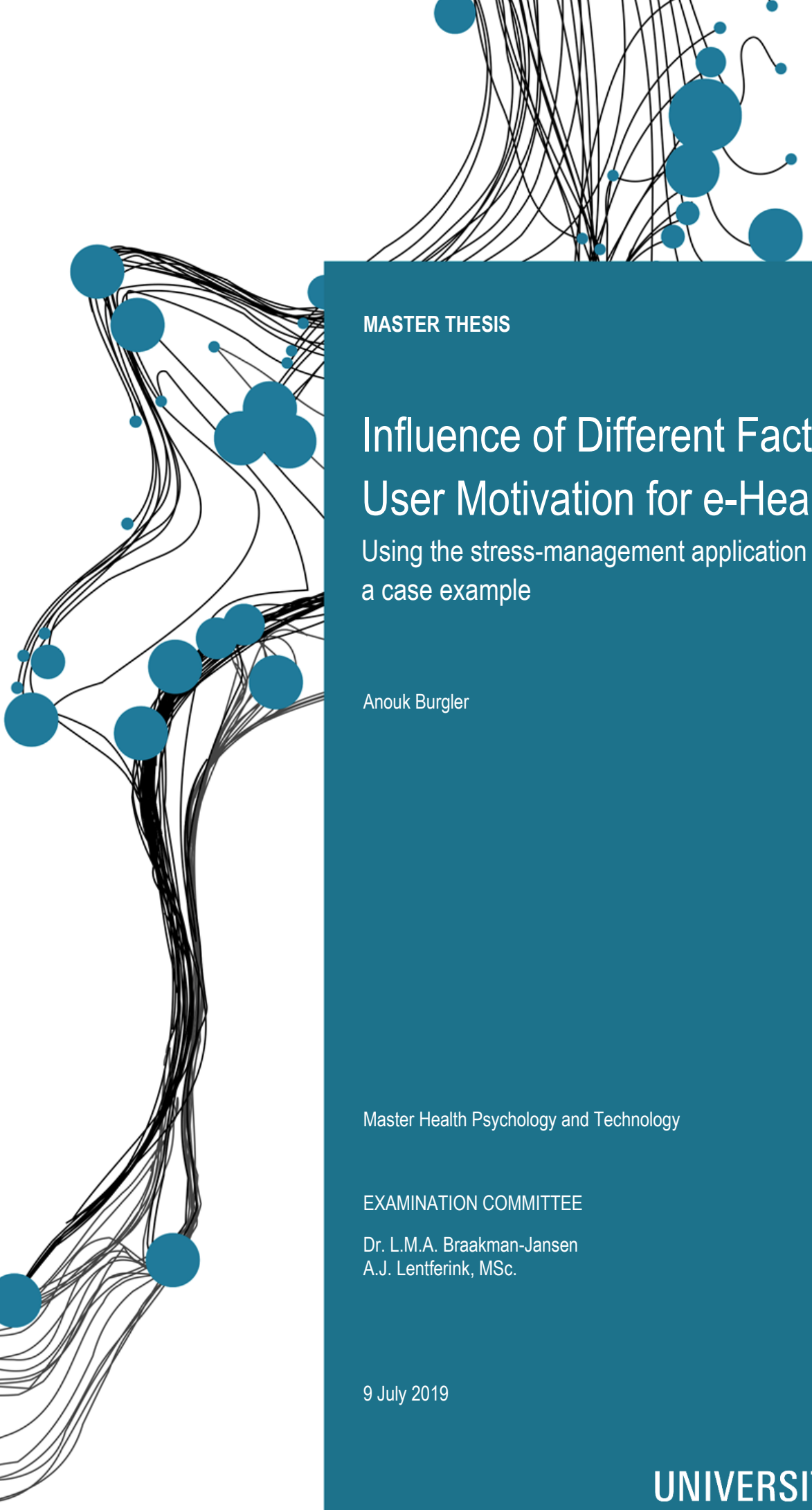

MASTER THESIS

Influence of Different Factors on User Motivation for e-Health

Using the stress-management application BringBalance as a case example

Anouk Burgler

Master Health Psychology and Technology

EXAMINATION COMMITTEE

Dr. L.M.A. Braakman-Jansen
A.J. Lentferink, MSc.

9 July 2019

UNIVERSITY OF TWENTE.

Abstract

Background: Stress under employees has increased extremely in the Netherlands and is imposing great pressure on public health. A large group of employees is at risk of suffering from long-term consequences of stress, which asks for affordable and scalable solutions for the prevention of stress. Therefore, mobile e-health applications have great potential for the prevention of stress. However, the effectiveness of e-health is often reduced by a lack of user motivation. The COM-B system and SDT describe contextual and internal factors that can influence motivation. This study will use these models to identify factors that influence user motivation for e-health, based on the experiences of users of the stress-management application BringBalance.

Objectives: The aim of this study is to identify the influence of the different components of the COM-B system and the SDT, by finding barriers and stimulators, which decrease or increase the motivation to use BringBalance. Also finding possible improvements for increasing user motivation by making use of the category *dialogue support* of the PSD-model will be investigated.

Methods: Qualitative research was performed by conducting semi-structured interviews with seven new users of BringBalance in order to identify barriers, stimulators and possible improvements to increase user motivation for stress-management.

Results: Results showed that in the case of BringBalance, user motivation was mainly decreased by the character of the application, such as the demandingness, while the content of the stress-management application was mostly experienced as stimulating. Besides, several improvements were mentioned to increase user motivation, such as the customization of reminders.

Conclusion: The combination of the COM-B system and the SDT provided a good overview of the contextual and internal factors that influenced user motivation for the stress-management application BringBalance. Also, the features of the category *dialogue support* of the PSD-model are promising in reducing a barrier, using a stimulator or preserving the balance between both in order to increase user motivation. Therefore, the combination of the COM-B system, SDT and PSD-model can be useful for increasing user motivation for e-health application.

Keywords: user motivation, e-health, stress-management, COM-B system, self-determination theory, persuasive features, PSD-model, dialogue support

Table of Contents

1. Introduction

Stress and stress related diseases are extremely increased worldwide, creating a major threat to public health. According to the World Health Organization 1 out of 3 employees in Europe experience stress at work (Leka & Jain, 2010). The Dutch organisation TNO presented that 36 percent of work absenteeism was caused through stress at work (Hooftman et al., 2015). In addition, 15 percent of all the employees in the Netherlands experience symptoms of burn out as consequence of long-term stress (CBS, 2018). Stress can be caused by a lot of different factors which can be work related or personal, such as work overload, time pressure or family problems (Michie, 2002; Schaufeli, Bakker, & Van Rhenen, 2009). Long-term stress can lead to various physical and mental health problems, such as coronary heart disease, anxiety, depression or burn out (Michie, 2002; Schaufeli, Bakker, & Van Rhenen, 2009). But it can also lead to sleeping problems, drug addiction, concentration problems and a decreased ability to make decisions (Michie, 2002). All this together, for individuals who are exposed to long-term stress this can lead to a decline in wellbeing, quality of life and health. Besides, the increase in stress under employees lead to high costs for employers, the government and the community as a result of an increase in absenteeism at work and reduction of the quality and quantity of work (Michie, 2002). For example, work stress related absenteeism in 2012 did cost employers in the Netherlands almost 2 billion euros (van der Ploeg, Pal, Vroome, & Bossche, 2014). Altogether, a large group of employees experience stress or are exposed to a high amount of stress factors and are therefore at risk to experience the long-term consequences of stress. Thus, more attention for prevention and reduction of stress under employees is needed in order to prevent individual harm and decrease the costs caused by stress related problems.

Stress can be defined as the interaction between a psychological and physical state of the body which occurs when an individual has insufficient resources to cope with the demands of a situation, also called the stressor (Michie, 2002). The cognitive transactional model of stress developed by Lazarus (1993) explains the psychological component of stress as a combination between an individual's interpretation of the stressor and the available resources to cope with this stressor (Morrison & Bennett, 2012). When a possible stressor is appraised as harmful, threatening or challenging, then an individual assessment is made of the resources and coping abilities. Stress is experienced when a stressor is perceived as threating in combination with low perceived coping abilities. Whereas high perceived coping abilities would lead to less or no stress, because the individual has the resources to deal with the stressor (Morrison & Bennett, 2012). There are two types of stress, acute and chronic stress. Acute stress can be manageable for a short time, such as a deadline or an exam (Morrison & Bennett, 2012). In this case, acute stress can be very useful in order to survive or to perform better. However, when a stressor persists and is present for a longer time, stress can become chronic (Morrison & Bennett, 2012). Selye's General Adaptation Syndrome (1974) is a model that gives a physical explanation of this process. In case of a stressor an alarm reaction activates the body into the so-called fight-or-flight response, acute stress. This response is caused by activation of the sympathetic nervous system, which increases adrenaline levels and thus increases heart rate and breathing (Morrison & Bennett, 2012). After the alarm reaction a stage of resistance occurs. In this stage the body tries to adapt to the persistent stressor. If the resistance stage lasts too long, it leads to exhaustion of physical and mental resources. When the stage of exhaustion occurs stress has become chronic (Morrison & Bennett, 2012; Selye, 1974) and could lead to various health problems such as a burn-out. The amount of experienced stress can differ between situations and between individuals, because every individual is exposed to different risk factors and has a unique set of resources which

influence the interpretation of a stressor (Morrison & Bennett, 2012). Therefore, stress is also a dynamic process which can change over time through adaptation and the improvement of resources (Morrison & Bennett, 2012), for example by creating more resilience. Charney (2004) describes resilience as the ability to adapt to acute stress while psychological well-being is maintained and physical stress levels are quickly recovered to normal. Consequently, resilient individuals can handle stressors without a large impact on daily life.

Stress-management strategies can be used to increase resilience and decrease stress levels by improving resources and coping abilities. Reflective coaching is an example of a stress-management strategy which makes use of the coaching's model of Gilbert and Trudel (2001). This model is originally developed to learn youth sport coaches how to coach through a reflective process (Gilbert & Trudel, 2001). Reflective coaching can be applied as a stress-management intervention where participants learn under supervision of a coach to identify which factors lead to stress. Followed by the determination of (reflective) strategies to deal with the stressor and experimentation with these strategies in daily life. At last the participants reflect on the impact of a certain strategy on the stressor. The reflecting process where participants learn to use strategies such as positive thinking or experiencing positive emotions can be used to increase resilience (Ong, Bergeman, Bisconti, & Wallace, 2006).

