max. 1 per 30 minutes

If (personality Complicated, Impulsive)
EmoBuddy contains sketchpad
//buddy is still/ again in red status after first 30 min.

- [open sketchpad] [Set timer 15min.]
  - If user reacts //uses sketchpad → back to basic behavior
  - If user does not react [check buddy status]
    - Not red → back to basic behavior
    - Red → [open sketchpad] [set timer 8 min.]
      - If user reacts //uses sketchpad → back to basic behavior
      - If user does not react [check buddy status]
        - If not red → back to basic behavior
        - If red → go to personality path *Brooder, Insecure* [open first suggestion button set]

//54 minutes before you reach other level of coerciveness

If (personality Brooder, Insecure)
EmoBuddy contains basic suggestion buttons
//Buddy is still/ again in red status after first 30 min.

- [opens the first suggestion button set] [Set timer 15 min.]
  - If the user reacts → [check appointment]
    - If yes→go back to basic behavior
    - If no → continue path
  - If the user does not react → [check status]
    - If not red →go back to basic behavior
    - If red → [open second suggestion button set] [Set timer 7 min.]
      - If user reacts [check appointment status]
        - If yes → go back to basic behavior
        - If no → continue path
      - If user does not react2 → [check status]
        - If not red →[remove second button set] [restart personality path, keep first button set open]
        - If red → [open third button set] [set timer 4 min.]
          - If user reacts→ [check appointment status]
            - If yes→go back to basic behavior

        - If no → continue path
    - If user does not react→ [check status]
        - If not red → [remove second and third button set] [restart personality path, keep first button set open]
        - If red→ go to personality path *Skeptic, Spectator*

//56 minutes before you the next level of coerciveness

Appointment

Suggestion button is pressed by user →[symbol suggestion button appears in avatar with question mark][set timer 5 min.] [check]

- Buddy does not react: no appointment →[clear avatar] go back to program behavior path
- Buddy presses different suggestion button→ [symbol appears in avatar with question mark] [set timer 5 min.] restart appointment check
- Buddy presses same suggestion button: appointment yes →[the symbol enlarges, question mark changes in exclamation point] go back to behavior path

If (personality Skeptic, Spectator)

EmoBuddy contains suggestion buttons

//Buddy is still/ again in red status after first 30 min.

- [Opens full suggestion button set] [Enlarges one specific button and places a question mark] [set timer 30 min]
    - If user reacts, check appointment: yes → Back to basic behavior
    - If user does not react, buddy not in red status→ [set timer 30min.] loop
    - If user does not react, buddy still/ again in red status→ [enlarge different button] [Set timer 15min.]
        - If user reacts → [check appointment]
            - If yes → go back to basic behavior
            - If no → continue path
        - If user does not react → [check status]
            - If not red →
            - If red→ [enlarge different button] [Set timer 5 min.][loop last cycle]

Annex E | User test materials

This Appendix contains user test material: The participant consent form, start-up survey, daily survey, final interview and final survey.

E.1 Participant consent form

Consent for Participation in the Philips Research **EmoBuddy Experiment**

INFORMED CONSENT FORM

I volunteer to participate in the EmoBuddy experiment.

The purpose and objective of this investigation are to gain more insight in user experience on EmoBuddy during normal work activities. In this study I will be asked

to use the EmoBuddy desktop application during work while skin conductance will be measured continuously.

There are no known potential risks associated with my participation in this investigation, except for people with nickel allergy. I declare I do not have a nickel allergy. Also the experimenter cannot and does not guarantee or promise that I will receive benefits from this study.

I have been informed and understand my role in the registration, participation and execution of the above mentioned investigation.

I had sufficient time to consider my participation into this investigation and I am aware that participation in this experiment is completely voluntary.

I realize that I may decide to refuse participation or stop participation at any time without penalty or loss of benefits to which I am otherwise entitled. I have the right to refuse to answer particular questions.

I understand and agree that personal information about me will be collected during this investigation, which will be used and processed anonymized (manually/ or by computer) by the researcher, responsible for this investigation.

I understand that I am entitled to access the personal information collected about me and to have inaccuracies corrected.

I agree to receive data with regard to my personal health, resulting from this investigation, as deemed appropriate by the researcher.