The face-to-face approach of coaching under supervision of a human coach can be effective (Rijken et al., 2016), but is also very time intensive and expensive. In the case of stress prevention, the number of employees at risk is very large and problems can be expected concerning manpower and costs of the face-to-face approach. Prevention of stress on such a large scale requires more scalable and affordable effective stress-management interventions (Heber et al., 2017). Through the increased use of the internet, the potential of e-health for stress-management has increased extremely (Heber et al., 2017; van Gemert-Pijnen, Kelders, Kip, & Sanderman, 2018). E-health contains all technology that can be used for the support and improvement of health care (Eysenbach, 2001), examples of technology useful for stress-management are mobile applications and wearables. Mobile applications have a huge potential for stress-management, because the scalability through the widespread availability and popularity of mobile phones has created opportunities to integrate stress-management interventions into daily life. The easy access throughout the day makes it possible to intervene at the right moment, even at times or places that are unreachable for a human supporter (van Gemert-Pijnen et al., 2018). This can be necessary to achieve behavioural change (IJsselsteijn, De Kort, Midden, Eggen, & Van Den Hoven, 2006; van Gemert-Pijnen et al., 2018). Besides, a stress-management application can increase the access to care through the 24/7 availability and hidden participation (Heber et al., 2017; Lal & Adair, 2014; van Gemert-Pijnen et al., 2018), this can reduce barriers such as a lack of time or the fear of stigma which are often experienced by employees (Carolan & de Visser, 2018). Also, the addition of biofeedback from wearables can be of potential value for stress-management applications. Wearables are able to measure at exact the right time and place and can collect automatically data of a lot of different body functions, including measurements that could indicate stress levels (van Gemert-Pijnen et al., 2018). Therefore, wearables can, when used correctly, be used to provide the user with biofeedback to increase the understanding of their own body and provide insight in how the user can positively influence their health and stress levels (Lentferink et al., 2017; van Gemert-Pijnen et al., 2018). This asks for a good balance between technological, human and contextual factors during the development process which requires a human-centred design (van Gemert-Pijnen et al., 2018; van Gemert-Pijnen et al., 2011). A human-centred design is based on the lives and needs of the end users.

The iterative process including users and other stakeholders is the key for development of an application that fits the user (van Gemert-Pijnen et al., 2018).

The effectiveness of e-health is often reduced by a lack of user motivation (van Gemert-Pijnen et al., 2018). Therefore, it is important to design an application which is able to motivate people to start using it, but also keep using it. A model that provides more insight in the contextual factors that influence the motivation for a certain behaviour, for instance application usage, is the COM-B system developed by Michie, Van Stralen and West (2011) . The COM-B system describes motivation as all reflective and automatic processes in the brain that directs and energize behaviour. This can be conscious reflective processes, such as decision-making and goal setting. But also unconscious automatic process, such as emotional responses and habitual processes (Michie et al., 2011). According to the COM-B system motivation is influenced by capability and opportunity. Capability can be described as the physiological and physical capacities of the individual to perform the desired behaviour (Michie et al., 2011). This means that the individual has sufficient technological knowledge and skills to use an mobile application for the self-management of stress (van Gemert-Pijnen et al., 2018). But it includes also self-efficacy, the individual beliefs in one's ability to use this application for reflective coaching without human support (Bartholomew, Parcel, Kok, Gottlieb, & Fernández, 2011). Secondly, opportunity can be defined as the physical and social factors outside of the individual that facilitate or stimulate the behaviour (Michie et al., 2011). Examples of physical opportunity are the ease of use of technology, the fit between user and technology and the availability of technology. While social opportunity is about whether the individual has the feeling that it is safe or accepted to use the application. All three components: motivation, capability, and opportunity influence behaviour, but performing a behaviour can also influence all three components (Michie et al., 2011), these interactions can be seen in Figure 1.1. However, motivation can be seen as the central component for performing a behaviour. Because even when capability and opportunity are available, without a sufficient level of motivation the behaviour will not occur (Noorbergen, Adam, Attia, Cornforth, & Minichiello, 2019).

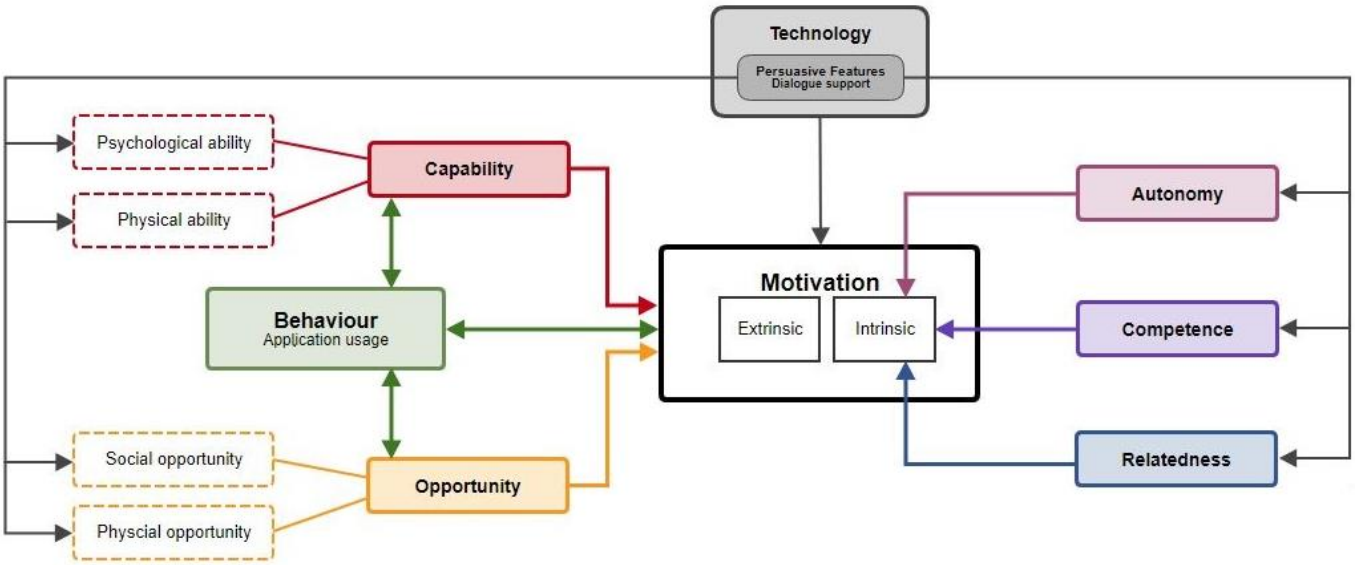

Figure 1.1. Overview of the interaction between the components of the COM-B system, the SDT and PSD-model on the central component motivation.

The COM-B system provides a good overview of the contextual factors that can influence motivation. Furthermore, it is also interesting to gather understanding of the internal factors that influence

motivation, the intrinsic and extrinsic motivation of users. Intrinsic motivation is the tendency for learning and exploration that exists in the individual itself and which is driven by the sole satisfaction of performing the behaviour (Ryan & Deci, 2000). While extrinsic motivation is driven by outcomes other than the performed behaviour itself. Extrinsic motivation can arise through non-autonomous external factors such as coercion or punishment, but also through autonomous factors such as the reward of accomplishing a goal through performing the behaviour (Ryan & Deci, 2000). When people are intrinsic motivated the behaviour change will persist longer (Mohr, Cuijpers, & Lehman, 2011; Ryan & Deci, 2000). The Self-Determination Theory (SDT) describes that intrinsic motivation can be stimulated or diminished by three environmental factors: autonomy, competence and relatedness (Ryan & Deci, 2000), see Figure 1.1. Autonomy refers to the need to have the freedom to be in control and to make choices in accordance with one's identity. While competence refers to the need to feel able to achieve the desired outcome. And the third factor relatedness, refers to the need for a sense of belonging and the need to feel valued by others (Ryan & Deci, 2000). Thus, the extent to which users have the freedom to make their own choices during a stress-management intervention, feel capable of achieving the desired outcomes and feel related to others by using the stress-management application can also influence user motivation.

The combination of the COM-B system and SDT can provide insight in which factors influence user motivation, which is important knowledge for the development of new e-health applications which fit the user. The Value Proposition Canvas is a useful tool for identifying positive or negative influences on user motivation based on three elements: customer pains, customer gains and customer jobs (Osterwalder, Pigneur, Bernarda, & Smith, 2014). Customer pains, further called barriers, are things that lower the motivation to use the application, such as undesired outcomes or obstacles (Osterwalder et al., 2014). Customer gains, further called stimulators, are those things that users want to achieve, expected outcomes by users or benefits that users seek. Some gains are required or expected by the user, when these are not met it can become a barrier. While desired and unexpected gains can act as stimulators to use the application (Osterwalder et al., 2014). At last, customer jobs are the things that users want to get done by using the application. When customer jobs are met it can be a stimulator, otherwise it can be a barrier. User motivation can be improved by adding or altering a stimulator or by removing or modifying a barrier, for example by making technology more persuasive through the addition of persuasive features. Research found that persuasive features seems to have a positive effect on the adherence and effectiveness of unsupported interventions and may have the same effect as human support (Kelders, Bohlmeijer, Pots, & van Gemert-Pijnen, 2015). Oinas-Kukkonen and Harjumaa (2009) developed a framework for persuasive system design (PSD-model) which categorized persuasive features into four categories: primary task support, dialogue support, system credibility support and social support. Noorbergen et al. (2019) mentioned the features of the category *dialogue support* as most important for increasing motivation. Because these features are aimed at keeping the user motivated to use the system and supporting the user to reach the desired behaviour (Lehto, Oinas-Kukkonen, Pätiälä, & Saarelma, 2012; Oduor & Oinas-Kukkonen, 2017). Furthermore, persuasive features can also act as indirect stimulators for motivation through the stimulation of other components of the COM-B system and SDT. For example, the increase in competence through verbal reward and positive feedback can increase user motivation (Mohr et al., 2011). In conclusion, the growing evidence in literature suggests that the persuasive features of the category *dialogue support* could be a valuable addition for increasing user motivation, by reducing a

barrier or reinforcing a stimulator associated with the different components of the COM-B system and SDT.

There is still a lot unknown about how these components influence user motivation and how user motivation can be improved, while user motivation is crucial for success (van Gemert-Pijnen et al., 2018). No previous research has investigated the combination between the COM-B system and SDT to gather insight in which contextual and internal factors influence the motivation to use e-health. Furthermore, users of a stress-management intervention are experiencing some level of stress and possibly also consequences such as concentration problems or fatigue. Besides, stressed users have already a lot of things that asks for their attention. It is unclear how stress levels will influence the motivation for using an application. At last, also the characteristics of an application can influence user motivation. Therefore, especially for development of a stress-management application that fits the user according user centred design contextual and internal factors cannot be ignored. In this research the mobile stress-management application BringBalance will be used as a case example for research into the different factors that influence user motivation for e-health. A broader description of BringBalance can be found in the method section. The application BringBalance is already using some persuasive features from the category *dialogue support*, which can have a crucial role in supporting the users interactions with the system to keep them motivated to use the application (Oduor & Oinas-Kukkonen, 2017). However, it is unknown what the impact of these features are in a stress-management intervention and how these features can be used to improve the user motivation of BringBalance. In conclusion, more insight is needed into the impact of contextual factors, internal factors and characteristics of an e-health application on user motivation. Because, it is important that a stress-management application is persuasive and motivates the stressed user to use the application, otherwise it becomes another thing that is asking for their attention.

This research will focus on factors that influence user motivation for e-health, based on the experiences of users with the stress-management application BringBalance. The focus will be on the influence of the different components of the COM-B system and the SDT, by finding barriers and stimulators, which decrease or increase the motivation to use BringBalance. In addition, possible improvements for increasing user motivation by making use of the category *dialogue support* of the PSD-model will be investigated. This leads to the following research questions:

1. What are barriers and stimulators experienced by new users of BringBalance regarding user motivation using the COM-B system and the SDT as a theoretical framework?

2. Which features from the category *dialogue support* of the PSD-model of Oinas-Kukkonen and Harjumaa (2009) could improve user motivation based on the experiences of users of BringBalance?

2. Methods

2.1. Background BringBalance

The application BringBalance is developed to combine self-tracking with e-Coaching and is based on the existing face-to-face method "Werken aan veerkracht". BringBalance is owned by De Maar training & advies[1] and is developed in collaboration between the University of Twente and the Hanzehogeschool Groningen. The method "Werken aan veerkracht" is an effective face-to-face stress-management intervention (Rijken et al., 2016) that is aimed at reducing stress by increasing resilience based on the psychophysiological coherence model (McCraty, Atkinson, Tomasino, & Bradley, 2009; McCraty & Zayas, 2014). Psychophysiological coherence is the state of the body in which the body is relaxed and in balance. This state can occur spontaneously through sleep and positive emotions or it can be created through breathing exercises and self-activation of positive emotions (McCraty, 2001; McCraty & Zayas, 2014). An individual that controls psychophysiological coherence even during challenging situations has become more resilient (McCraty, 2001).

The application BringBalance tries to interpret and reflect on self-tracking data received from biofeedback and Ecological Momentary Assessment (EMA). EMA is a method which can be very useful to research behavioural and cognitive processes in a real life setting without the threat of biases such as recall (Spook, Paulussen, Kok, & Van Empelen, 2013; Stone & Shiffman, 1994). Therefore, measurements must be carefully timed, repeated and carried out in the natural environment of the participant (Stone & Shiffman, 1994). BringBalance uses EMA measurements three times a day to gather more insight in the events that provide energy and costs energy. Additionally, biofeedback through wearables provides at the moment only sensor data with basic interpretation to the user and do not provide supportive reflection on the data in order to stimulate behavioural changes (Li, Dey, & Forlizzi, 2011; van Gemert-Pijnen et al., 2018). BringBalance is developed to guide the user through this process of reflection using an automatic e-Coach. An automatic e-Coach is coaching without human involvement and merely based on the collection of data, the analysis of this data in order to increase the users self-insight and generation of a coaching strategy, and the provision of persuasive and motivating feedback (Kool, Timmer, & van Est, 2014). BringBalance will be used in combination with the application Innerbalance developed by HeartMath Benelux[2]. Innerbalance provides BringBalance biofeedback through an ear sensor using heart rate variability (HRV). HRV is the variation in time between adjacent heartbeats (Shaffer, McCraty, & Zerr, 2014). The active state created by stress lead to a more regular heart rate with a lower variation and thus a lower HRV. On the contrary when the body is relaxed, the heart rate is less regular with more variation and thus a higher HRV (Kraaijenhof, 2005). A high HRV reflects health and physiological coherence (Shaffer et al., 2014). BringBalance uses HRV for interpretation and reflection of current stress levels and to provide understanding of the influence of breathing and relaxation exercises on stress levels (Shaffer, McCraty, & Zerr, 2014).

BringBalance consists of four phases, based on the reflective coaching model of Gilbert and Trudel (2001), see Figure 2.2 for an overview of each phase. The first phase is the issue setting phase where self-tracking through EMA and e-coaching are combined to provide insight in the energy balance by identifying and recognizing energy sources and energy leaks. Secondly, in the strategy generation

[1] De Maar training & Advies - www.demaar.nl
[2] HeartMath Benelux - www.heartmathbenelux.com

phase the HeartMath breathing techniques are learnt combined with self-tracking through biofeedback, in order to receive control over the body and increase psychological resilience. At the end of the second phase the learned techniques and energy sources can be used as strategies to reduce energy leaks. In the third phase, the experimentation phase, the chosen strategies are used in real situations. In the last phase, the evaluation phase, the used strategies and the whole process are evaluated. In addition, to increase the persuasiveness of BringBalance several persuasive features are used. From the category *dialogue support* of the PSD-model (Oinas-Kukkonen & Harjumaa, 2009), the features reminders, suggestion, praise and similarity are used. The feature reminders is used in phase one and three to remined the user of filling in and reflection on the energy balance. Furthermore, the additional help from the e-Coach and the provided strategy database are using the feature suggestion. Praise is used at small extend in the content of BringBalance, for example at the end when users received a last recommendation. At last, the feature similarity is used in phase two by the user's personal choice for which strategy is applied to a leak. Besides, similarity is also used in phase three were the user can set and receive personalized reminders for experimenting with the goals.

Figure 2.2. Phase specific overview of BringBalance

2.2. Participants

A pilot study to test BringBalance was conducted with employees of a software company located in the Netherlands. Participants participated voluntary and were recruited through the HR department of the company via an e-mail to all employees. Of the 45 interested employees 30 participants were selected for the pilot study based on the following inclusion criteria: aged above 18; a mobile phone which was newer than Android version 5 or iOS version 10, otherwise the applications could not be used; and a score of 14 or higher on the perceived stress scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983). The PSS measures perceived levels of stress experienced by the individual, a score of 14 or higher on the PSS scale is above average (Nordin & Nordin, 2013). These 30 participants were dived in two groups, the first group started in November with the pilot of BringBalance and the second group

in January. From the first group of 15 participants, the 4 most and 4 least active users were interviewed for the pilot study of BringBalance. The other 7 participants were interviewed for this research. User activity was based on log data.

2.3. Materials and research methods

Before the start of BringBalance all participants filled in the PSS questionnaire and a questionnaire with their expectations of BringBalance, their expectations were used during the interviews. A semi-structured interview was used to identify the motivational barriers and stimulators experienced by new users of BringBalance and gather more insight in possible improvements of BringBalance. This method was chosen because it provided a structural approach to discuss all the different aspects of user motivation, but it also allowed participants to elaborate on possible improvements and things that are important for them. The interview was divided into five phases: 1. Value specification; 2. BringBalance in general; 3. BringBalance phase specific; 4. Fit with lifestyle and 5. Appearance of BringBalance. Questions were based on the different components of the COM-B system, the SDT and the PSD-model. For identification of the barriers and stimulators of BringBalance the Value Proposition Canvas was used (Osterwalder et al., 2014). The interview schedule can be found in Appendix A.

2.4. Procedure for data collection

Participants used BringBalance for six weeks and were interviewed in the last week of the pilot study after finishing the intervention. Participants were interviewed by the researcher without special circumstances. They were informed about the aim and procedure of the interview. Participation was anonymous and voluntary with the right to withdraw at any desired time without consequences. All participants signed informed consent and gave consent for recording. The interviews were conducted at the software company and lasted for approximately 30 minutes. All interviews were recorded and transcribed verbatim before further analysis.

2.5. Procedure for data analysis

The transcribed data was coded with use of Atlas.ti 8. Coding was done by one coder in three phases, open coding, axial coding and selective coding. During open coding data was analysed and useful fragments were coded. Coding was deductive and based on the research questions which leaded to three categories: barriers, stimulators and improvements. In the axial coding phase, the data was structured and the main codes in the three categories were based on the theoretical constructs of the COM-B system, SDT and PSD-model, see Table 2.1 for the description of each component of the theoretical constructs. Due to the high overlap between the PSD-model and the other two theoretical constructs was decided to use the components COM-B system and SDT as main codes for the categories barriers and stimulators, and the components of the category *dialogue support* of PSD-model as main codes for the category improvements. This decision was based on the insight that the COM-B system and SDT can provide for factors, including persuasive features, that can be a barrier or stimulator for motivation, while the PSD-model provides not only what should be improved but also more concrete options for improvement. Inductive coding was used on the remaining data which lead to the addition of the main code technology. Within each main code sub codes were inductively coded, which leaded to a coding scheme consisting of main and sub codes for each category. At last, during selective coding the overarching concept was identified to answer the research questions. This final code schedule provided an overview of the most relevant barriers and stimulators based on the COM-

B system and SDT and the most important improvements based on the PSD-model which can be used to increase user motivation. See Appendix B for the final coding scheme.

Table 2.1
Overview of the theoretical constructs on which the coding scheme was based.

Theoretical construct	Component	Description
-	Technology	All technological aspects which stimulate or demotivate the use of the application. This can be amongst others usability, ease of use, lay-out or technological problems.
Self-Determination Theory	Autonomy	The need to feel in control of one's own life and choices and act in harmony with the one's self.
	Competence	The need to feel capable to control the outcome and experience mastery.
	Relatedness	The need to interact, be connected to and experience caring for others.
COM-B system	Capability	The psychological and physical ability of the individual to engage in the activity concerned.
	Opportunity	All social and environmental factors outside of the individual that influence the desired behaviour and the way we think about it.
PSD-model *Dialogue Support*	Praise	By offering praise, a system can make users more open to persuasion.
	Rewards	Systems that reward target behaviours may have great persuasive powers.
	Reminders	If a system reminds users of their target behaviour, the users will more likely achieve their goals.
	Suggestion	Systems offering fitting suggestions will have greater persuasive powers.
	Similarity	People are more readily persuaded through systems that remind them of themselves in some meaningful way.
	Liking	A system that is visually attractive for its users is likely to be more persuasive.
	Social role	If a system adopts a social role, users will more likely use it for persuasive purposes.