If I have any questions, concerns, or complaints about this research study, its procedures, risks and benefits, I should ask Liesbeth Stam, HTC34.4.065, liesbeth-marije.stam@philips.com.

I agree to participate in this investigation.

Volunteer

---------- ---------- ----------

Name Signature Date

E.2 Handout

Information EmoBuddy User Studies

Thank you for your participation in the EmoBuddy user studies!

This experiment aims to gain understanding in how users experience EmoBuddy, a desktop application developed to guide employees in their stress management.

You will be asked to use the EmoBuddy application and wear the GSR wristband during four normal workdays. If you have any kind of allergic reaction to the device or skin irritation, please make sure to contact me. During the four days of testing you are coupled to your so called buddy who will have the same task. Please stick to your normal work activities during the test.

Each day you will be asked to fill out a short questionnaire. In the week after the user test you will be invited for a final interview, taking 30 minutes of your time.

Start up Manual

Please follow the following instructions for starting up. If there are any questions/ problems let me know! Liesbeth Stam/ liesbeth-marije.stam@philips.com / +316 19466991/ HTC34 4 065
In case I am not there you can contact Gert-Jan de Vries/ gj.de.vries@philips.com / 040 2748237/ HTC34 4 037 or Elke Daemen/ elke.daemen@philips.com / 040 2741603/ HTC34 4 013.

Start up

1. Fill out the questionnaire.
2. Remove GSR Module from charger and place in wristband.
3. Put on the wristband, turn the sensor on.
4. Start Laptop using: username: EmoBuddy and password: Emo2011!
5. Start ESTE on laptop: choose *start data server only/ full application.*
6. Start the EmoBuddy application on your computer.

During your workday you are asked to stick to your normal work activities. Leave the sensor turned on during breaks or meetings.

The end

1. Close EmoBuddy application.
2. Turn off the sensor and take the wristband off. Take out the module and charge it according to the picture on the next page.

3. Fill out the questionnaire.
4. Open the EmoBuddy Overview application (start – EmoBuddy – EmoBuddy Overview), select the correct date and adapt the slider.
    - The overview indicates your stress level throughout the day. However you might have experienced a different emotional intensity than EmoBuddy portrays. You can use the slider to adjust to the stress intensity you experienced.
5. Close the ESTE application on the laptop. Overnight you can leave the laptop on.

That's it!

EmoBuddy User Studies

Start up Survey

Please answer the following questions. The answer will remain anonymous and will only be used for this experiment

Gender: male/ female Age: ….

Do you use medications that can cause sedation or calmness? O yes O no

Which hand is your dominant hand? O right O left

On which wrist do you wear the wristband? O right O left

How often do you and your buddy have face to face contact? ……per day/week/month

How often do you and your buddy have contact in another way such as by telephone or email? ……per day/week/month

Is the contact personal, work related or both, can you estimate a percentage? …. % personal, …. % work related

How would you describe the relationship with your buddy?
……

Daily Survey

Please fill in the following questionnaire at the start of your working day

Date …./…./…. Day: Mon/ Tue/ Wed/ Thu/ Fri/ Sat/ Sun

		1	2	3	4	5	6	7	
How did you sleep last night?	very bad	O	O	O	O	O	O	O	very good
Do you feel stressful?	not at all	O	O	O	O	O	O	O	very much
Do you feel tired?	not at all	O	O	O	O	O	O	O	very much

Please start up ESTE (Emotion Sensor Test Environment) on the laptop.

Please fill in the following questionnaire at the end of your working day

0 did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree, or a good part of the time
3 Applied to me very much, or most of the time

I found it hard to wind down	0	1	2
I was aware of dryness of my mouth	0	1	2
I couldn't seem to experience any positive feeling at all	0	1	2
I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in absence of physical exertion)	0	1	2
I found it difficult to work up the initiative to do things	0	1	2
I tended to over react to situations	0	1	2
I experienced trembling (e.g. in the hands)	0	1	2
I felt I was using a lot of nervous energy	0	1	2
I was worried about situations in which I might panic and make a fool of			

myself	0	1	2
I felt that I had nothing to look forward to	0	1	2
I found myself getting agitated	0	1	2
I found it difficult to relax	0	1	2
I felt down-hearted and blue	0	1	2
I was intolerant of anything that kept me from getting on with what I was doing	0	1	2
I felt I was close to panic	0	1	2
I was unable to become enthusiastic about anything	0	1	2
I felt I wasn't worth much as a person	0	1	2
I felt I was rather touchy	0	1	2
I was aware of the action of my heart in the absence of physical exertion (e.g. heart rate increase, heart missing a beat)	0	1	2
I felt scared without any good reason	0	1	2
I felt that life was meaningless	0	1	2