Two interviews were coded by a second coder and the results were discussed to optimize the coding scheme in order to reach intercoder agreement. During the intercoder agreement a clear distinction was made between the components of the COM-B system and the SDT. At which the COM-B system represented the existence or absence of factors which influenced motivation. While the SDT influenced motivation through the degree of satisfaction of the needs of the user. For example, the component capability and competence were coded a lot interchangeably. Therefore, a clear distinction was made, whereby was decided that capability represented only if the ability was present or not which was stimulating or demotivating. Whereas competence reflects the extend in which the process of being capable and experience mastery is satisfied. Thus, someone can have the ability to perform a behaviour but is not challenged to perform this behaviour. Then a barrier is experienced for competence and not for capability.

3. Results

The 7 participants which were interviewed consisted of 4 females and 3 males. The ages of the participants ranged between 25 and 54 years. The mean age of the participants was 35.4 with a standard deviation of 8.7. All participants had a high educational level, higher education (71,4%) or University (28.6%). The PSS scores of the participants ranged between 14 and 23, with a mean PSS score of 17.9 and a standard deviation of 3.0. See Table 3.1 for an overview of participant characteristics and the level of completion for each participant, this is the extent to which a participant finished the intervention.

Table 3.1
Overview of participant characteristics

Participant	Gender	Age*	Educational Level	PSS score	Level of completion
1	Male	25 - 29	Higher education	16	Full completion
2	Female	30 - 34	University	20	Drop out phase 2
3	Female	25 - 29	Higher education	23	Drop out phase 2
4	Male	35 - 39	Higher education	19	Full completion
5	Male	30 - 34	Higher education	17	Drop out phase 1
6	Female	50 - 54	University	14	Drop out phase 3
7	Female	40 - 44	Higher education	16	Drop out phase 3

* For privacy reasons the age of participants is classified in groups of five years.

Before the start of BringBalance, most participants mentioned in the questionnaire that they expected that BringBalance could help to gather more self-understanding. They expected to learn more about their energy balance. Some of them expected to learn useful breathing techniques to deal with stress, but also more practical solutions to solve the problems that create stress. Some participants already had experience with breathing exercises and reflection and were looking for an addition to this. A few participants did not have expectations and were just curious of what BringBalance could bring them.

Two participants completed the intervention and they mentioned that BringBalance had provided them with more self-understanding and some useful techniques to deal with stress. Two participants dropped out, in phase two and three, because BringBalance was not an addition to their already existing experiences with stress-management techniques. One participant did value the breathing techniques but dropped out in phase three because of the high number of questionnaires to fill in. Another participant dropped out in phase two, because she did not like the breathing exercises. However, she valued the self-understanding gathered in phase one. At last, one participant dropped out in phase one due to experienced demandingness of the application.

3.1. Experienced barriers and stimulators for the use of BringBalance

The barriers and stimulators experienced by participants were connected to the components of the SDT, COM-B system and the component technology. For almost all components barriers as well as stimulators were found. Except for the components autonomy (freedom of use) and capability (program structure) only barriers were found. Besides, the component relatedness was not clearly present in the results. An overview of the occurrence of the components and most important subcomponents can be found in Table 3.2. For a broad overview see Appendix C, Table C.1.

Table 3.2
Overview of stimulators and barriers mentioned by participants for each component.

Component	Subcomponent	Description	Occurrence Barrier (N)	Occurrence Stimulator (N)
Autonomy	*Freedom of use*	The need to feel the freedom to choose how BringBalance is used is (not) met.	7	-
	Harmony with one's self	The need to act in harmony with one's self and one's personal goals is (not) met.	7	5
Competence	*Being Capable*	The need to feel capable of controlling and achieving the outcome is (not) met.	6	5
	Being Challenged	The need to feel challenged and be able to experience mastery is (not) met.	6	7
Capability	*Program Structure*	The available knowledge, cognitive capacity and skills do (not) match or are (not) enough to understand the program structure and the introductory information.	7	-
	Program Content	The available knowledge, cognitive capacity and skills do (not) match or are (not) enough to understand the program content.	5	7
	Breathing Techniques	The available knowledge, cognitive capacity and skills do (not) match or are (not) enough to perform the breathing techniques and use the HeartMath sensor.	4	5
Opportunity	*Applicability*	Environmental and social factors outside of the individual that reduce, obstruct, initiate or enforce the use of BringBalance.	7	4
	Trigger	Triggers in BringBalance do (not) motive to use BringBalance.	5	5
Technology		Technological aspects and aspects of the lay-out of BringBalance that (de)motivates the user to use BringBalance.	7	4

3.1.1. Autonomy

Freedom of use

All participants experienced a loss of autonomy and described the application as too demanding. They experienced BringBalance as controlling and compulsory which created a feeling of obligation. This feeling was a combination of the number of intervention components, the number of reminders and the freedom to choose when the application was used. Half of the participants experienced that the number of intervention components, such as questionnaires to fill in, videos to watch et cetera was too much. *"At that moment I thought: Now it has been asked so many times and at that point my motivation lowered to fill in a questionnaire over and over again, because in my opinion it was really too much." (Participant 3).* Also, the number of reminders in BringBalance reinforced the demanding character of the application. *"Less demanding, less pushy reminders. […] And I don't like it when an app tries to exercise some control, or be very directive, now you need to do this." (Participant 4).* These two aspects created that almost all participants experienced a lack of freedom to choose when they used the application. They had the feeling that they had to use BringBalance on moments that they were reminded, that they were not able to choose their own time moments to use BringBalance and that they had to use BringBalance in order to keep up with the demand of the application. All participants

named the demanding character of the application as one of the most important barriers that lowered their motivation to use BringBalance.

Harmony with one's self

Another aspect of autonomy is the desire to act in harmony with the self and one's personal goals. Half of the participants mentioned that it was stimulating that BringBalance was of additional value for or did match how they normally dealt with stress. While for a few participants BringBalance had no additional value, because it did not bring anything new in addition of their existing stress coping strategies. Most participants were stimulated through the experience that BringBalance was useful to achieve their personal goals. When the learned techniques were effective in reducing stress and they had gathered more self-insight. Especially the Neutral, which is a breathing technique focused on creating a neutral emotional state, was mentioned by several participants as a good fit for them. *"I think the Neutral is just take it easy. Which is helping me also to look at the next situation from a different feeling. This one is more useful [than the other breathing techniques], faster, easy applicable and also effective." (Participant 4).* Most participants experienced also some barriers in relation to the use of BringBalance for achievement of their personal goals. Some of the participants believed that they could had gathered the same insight in their energy balance with filling in much fewer questionnaires. In their experience the high number of questionnaires was more useful for the research than for their personal process. *"I think that it was more valuable for the study, than it was for me. I think that for me once a day was enough." (Participant 1).* For other participants it was too structured, and they had expected that they could do the interesting parts without following the whole program. *"You are really working towards something, I found that difficult sometimes. While you just want to learn some techniques and hopefully you will use them one day at a moment you need it." (Participant 6).*

3.1.2. Competence

Being Capable

One of the aspects of competence is the need to feel capable and be in control of achieving an outcome. Most of the participants experienced a feeling of incapability, failure or exhaustion through the inability to keep up with the demand of the intervention which was often created through the accumulation of intervention components. *"And of course, the next Monday I had more than 33 messages. Well yeah, then you don't know where to start." (Participant 7).* On the other hand, half of the participants felt more capable to manage stressful situations with BringBalance. Participants experienced it as stimulating that they were now able to regain their balance through reflection on their energy sources and energy leaks. Likewise, they were now able to maintain their energy balance by using the breathing techniques. The visualized feedback from the HeartMath sensor gave a clear image of the effects of the breathing techniques on the body which increased the feeling of competence for most of the participants. *"And by being aware of it, you can really bring down your heartrate. Actually, I thought it was great to see how much effect it can have, and after that feeling more at peace." (Participant 1).*

Being Challenged

The second aspect of competence is about the need to be challenged. Half of the participants mentioned that the learned breathing techniques, instruction movies and the HeartMath sensor were interesting and stimulated them to keep using BringBalance. While the other half of the participants mentioned that they already had experience with reflection, coaching or breathing exercises for stress-

management. Therefore, some of them were not challenged by BringBalance to gather new insights about their energy balance or learn additional breathing techniques. Besides, these participants experienced the intervention also as slow and long-winded. Another aspect that led to insufficient challenge for some participants was the coherence of the baseline measurement, which did not give room for improvement. *"I thought it was remarkable that by the base-line measurement and also after that, I was already in the green area. […] So, it gave me insight, but I also lost a part of the motivation. Because I thought: I am already at 80%, I can only improve to 100%." (Participant 7).* On the other hand, most of the participants saw the process of obtaining self-understanding provided by BringBalance as stimulating. Especially the combination with the HeartMath sensor was experienced as interesting and informative, but also the energy balance which provided insight in energy sources and energy leaks was useful for obtaining self-understanding. More than half of the participants named the challenging aspects or the process of obtaining self-understanding through the HeartMath sensor and energy balances as main stimulators to use BringBalance.

3.1.3. Capability

Program Structure

A lot of participants had missed or did not understood parts of the information provided in advance about the program structure and expectations of BringBalance. Most participants did not have a clear view of how BringBalance was built up. Some of them were not aware of the purpose of the different phases, did not understand why they had to fill in things or they thought that they filled in all the questions in phase 1 and 3 for the research and not for themselves. Besides, some participants mentioned that they had not properly estimated the impact and effort that BringBalance needed. In addition, participants mentioned that enough information was available, but that these misunderstandings were caused by an incorrect evaluation of the information, too little preparation or too much information to go through.

Program Content

Most of the participants experienced a good match between the program content of BringBalance and their personal abilities. Half of the participants mentioned that they had the ability to collect data and reflect on this data and that it was stimulating to have an application which helped them to gather more insight in which strategies could be used in a stressful situation. *"Then you think indeed: Ok, this way was suggested, so I can try now if that really works. So, that works well. That is stimulating." (Participant 1).* Besides, almost all participants were stimulated by the instruction movies which were seen as nicely animated, informative and with a clear message. For a few participants the provided knowledge through the energy balance was one of the most important stimulators for the use of BringBalance, because it provided quick an easy interpretable overview of the day. On the other hand, half of the participants experienced a barrier through the way of questioning. The questionnaires contained too much text, too many open questions or too many of the same questions. *"Sometimes the questioning was really vague. You could go either way, it had not proper boundaries*." *(Participant 1).* Besides, some participants missed visual aspects while answering questions or experienced the options of the emotional status (positive, negative, neutral) as to limited.

Breathing Techniques

The ability to perform the breathing techniques and the experience that it was applicable and effective, was mentioned by some participants as stimulating. While other participants experienced it as difficult to practice the breathing techniques. The combination of both apps made it for some participants

difficult to interpret and reflect on the value of the physical data of the HeartMath sensor in relation to the psychological aspects. For others was it difficult to imagine a situation and practice the breathing technique. *"Thinking about a previous situation is for me somewhat spiritual, artificial." (Participant 2).* However, the combination with the HeartMath sensor was experienced by most participants as stimulating. Half of the participants mentioned that they valued the additional information and visuality provided by the sensor. This information was a good match with their existing abilities and supported them in learning the breathing techniques. A few participants valued especially the breath pacer of the Innerbalance application and mentioned that they needed the breath pacer to have the ability to perform the breathing techniques. *"A slow pace, that is very decisive for me, that made me able to do it right. Otherwise I can't, then I notice that I am going way to fast." (Participant 4).* However, they found it unfortunate that the breath pacer could not be used without the HeartMath sensor.

3.1.4. Opportunity

Applicability

All participants mentioned some environmental or social factors that lowered the motivation to use BringBalance. Participants found it extremely difficult to integrate BringBalance into daily life and combine it with work activities. All participants mentioned that it was difficult to find the time to use BringBalance. Some of them said that they were too busy and did not have time during the day or on the moments that BringBalance reminded them to do something. Others mentioned that they found it difficult to make time to use BringBalance due to work routine or a busy family life. Half of the participants experienced BringBalance as too time-consuming, which was also one of the main factors for them to stop using BringBalance. A part of the participants was ashamed to use the HeartMath sensor in the open work environment. *"So, now I went to a meeting room. Because I thought, now I have that thing on my ear, and everyone sees me with it. People see me coming with that thing attached to my ear." (Participant 7).* Sometimes a separate room or quiet space was not available. For other participants searching for an empty room required too much effort. Besides, during meetings or collaboration using BringBalance was experienced as a disruptive factor for connection with the social environment. *"When you have a meeting with each other the whole morning, it will be difficult to find a moment in between. That is not a problem when it happens not that often, but when it happens 2 or 3 times a day, it is not so practical anymore for collaboration." (Participant 2).*

Trigger

For some participants BringBalance acted as a trigger which stimulated them to go through the process of reflection. *"When I take a moment to think about what my stressors and energy sources are […] then I will find out too. This just gave me a reason to do it more actively." (Participant 4).* Some participants mentioned that the concept of reminders was stimulating, because it reminded and triggered them to use BringBalance. However, for most participants the current implementation of reminders did not work as a trigger, because the reminders always came at the same moment, at an inconvenient moment in combination with work related activities or without a specific message. *"Then you just receive: 'There are some questions available for you'. That is just a basic message." (Participant 7).* A lot of the participants were highly irritated by the number of reminders. Therefore, some of them did not want to set up additional reminders in phase 3 to remind them of experimenting with their personal goals.

3.1.5. Technology

Almost all participants mentioned that the application did not always work properly. For some of them this was demotivating, others saw the application as a prototype and were not demotivated by errors. Besides, a few participants mentioned that they experienced BringBalance as clear and intuitive. While more than half of the participants experienced the layout and functioning of BringBalance as chaotic and unclear. They could not always find or retrieve the needed information. *"Well you cannot go through the App. I found it sometimes difficult to look back on things, to find previous answers when it was needed." (Participant 1).* Most participants mentioned that the look and feel of the application was sufficient, decent and professional. However, for some of them it should be improved to become more stimulating.

3.2. Suggested improvements to increase user motivation for BringBalance

Participants mentioned improvements to increase the motivation to use BringBalance. These improvements were connected to the persuasive features: reminders, similarity, liking, suggestion and social role of the category *dialogue support* of the PSD-model. For the features praise and rewards no clear improvements were mentioned. The suggested improvements based on the persuasive features were linked to the different components of the SDT and COM-B system, see Table 3.3. A broad overview can be found in Appendix C, Table C.2.

Table 3.3
Overview of suggested improvements based on the persuasive features of the category dialogue support of the PSD-model.

Feature	Section	Occurrence (N)	Linked to Component(s)
Reminders	*Customization*	6	Autonomy
	Trigger	3	Opportunity
Similarity	*Freedom to choose*	7	Autonomy, Competence, Capability, Opportunity
	Content Changes	5	Competence, Capability
	Technological Changes	4	Opportunity
Liking	*Overview*	5	Capability, Technology
	Visuality	3	Capability, Opportunity
Suggestion		3	Autonomy, Competence, Capability
Social role		2	Autonomy, Relatedness, Opportunity

3.2.1. Reminders

Customization

All participants mentioned improvements for how reminders should be used in BringBalance to make the application less demanding and give the user more autonomy to use the application as desired. Most participants preferred less reminders, one reminder a day was thought to be enough. Besides, participants preferred that they had the freedom to choose when and how many reminders they received. They would like to set reminders by themselves or automatically in free calendar space. Other participants would like to turn of the reminders completely or just for a day.

Trigger

A few participants mentioned improvements of the existing reminders in order to create a better trigger for using BringBalance. *"I think that random is sometimes also the surprise effect, because otherwise it will be the same thing over again." (Participant 2).* Another suggested improvement to

increase the opportunity to use BringBalance was that the reminders of phase 3 should display the goal of the reminder instead of a basic message. *"I just want to know: 'Don't forget your exercise.'" (Participant 7).*

3.2.2. Similarity

Freedom to choose

To make BringBalance less demanding and better applicable in daily life, participants would prefer to choose their own moments to use BringBalance. *"Maybe you can plan a moment for yourself, once a day, to fill in the required stuff that is needed." (Participant 1).* They would like to fill in questionnaires afterwards or have the possibility to start and finish later. Besides, to make BringBalance less demanding and more challenging participants would also like to choose which intervention components they would do. They want to decide how many times a day they fill in the questionnaires, how long they practice a breathing technique or have the possibility to skip parts. *"It was taking too long actually (phase 2). You must be able to continue, to have the freedom to watch all the movies at the same time. This are the techniques and then I can connect them." (Participant 7).* Furthermore, participants want to choose when they want to start with a next phase. This increases the autonomy of the user, because participants have more time to complete a phase. Additionally, for participants who are already familiar with the content, this option makes it more challenging because they can go quicker through the phases. Besides, some participants expected that starting earlier with learning the breathing exercises would help them to become more capable to use the breathing techniques in real life situations. *"You learn multiple techniques now and then you have to choose one. Meanwhile it's very dependent on the situation which technique is the best. When you start with this at the beginning, you can take some days to look how to use the technique, that would work a lot better. And afterwards you can reflect on which techniques you liked the most." (Participant 6).*

Content Changes

Half of the participants mentioned improvements to increase the competence and capability of the user through creating a better match between BringBalance and the existing abilities of the user. A few participants expected to be challenged by more diversity in questions, especially in the questionnaires of the energy balance. Other participants mentioned that shorter and more specific questions or a selection of subjects to choose from would be a better match with their abilities. To make BringBalance more challenging it was suggested to create different levels such as beginner and expert. Also learning to perform the breathing exercises without sensor would be a valuable addition for some participants. *"That you try to discover how it feels, and then look back and compare this to what was measured. That would be interesting for me." (Participant 6)*

Technical Changes

Some technological improvements were mentioned to increase the opportunity to use BringBalance. A few participants mentioned that a watch instead of the ear sensor would be a good improvement for integrating BringBalance into daily life. It was thought to be less invasive and more socially accepted. Other participants would like to use only the breath pacer of the Innerbalance app without the connection to the sensor to make it more applicable.

3.2.3. Liking

Overview

A timeline or chapter structure was preferred by half of the participants to make the lay-out of BringBalance more stimulating. A timeline could increase the capability of the user by providing a clearer overview of the intervention which match the abilities of the user. Besides, it would make it easier to find previous information. In addition, a few participants mentioned that they would like to see a progress bar which showed how far they were during an exercise or questionnaire.

Visuality

Some participants would like to see more visuality in the questions. This could increase the opportunity and capability to use BringBalance and lower the monotony of the questionnaires. *"At different moments you were asked to do things, but you don't always have the time for that, because you have a meeting and then it is not possible. But you can give some feedback, for example pushing a simple button: I am feeling good, bad, etc. Perhaps with a smiley or a traffic light system. With more diversity an overview of the day can be created which consist of something more than only bars and text. Then it becomes more of a story." (Participant 2).* In addition, another participant expected that the use of a smiley system to display the energy levels instead of the limited options would increase their capability. Furthermore, a few participants mentioned that the instruction movies could be more enthusiastic and with a smoother voice to become more stimulating. One of the participants preferred a step-by-step plan instead of a movie to make BringBalance more applicable. *"Maybe replace the movies with something such as several steps to swipe through. [..] Then you need less effort to do this." (Participant 3).*

3.2.4 Suggestion

To improve their motivation half of the participants mentioned that they needed more suggestions or feedback from BringBalance. Some participants would have felt more capable with suggestions and feedback on physical data. *"I am very interested in what they would say about this, maybe they say that it was ridiculously high or super bad or that I could work on this or that. I have missed some of that feedback." (Participant 4)* For other participants it would have helped if they were talked through the breathing exercises. Also, more personal suggestions to integrate BringBalance into daily life were desired to feel more competent. *"When it is more adaptive and would say: 'Hey, I notice that you skip a lot of things. Keep going! Try this or that.'" (Participant 3).* Besides, they thought that when the application provided more suggestions, it could increase the autonomy of the user by make it more inviting and less demanding.

3.2.5 Social role

Although it was not experienced as a barrier, a few participants expected that relatedness to others would increase their motivation to use BringBalance. They would have preferred social support from a coach or support group, face-to-face or through a more adaptive system that could fulfill this social role. They would have liked to consult and wanted to receive more practical advice and tips. *"It would be nice, maybe only once a week, to receive some feedback on the things you have been struggling with and that a coach or something like that could keep you on track. Maybe this could help to keep people motivated, with messages as: 'keep going' and 'keep this goal in mind, in the end this or that will help you.'" (Participant 3).* They thought this could increase the commitment to the application, make it more applicable and that it could motivate users through reminding them of their goals.