How did EmoBuddy affect your workday?		1	2	3	4	5	6 7
	very negative	O	O	O	O	O	O O very positive

How often did you and you buddy meet via Emobuddy? …….

How often did you and your emobuddy meet but not via EmoBuddy? …….

Please indicate any special circumstances or events that could have influenced your physiological measurements and you feel is important to note:

……

……

……

……

Do you have any general comments on using EmoBuddy today?

……

……

……

……

Please start up EmoBuddy Overview via *Start – All programs –EmoBuddy – EmoBuddy Overview* **select the correct day and adjust the slider according to the stress intensity you experienced.**

Please end the ESTE session on the laptop but leave the laptop on.

E.3 Final Interview

Final Interview EmoBuddy User Studies

1. Je hebt EmoBuddy bijna een volle werkweek gebruikt. Hoe was dat?
2. Hoe verliep je werkweek? Was het een normale week of waren er bijzonderheden, die extra stress op leverden?
3. Hoe heb je EmoBuddy gebruikt? Heb je er vaak naar gekeken? Of alleen als de applicatie waarschuwingen gaf?
4. Hoe heeft EmoBuddy je werk beinvloedt? In hoeverre beperkte Emobuddy je werk activiteiten? Was je in staat om alles te doen wat je normaal doet?

Algorithm

1. Kon je de interpretatie EmoBuddy relateren aan emotie?

2. Sloot Emobuddy aan bij jou stress-ervaring? Measurement vs. Experience?
3. Waren er momenten waarop je verwachtte dat EmoBuddy zou verkleuren en dat niet deed? Kun je daar iets meer over vertellen?
4. Waren er momenten dat Emobuddy reageerde maar dat je het helemaal niet verwachtte? Kon je dat wel aan iets anders relateren, zoals temperatuur/ beweging?
5. Wanneer zou je iemand als gestrest ervaren? En puur op basis van kleur?

Persoonlijkheid

1. Hoe ga jij normaal met stress om?
2. Past EmoBuddy daarbinnen? Sluit EmoBuddy aan op jouw manier om met stress om te gaan?
3. Heb je de deadline button wel eens gebruikt? Waarom?

Awareness

1. Heb je de overview button wel eens gebruikt? Wat deed je met die informatie?
2. Maakt het je bewust van je emotionele toestand?
3. Kon je de rode punten relateren aan specifieke momenten? Ging je terug in de tijd om te bedenken wat je op die momenten deed?

Contact

1. Heb je meer contact gehad met je buddy dan normaal? Hoe ging dat?
2. Bespraken jullie bijvoorbeeld dezelfde onderwerpen als anders?
3. Hebben jullie gesproken over stress/ stressgerelateerde onderwerpen?
4. Heeft het gebruik van EmoBuddy jullie relatie beïnvloed?
5. Denk je dat EmoBuddy überhaupt jullie relatie zou kunnen beïnvloeden?

6. Vond je dat EmoBuddy beschikte over goed mogelijkheden om contact te leggen?

   Of zou je dit liever anders zien? Hoe?
7. Werd je rustiger?
8. Zou je het fijn vinden om een meer persoonlijke relatie te krijgen met een collega?
9. Wie kunnen buddy's van elkaar zijn?
10. Op een 7 punt schaal van persoonlijk tot werkgerelateerd hoe persoonlijk moet de relatie zijn?

Empathie

11. Werd jij beinvloedt door de emotionele staat van jou buddy? Hoe?
12. Was je wel eens nieuwschierig wat er was als je buddy van kleur veranderde? Of maakte je je zorgen?
13. Voelde jij je verplicht om contact op te nemen met je buddy?
14. Ervoer je die wetenschap (emo staat buddy) wel eens als belastend?
15. Denk je dat EmoBuddy een manier is om social support op de werkvloer te versterken?