4. Discussion

The goal of this study was to identify factors which are associated with the motivation to use e-health for stress-management using the BringBalance application as a case example. Firstly, the results show that barriers and stimulators for almost all components of the COM-B system and SDT can be associated with the motivation to use BringBalance, except for relatedness. The motivation of users was mainly decreased by the demandingness of BringBalance which lowered the experienced autonomy of the user. Also, the experienced difficulties with integration of BringBalance in daily life lowered the opportunity to use BringBalance. On the other hand, the content of BringBalance and especially the combination with the breathing techniques and HeartMath sensor stimulated users without a lot of previous experience with stress-management. This was the result of a good match between the content and capability of the user, and fulfilment of the need for competence by challenging the user to deal with stress. However, the more experienced users did not experience challenge, which suggests that in the current form, BringBalance is really aimed at individuals without previous experience with stress-management. Secondly, the improvements suggested by participants based on the category *dialogue support* of the PSD-model were connected to the different components of the COM-B system and SDT. The customization of reminders was suggested to increase the autonomy of the user and improve the trigger to create more opportunity to use BringBalance. The feature similarity was also suggested to provide more autonomy to the user and create more opportunities to use BringBalance by increasing the freedom to choose when the application was used, and which parts of the content were used. Liking and suggestion could increase the user's autonomy and increase capability and competence, by creating more structure through a clear overview and guidance through additional feedback. At last, although users did not experience a barrier through the missing component relatedness, it was expected that discussing issues with a coach by using the feature social role could increase user motivation.

Interestingly, it was found that for almost each component of the SDT and COM-B barriers as well as stimulators were mentioned. This means that what is stimulating for one person can be demotivating for another. More interestingly is the apparent contradiction found in this study that a component can be experienced as a barrier as well as a stimulator for the same participant. This is in line with a previous study of Kekkonen, Oinas-Kukkonen, Korkiakangas, and Laitinen (2019). They found that within the same user the motivation to use the application was reduced due to a high demandingness, although it was in harmony with one's goals, this created stress and drop-out (Kekkonen et al., 2019). This corresponds with the findings of this research for the component autonomy, which indicates that the experienced barrier of demandingness outweighs the stimulator of acting in harmony with one's goals. Therefore, it is important to reduce a barrier in order to benefit from the stimulator. The same apparent contradiction can be seen in the component competence. Some participants feel capable to handle stress with the intervention, while at the same time incapability is experienced through the inability to keep up with the intervention. This inability to keep up was in most cases the result of a lack of time or priority to invest time in the intervention. Murray (2012) mentioned that the motivation of healthy people to invest time in an intervention can be lower because the problem seems less urgent and less personal. On the other hand, according to Oduor and Oinas-Kukkonen (2017), most people are aware of their problems, but are not able to make the decision to change their behaviour because the immediate costs outweigh the long-term benefits. Especially in the case of stress-management, where time is already limited, investing in the application can become another thing that is asking for their attention which outweighs the expected positive effects. Therefore, it could be useful to increase

problem awareness or create commitment to the application through reminding users of the achievable benefits and experienced effects.

Apparent contradictions were also found in the category *dialogue support* of the PSD-model. The results show that there is friction between the freedom of the user on the one hand and the desired guidance of the user on the other hand. Although participants found it useful to receive reminders to remind them of the use of BringBalance, the high number of reminders was also experienced as highly irritating and obtrusive which lead to a lower feeling of autonomy by the user. Participants preferred to set reminders by themselves in order to be autonomic, but also be reminded to use BringBalance. These findings are in line with the findings of Kekkonen et al. (2019) who also mentioned the customization of reminders as a solution. Literature showed that being autonomous and have the freedom to make own choices is important to be motivated (Ryan & Deci, 2000), but when a user is not intrinsic motivated support from the application is necessary to enhance and sustain application usage (Mohr et al., 2011). This is supported by the findings of Heber et al. (2017) that guided interventions are more effective than unguided interventions for stress-management. In addition, van Gemert-Pijnen et al. (2018) argued that the addition of persuasive features can be useful to guide and support, however too much support might reduce the autonomy of the user and can negatively impact user motivation. It should be noted that guidance is not always a limitation to freedom. In the case of the reminders, customization does not necessary lead to the loss of guidance (Kekkonen et al., 2019). On the other hand, when the user receives too much freedom to choose which parts of the intervention will be done, this can endanger the effectiveness of the intervention (Kelders et al., 2015). Therefore, it is important to create a good balance between freedom and guidance, to find a way to persuade the user in the desired direction while the autonomy of the user remains.

The results showed that the different components of the contextual factors of the COM-B system and the internal factors of the SDT have a reinforcing or reducing interaction. First, a reduced effect was seen between the contextual factor a 'lack of time' and the internal factor 'feeling incapable'. Second, reinforcement of components was seen for the contextual factor capability which was necessary for the internal factor's competence and autonomy, for example being able to learn the necessary skills was needed to feel competent and reach the personal goals. These two examples indicate that for stress-management, contextual factors and internal factors interact. This was also mentioned by Ryan and Deci (2000) who stated that contextual factors can facilitate or undermine intrinsic motivation. At last, it is interesting that the component relatedness, the need for interaction and connection with others, was mainly absent but was not experienced as a barrier for user motivation. However, the results suggest that the addition of interaction with others could be used as a stimulator. This is in line with the findings of Ryan and Deci (2000) who found strong evidence that fulfilment of the need for autonomy and competence is a condition for motivation, while satisfaction for the need of relatedness is also important but not always necessary. Therefore, the combination of the COM-B system and SDT can be useful for research into user motivation for stress-management because it includes the interaction between contextual and internal factors which both play a role in user motivation.

4.1 Strengths and limitations

A strength of this study was the use of two motivational models which combines contextual and internal factors. This combination has proven to be useful, because after coding all the barriers and stimulators of user motivation that were found could be linked to the components of the SDT or COM-B system. Only barriers and stimulators which were strongly connected to the functioning of the

technology were connected to the separate component Technology because of the direct impact on motivation. However, it can be argued that it could also be a part of the component opportunity, because it impacts the fit between the user and the application.

The focus of this research was limited to the category *dialogue support* of the PSD-model. In accordance with the literature, the results have proven the importance of the category *dialogue support* for user motivation. However, the results showed that some participants would have liked more interaction which indicates that the category *social support* could also be useful for increasing user motivation. Furthermore, literature suggest that the combination of the category *dialogue support* and *social support* can be useful to motivate users to keep using the application (Oduor & Oinas-Kukkonen, 2017).

Another limitation of the current study was the small sample size and participant characteristics. Participants were all highly educated, and it can be assumed that they had a higher technological knowledge than an average user due to their work. Therefore, the results cannot be generalized. Nonetheless, it could be argued that improvements based on these results are a major improvement for all users, because the main barriers were about the applicability of the application and not about the content of BringBalance. On the other hand, it is possible that the abilities of users with a lower education level are different and therefore does not match with the content of BringBalance. Besides, the participants which were moderate actively using the application were selected for the interviews. It is possible that this selection of participants created an average view and outliers were missed. In addition, a strength of this research was that saturation was reached concerning the major barriers and stimulators of the application, because no important new information was found in the last interviews. However, this could also be a limitation because it is possible that saturation was reached as result of the small sample size and the homogenous participant characteristics. However, concerning the different phases of BringBalance saturation was not reached in phase 3 and 4 due to the high number of dropouts. Only four participants started with phase 3 of which only two completed the whole intervention and were able to provide information about phase 3 and 4.

4.2 Recommendations and future research

More research is needed to find a way to guide the user while the user's autonomy remains intact. Mohr et al. (2011) summarized some implications for coaching in e-health interventions in order to intrinsically motivate while securing the autonomy of the user, such as: providing choice regarding how to complete tasks; and verbal reward or positive feedback. First, it would be interesting to try out different options for a few days, such as a reminder once a day, three times a day or random, and let the user choose which is preferred. In this way the user experienced autonomy but is still guided. The same concept can be applied to the content, provide some selected choices for the user in order to create the feeling of autonomy, but still be able to guide the user through the intervention. In addition, the results showed that users like to have more suggestions and additional feedback to increase user motivation than what was currently used. In order to preserve the balance between freedom and guidance, the addition of positive feedback and verbal reward can increase guidance without being experienced as controlling (Mohr et al., 2011). For example, through combining the features suggestion and social role with the features praise and rewards. But be aware that when the user is motivated to use the application, too much support can be experienced as controlling or a lack of faith in the users abilities (Mohr et al., 2011). So, it would be interesting to investigate if support can be

reduced during the intervention or if the intervention can be personalized based on the amount of user motivation.

For developing e-health for stress-management, the combination between the COM-B system and SDT are useful to increase user motivation, because it includes contextual factors and internal factors which are both important for stress and application use (Michie, 2002; van Gemert-Pijnen et al., 2011). A larger study based on log data and questionnaires, should be done to investigate not only the influence on motivation but also the relations between the other components, for example the relation between opportunity and competence by measuring the invested time with log data and compare this with the scored feeling of competence in the questionnaire. Future research should also investigate the role of the component relatedness on user motivation, for example by creating an interaction between the user and the application through the features social role, praise and personalized suggestions or through addition of the features of the category *social support* of the PSD-model. Because, it was expected by participants that increasing the interaction with peers and the application can positively influence user motivation. Literature has shown that persuasive features increase the effectiveness of an intervention, however not all features work well together (van Gemert-Pijnen et al., 2018), therefore a literature research should provide more information on which persuasive features can be combined with the features found in this research to improve BringBalance.

In conclusion, the combination of the COM-B system and the SDT provided a good overview of the contextual and internal factors that influenced user motivation for the stress-management application BringBalance. Besides, also the interaction between the contextual and internal factors which influenced user motivation as well as the apparent contradiction within the different factors became visible. In addition, the features of the category *dialogue support* of the PSD-model are promising in reducing a barrier, using a stimulator or preserve the balance between both in order to increase user motivation. Future development of e-health for stress-management should include persuasive features, although the amount and combination of persuasive features must be chosen carefully. Contextual and internal factors play not only a role in stress-management, but also in a large area of other health problems. Therefore, the combination of the COM-B system, SDT and PSD-model can be useful for a broader area of e-health applications.

References

Bartholomew, L. K., Parcel, G. S., Kok, G., Gottlieb, N. H., & Fernández, M. E. (2011). *Planning Health Promotion Programs: An Intervention Mapping Approach*: Jossey-Bass.

Carolan, S., & de Visser, R. O. (2018). Employees' Perspectives on the Facilitators and Barriers to Engaging With Digital Mental Health Interventions in the Workplace: Qualitative Study. *JMIR mental health, 5*(1), e8.

CBS. (2018, 20 april 2018). Psychosociale arbeidsbelasting (PSA) werknemers; geslacht en leeftijd. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83049NED/table?dl=711D

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of health and social behavior*, 385-396.