Einde

16. Hoe denk je dat EmoBuddy verbeterd kan worden?
17. Zou je EmoBuddy gebruiken?

E.4 Final Survey

Final Survey EmoBuddy User Studies

Please answer the following questions. The answer will remain anonymous and will only be used for this experiment

How often did you and your buddy have face to face contact past week? …… times per day/week

How often did you and your buddy have contact in another way such as by telephone or email past week? …… times per day/week

Is the contact personal, work related or both, can you estimate a percentage? …. % personal; …. % work related

How would you describe the relationship with your buddy?

Annex F | List of Variables

F.1 Variables Interview

Experiences stress from color?	Green (1), yellow(2), orange(3) red(4)
Red acceptable?	No (0)/ Yes (1)
Work week	Quiet (1)/ Normal (2)/ Stressed(3)
Limited your work?	No (0)/ Yes (1)
Correlation Stress	No (0)/ Yes (1)
Measurements vs. Experience	Too green(1)/ ok(2)/ too red(2)
Did you experience stress moment, while EB did not react?	No (0)/ Yes (1)
Trust in measurement	0 - 10
Correlation with events via overview	No (0)/ Yes (1)
Create stress awareness	No (0)/ Yes (1)
More contact than before	No (0)/ Yes (1)/ Same(2)
Influence relationship	No (0)/ Yes (1)
Different contact	No (0)/ Yes (1)

Did contact give you a positive feeling?	No (0)/ Yes (1)/Neutral(2)
Did you feel more relaxed after meeting?	No (0)/ Yes (1)
Contact content more personal	No (0)/ Yes (1)
More personal relationships in work environment desirable?	No (0)/ Yes (1)
Can EmoBuddy change a relationship?	No (0)/ Yes (1)
Desired relationship buddy? How personal should a work relation be?	0 - 10
Empathy	No (0)/ Yes (1)
Feeling responsibility towards buddy	No (0)/ Yes (1)
Obligation to react	No (0)/ Yes (1)
Experienced as a burden	No (0)/ Yes (1)
Long term burden?	No (0)/ Yes (1)
Would you use EmoBuddy social function?	No (0)/ Yes (1)
Would you use EmoBuddy awareness function?	No (0)/ Yes (1)
Product material?	No (0)/ Yes (1)
Does EmoBuddy enhance social support in the workplace?	No (0)/ Yes (1)

F.2 Variables Daily Survey

BFI -N	%
BFI-E	%
BFI-C	%
BFI-O	%
BFI-A	%
Gender	Male/ Female
Gender buddy	Male/ Female
Dominant hand	Left/ Right
Wristband dominant hand	Left/ Right
F2F contact before	#
Other contact before	#
% personal related before	%
% work related before	%
F2F contact during EB	#
Other contact during EB	#
% personal related EB	%
% work related EB	%
Over 4 Days of EmoBuddy Usage:	

Sleep indication	Likert 7, very bad – very good
Tiredness indication	Likert 7, not at all – very much
Stressfulness indication	Likert 7, not at all – very much
Week day	Mon/ Tue/ Wed/ Thu/ Fri
Affect work	Likert 7, very negative – very positive
EB contact	#
Other Contact	#
DASS	0 – 42

F.3 Data Variables

Overall Histogram	#Samples Grey/ Green/ Yellow/ Orange/ Red
Total # Samples	#
Over 4 Days of EmoBuddy Usage:	
Day Histogram	#Samples Grey/ Green/ Yellow/ Orange/ Red
# Samples	#
# Sessions	#
Time span (sec, hrs)	Sec, hrs
Duration sessions (sec, hrs)	Sec, hrs
Coverage – Time span	%
Coverage - Duration	%
Bad Data	%
Average SC	mS
Both Active & Colored	%
Button Events	#
Coffee Button presses	#
Walk Button Presses	#
Lunch Button Presses	#
Equal Icons	#
Unanswered Events	#
Green during event Me	#
Yellow during event Me	#
Orange during event Me	#
Red during event Me	#
Green during event Other	#
Yellow during event Other	#
Orange during event Other	#
Red during event Other	#
Parameter setting	Value