Eysenbach, G. (2001). What is e-health? *J Med Internet Res, 3*(2), e20. doi:10.2196/jmir.3.2.e20

Gilbert, W. D., & Trudel, P. (2001). Learning to coach through experience: Reflection in model youth sport coaches. *Journal of teaching in physical education, 21*(1), 16-34.

Heber, E., Ebert, D. D., Lehr, D., Cuijpers, P., Berking, M., Nobis, S., & Riper, H. (2017). The benefit of web-and computer-based interventions for stress: a systematic review and meta-analysis. *Journal of medical Internet research, 19*(2).

Hooftman, W., Mars, G., Janssen, B., de Vroome, E., Janssen, B., Michiels, J., & van den Bossche, S. (2015). Nationale Enquête Arbeidsomstandigheden 2014. In: TNO/CBS Leiden/Heerlen.

IJsselsteijn, W., De Kort, Y., Midden, C., Eggen, B., & Van Den Hoven, E. (2006). *Persuasive technology for human well-being: setting the scene.* Paper presented at the International conference on persuasive technology.

Kekkonen, M., Oinas-Kukkonen, H., Korkiakangas, E., & Laitinen, J. (2019). *Recovering from Work-Related Strain and Stress with the Help of a Persuasive Mobile Application: Interview-Based Thematic Analysis of Micro-entrepreneurs*, Cham.

Kelders, S. M., Bohlmeijer, E. T., Pots, W. T., & van Gemert-Pijnen, J. E. (2015). Comparing human and automated support for depression: Fractional factorial randomized controlled trial. *Behaviour research and therapy, 72*, 72-80.

Kool, L., Timmer, J., & van Est, R. (2014). Eerlijk advies - De opkomst van de e-coach.

Lal, S., & Adair, C. E. (2014). E-mental health: a rapid review of the literature. *Psychiatric Services, 65*(1), 24-32.

Lazarus, R. S. (1993). From psychological stress to the emotions: A history of changing outlooks. *Annual review of psychology, 44*(1), 1-22.

Lehto, T., Oinas-Kukkonen, H., Pätiälä, T., & Saarelma, O. (2012). *Consumers' Perceptions of a Virtual Health Check: an Empirical Investigation.* Paper presented at the ECIS.

Leka, S., & Jain, A. (2010). *Health impact of psychosocial hazards at work: an overview*. (9241500271).

Lentferink, A. J., Oldenhuis, H. K., de Groot, M., Polstra, L., Velthuijsen, H., & van Gemert-Pijnen, J. E. (2017). Key components in eHealth interventions combining self-tracking and persuasive eCoaching to promote a healthier lifestyle: a scoping review. *Journal of medical Internet research, 19*(8).

Li, I., Dey, A. K., & Forlizzi, J. (2011). *Understanding my data, myself: supporting self-reflection with ubicomp technologies.* Paper presented at the Proceedings of the 13th international conference on Ubiquitous computing.

McCraty, R. (2001). Psychophysiological coherence: A proposed link among appreciation, cognitive performance, and health. *Retrieved November, 21*, 2007.

McCraty, R., Atkinson, M., Tomasino, D., & Bradley, R. T. (2009). The Coherent Heart Heart-Brain Interactions, Psychophysiological Coherence, and the Emergence of System-Wide Order. *Integral Review: A Transdisciplinary & Transcultural Journal for New Thought, Research, & Praxis, 5*(2).

McCraty, R., & Zayas, M. A. (2014). Cardiac coherence, self-regulation, autonomic stability, and psychosocial well-being. *Frontiers in Psychology, 5*, 1090.

Michie, S. (2002). Causes and management of stress at work. *Occupational and environmental medicine, 59*(1), 67-72.

Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science, 6*(1), 42.

Mohr, D., Cuijpers, P., & Lehman, K. J. J. o. m. I. r. (2011). Supportive accountability: a model for providing human support to enhance adherence to eHealth interventions. *13*(1), e30.

Morrison, V., & Bennett, P. (2012). *An Introduction to Health Psychology*: Pearson Education Limited.

Noorbergen, T. J., Adam, M. T., Attia, J. R., Cornforth, D. J., & Minichiello, M. (2019). Exploring the Design of mHealth Systems for Health Behavior Change using Mobile Biosensors. *Communications of the Association for Information Systems*.

Nordin, M., & Nordin, S. (2013). Psychometric evaluation and normative data of the Swedish version of the 10-item perceived stress scale. *Scandinavian journal of psychology, 54*(6), 502-507.

Oduor, M., & Oinas-Kukkonen, H. (2017). *Commitment devices as behavior change support systems: a study of users' perceived competence and continuance intention.* Paper presented at the International Conference on Persuasive Technology.

Oinas-Kukkonen, H., & Harjumaa, M. (2009). Persuasive Systems Design: Key Issues, Process Model, and System Features. *Communications of the Association for Information Systems, 24*(1), 28.

Ong, A. D., Bergeman, C. S., Bisconti, T. L., & Wallace, K. A. (2006). Psychological resilience, positive emotions, and successful adaptation to stress in later life. *Journal of personality and social psychology, 91*(4), 730.

Osterwalder, A., Pigneur, Y., Bernarda, G., & Smith, A. (2014). *Value proposition design: How to create products and services customers want*: John Wiley & Sons.

Rijken, N. H., Soer, R., de Maar, E., Prins, H., Teeuw, W. B., Peuscher, J., & Oosterveld, F. G. (2016). Increasing performance of professional soccer players and elite track and field athletes with peak performance training and biofeedback: a pilot study. *Applied psychophysiology and biofeedback, 41*(4), 421-430.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American psychologist, 55*(1), 68.

Schaufeli, W. B., Bakker, A. B., & Van Rhenen, W. (2009). How changes in job demands and resources predict burnout, work engagement, and sickness absenteeism. *Journal of Organizational behavior, 30*(7), 893-917.

Selye, H. (1974). Stress without distress. *New york*, 26-39.

Shaffer, F., McCraty, R., & Zerr, C. L. (2014). A healthy heart is not a metronome: an integrative review of the heart's anatomy and heart rate variability. *Frontiers in Psychology, 5*(1040). doi:10.3389/fpsyg.2014.01040

Spook, J. E., Paulussen, T., Kok, G., & Van Empelen, P. (2013). Monitoring dietary intake and physical activity electronically: feasibility, usability, and ecological validity of a mobile-based Ecological Momentary Assessment tool. *Journal of medical Internet research, 15*(9).

Stone, A. A., & Shiffman, S. (1994). Ecological momentary assessment (EMA) in behavorial medicine. *Annals of Behavioral Medicine*.

van der Ploeg, C., Pal, S., Vroome, E. d., & Bossche, S. (2014). De kosten van ziekteverzuim voor werkgevers in Nederland.

van Gemert-Pijnen, J. E. W. C., Kelders, S. M., Kip, H., & Sanderman, R. (2018). *eHealth Research, Theory and Development: A Multi-Disciplinary Approach*: Routledge.

van Gemert-Pijnen, J. E. W. C., Nijland, N., van Limburg, M., Ossebaard, H. C., Kelders, S. M., Eysenbach, G., & Seydel, E. R. (2011). A holistic framework to improve the uptake and impact of eHealth technologies. *Journal of medical Internet research, 13*(4).

Appendix A – Interview schedule

Onderwerp *Deelonderwerp*	Vragen	Onderbouwing/ Opmerkingen
Opstarten	1. **Voorstellen:** Anouk Burgler, master student aan de Universiteit Twente. Afstudeeropdracht voor mijn master als onderdeel van het project van Aniek Lenteferink over de BringBalance app. 2. **Doelen uitleggen:** Het doel van dit interview is om te duidelijk te krijgen welke factoren van invloed zijn op de motivatie van gebruikers om BringBalance te blijven gebruiken en wat de motivatie voor het gebruik van BringBalance zou kunnen verbeteren. 3. **Toestemming vragen:** Informed consent uitleggen en laten tekenen.	
Value specification	Eerst wil ik graag iets dieper ingaan op de verwachtingen die had voordat u met BringBalance begon en hoe er nu op terugkijkt. Voor de start van BringBalance heeft u aangegeven wat u verwachte dat BringBalance u ging opleveren. U heeft daar toen het volgende ingevuld: [citaat uit vragenlijst] **4. In hoeverre is uw verwachting uitgekomen?** a. Waarom wel of niet? Voorbeeld bij ja	Customer Jobs Autonomy
Algemeen	Ik wil graag eerst kijken naar BringBalance als geheel. **1. Wat zijn uw ervaringen met BringBalance?** **2. Kunt u beschrijven hoe uw motivatie tijdens het gebruik van BringBalance verliep?** **3. Wat motiveerde u om BringBalance te blijven gebruiken?** a. Hoe denkt u dat dit komt? **4. Wat demotiveerde u om BringBalance te blijven gebruiken?** a. Hoe denkt u dat dit komt? Hoe had u dit graag anders gezien?	Pains and Gains
Fase specifiek	Ik wil nu graag specifiek kijken naar de verschillende fases van BringBalance **Op basis van de logdata kijken naar de fases. → respondent specifieke vragen.** Daarna doorvragen **1. Waren er nog andere onderdelen die een negatief effect hadden op uw motivatie?** a. Waarom denkt u dat dit uw motivatie verminderde? Wat vond u lastig aan dit onderdeel? Hoe had u dat graag anders gezien? (*Werking, inhoud, uiterlijk)* **2. Welke fases of onderdelen hadden juist een positief effect op uw motivatie?** a. Wat maakte dat dit uw motivatie verhoogde? (*Werking, inhoud, uiterlijk)* 3. **Bij welke onderdelen of fases had u meer hulp gewild?**	Pains and Gains Competence and Autonomy Capability – *Physical & psychological ability* Motivation - *Reflective motivation* PSD – dialogue support

	a. Kunt u uitleggen waarom? b. Hoe zou die hulp er dan uit moeten zien?	
Aansluiten bij levensstijl	Ik wil nu graag specifiek kijken naar hoe BringBalance aansluit bij uw levensstijl en werkzaamheden. **4. In hoeverre was u in staat om BringBalance te gebruiken waar en wanneer u wilde?** a. Kunt u uitleggen waarom wel/niet? b. Hoe had dit invloed op uw motivatie? c. Wat zou u hier graag aan willen veranderen? 5. **Wanneer vond u het gebruik van BringBalance storend?** a. Waarom vond u dit storend? b. Welke invloed heeft dit gehad op uw motivatie? c. Wat zou u daar graag aan willen veranderen? 6. **Op welke manier hebben de reminders (push berichten) van BringBalance uw motivatie beïnvloed?** a. Kunt u uitleggen hoe u uitleggen waarom? Of hoe u daar op reageerde? b. Wat zou u willen verbeteren aan de reminders van BringBalance. **7. Op welke manier paste BringBalance bij hoe u normaal met stress omgaat?** *(Aanvullend, tegenstrijdig etc.)* a. Kunt u uitleggen hoe dit uw motivatie beïnvloed? b. Wat had u graag anders gewild?	Pains and Gains Autonomy and Relatedness Capability – *Physical ability* Opportunity *Physical & Social opportunity* PSD – similarity, reminders
Uitstraling	In de volgende vragen wil ik specifiek kijken naar de uitstraling van BringBalance. Met uitstraling bedoel ik hoe het eruit ziet, maar ook hoe leuk het is om uit te voeren. **8. Hoe heeft de uitstraling van BringBalance invloed gehad op uw motivatie?** a. Kunt u uitleggen waarom? b. Wat zou u willen veranderen aan de uitstraling van BringBalance? **9. Hoe hebben de filmpjes uw motivatie om BringBalance te gebruiken beïnvloed?** a. kunt u uitleggen waarom? b. Wat zou u graag anders willen zien?	Pains and Gains PSD – liking Motivation – *automatic motivation* Capability – *Psychological ability*
Afronden	Ik wil graag het interview gaan afronden. U heeft ons veel inzicht gegeven in uw ervaringen met BringBalance en nu ben ik benieuwd wat voor uw nou echt de belangrijkste dingen waren. **10. Van alle dingen die u genoemd heeft, wat is voor u het meest belangrijke punt die uw motivatie tijdens het gebruik van BringBalance heeft verminderd?** a. En daarna? **11. Wat is het belangrijkste punt dat uw motivatie tijdens het gebruik van BringBalance heeft verhoogd?** a. En daarna?	Waarde bepalen van wat gezegd is.
	Bedankt voor uw medewerking	

Appendix B – Coding Scheme

Table B1.1.
Experiences - Barriers for components of the COM-B system and SDT

Code	Subcode	Description	Citation	Occurrence*
Autonomy	*Timing*	The need to feel the freedom to choose the own time moments for using BringBalance is not met.	*"Ja dat ik het niet kon doen op tijden dat ik het zelf wilde, of ik het gevoel had dat ik het niet kon doen op tijden dat ik het zelf wilde."[6]*	14/5/2
	Components	The need to feel the freedom to choose which and how much components are filled in or performed is not met, such as questionnaires that are filled in.	*"was nou volgens mij moest je 7 dagen lang 3 keer per dag, niet 7 dagen, 5 dagen 3 keer per dag aangegeven wat die energielekken en die dingen waren van uh.. En voor mij was dat na 2 keer eigenlijk wel genoeg geweest" [6]*	6/4/3
	Demanding	The need to feel the freedom to choose to use BringBalance is not met which created a feeling of obligation.	*"Ik vind de verwachting zeg maar die de app op een gegeven moment zegt van nou weetje je moet op dit moment moet je dit doen, op dit moment moet je dit doen, dat er heel weinig flexibiliteit is om dat in je dagelijks leven in te plannen. En dat heeft mij op een gegeven moment ook wel tot irritatie toe, moet ik eerlijk zeggen. Ik werd op een gegeven moment denk ik, joh weet je, laat maar. Dan ja. Misschien dat werkt averechts zelfs". [4]* *"Maar wat ik lastig vond is, in het begin al toch een beetje het het moeten. Laat 'k maar zeggen hè, van je moet 3 keer per dag iets doen." [6]*	35/7/5
	Harmony with self	The need to act in harmony with one's self and the related	*En dan denk ik van ja, mmh, is dat eigenlijk dat wat ik wil invullen. Is dat waar ik inzicht in wil krijgen. [2]*	16/7/0

		personal goals is not met		
Competence	*Feeling incapable*	The need to feel capable of controlling and achieving the outcome is not met. This can be caused by the app, but also through personal and contextual factors.	*"Heb je ook gelijk 't idee van oh, ja 'k loop gelijk al achter de feiten aan te rennen hè."[6]*	14/6/1
	Insufficient challenge	The need to feel challenged and be able to experience mastery is not met. Users have enough capability but are not challenged enough to use this.	*"Of de coherence, want daar gaat het dan vooral om. Ja bij mij was die altijd super hoog. Denk ja, ik had altijd eigenlijk altijd alles groen en ik denk nou, het zal wel. Ja" [4]* *"Dus ik vond hem iets te simpel en te eenzijdig."[2]*	32/6/2
Relatedness		The need to interact, feel connected and experience caring for others by using BringBalance is not met	*"Ja, dat dat misschien al wel zou helpen, maar ik denk ook wel heel erg die sociale factor, omdat als je echt met iemand spreekt dan heb je denk ik toch meer. Hoe noem je dat? Je legt een soort van commitment af." [3]*	2/1/0
Psychological ability	*Knowledge*	The available knowledge did not match or was not enough to use BringBalance.	*"Ja. Ik moet zeggen ik had op het begin denk ik beter op moeten letten, want ik weet eigenlijk niet zo goed wat goed is of wat niet goed is. Of de coherence, want daar gaat het dan vooral om." [4]*	16/7/0
	Cognitive capacity	The available cognitive capacity did not match or was not enough to use BringBalance	*"Nou ja weet je 't is niet lastig om aan te leren. Principe is heel duidelijk, alleen op het moment dat je uh. Stel nou hè, ik heb echt een knetter drukke dag en die heb ik eigenlijk heel vaak. En dan moet ik dus zeg maar van tevoren even, dan moet ik gaan zitten. En dan moet ik een situatie op gaan halen zoals ik de vorige keer dan had en dan hoe ik mezelf nu beter, weet je*	14/5/0

			dat kost gewoon meer. Dat geeft complicaties gewoon, dat kost meer capaciteit."[4]	
	Skills	The available skills did not match or were not enough to use BringBalance	*"Ik heb geprobeerd om, zeg maar, voor een bepaalde gebeurtenis waar je, wat je spannend vondt of in ieder geval waar je moeite mee had, heb ik geprobeerd. Maar ik heb wel moeite om me dan in te leven in die situatie. Dus dat ja, dat vond ik wel lastiger heb ik wel geprobeerd, maar dat lukte niet echt, dus die heb ik daarna ook gewoon niet meer gebruikt" [1]*	11/6/0
Physical ability		The physical skills were not enough to use BringBalance	*"Ik heb, oh ja, ik heb 2 keer, heb ik ook ademhalingsoefeningen gedaan in bed. Gewoon even rustig op mijn ademhaling letten. Kijken wat het doet. En ik had 1 keer dat ik of te langzaam deed of om te ongecontroleerd en dat ik op een gegeven moment merkte dat mijn. Ondanks dat ik gewoon, wel gewoon de lucht binnenkreeg, dat ik een beetje te weinig zuurstof had. Dat was dus geen prettig gevoel en toen ben ik gewoon gaan doen en toen werd het weer rustig. Alsof ik het gevoel krijgen dat ik ging, ja, dat ik bijna na het hyperventileren toe ging. Ik weet niet hoe dat voelt, eigenlijk nooit gehad, maar in ieder geval dat idee." [1]*	3/3/0
Social opportunity		Social factors outside of the individual that reduce or obstruct the motivation to use BringBalance	*"nu ging ik echt in een apart hokje zitten. Omdat ik dacht: ja, zit ik nu een beetje met dat ding aan m'n oor. Iedereen die in een kantoortuin zitten. Mensen zien me aankomen met een dingetje aan aan mijn oor."[7]*	11/4/0
Physical opportunity	*Applicability*	Environmental factors outside of the individual that reduce or obstruct the motivation to use BringBalance, with exception of the factor time, this must be coded under time.	*"Alleen daarin, ja soms is het dan lastig want op je telefoon, dan zet je het geluid dus hard aan. Ik zit hier op open werkvloeren. Dus dat is niet handig en als ik dan m'n oortjes vergeten was dan."[2]*	29/6/0
	Time	The environmental factor time reduce or obstruct the motivation to use BringBalance.	*"Soms vond ik ook wel dat toch stiekem wel tijdrovend was" [2]* *"maar dat het op werkdagen van dan kom je er ook niet van" [6]*	20/6/3

		During a workday no or not enough time is available for using BringBalance, BringBalance is experienced as time-consuming.		
	No trigger	Reminders and other triggers in BringBalance did not motivate (enough) to use BringBalance		20/5/1

* Amount of citations/number of participants/main barrier for number of participants

Table B1.2
Experiences – Barriers for Technology and PSD-model

Code	Subcode	Description	Citation	Occurrence*
Technology		Technological aspects that demotivate to use BringBalance. Not easy to use, errors etc.	*"Ja en bij 1 techniek kon ik gewoon niet door de vragen heen komen, dus dat vond ik jammer. Dus dat werkt dan ook niet om je motivatie te doen"[6]*	23/7/1
PSD – Dialogue support	*Reminders*	Aspects of reminders that demotivate the user to use BringBalance. Reminders remind users of their goal.	*"Veel minder pushy berichten." [4]*	39/7/4
	Liking	Aspects of the layout and visuality of BringBalance that demotivate. A system that is visually attractive	*"Verder de app vond ik geen positieve uitstraling." [7]*	12/5/3

	is likely more persuasive.		
Praise	Aspects with regard to praise used in BringBalance that demotivate. By offering praise, a system can make users more open to persuasion.		-
Suggestion	Aspect with regard to the suggestions given in BringBalance which demotivated. Systems which offer fitting suggestions will have greater persuasive powers	*"alleen sommige vragen we inderdaad niet genoeg afgebakend. Dat het echt sturen ging naar 1 situatie, terwijl je meerdere situaties kan hebben. Ja, nee, vind ik best wel lastig."[1]*	3/3/0
Similarity	Aspects with regard to the similarity of BringBalance that motivated the user. BringBalance did not remind the user of themselves or did not integrate good enough in their daily life.	*"Maar terugdenken aan een situatie wordt voor mij ook wat het spiritueel, kunstmatig" [2]*	23/7/3

* Amount of citations/number of participants/main barrier for number of participants

Table B1.3
Experiences – Stimulators for components of the COM-B system and SDT

Code	Subcode	Description	Citation	Occurrence*
Autonomy	*Use*	The need to feel the freedom to control the use of BringBalance is met and is experienced as stimulating.		-
	Harmony with self	The need to act in harmony with one's self and the related goals is met and is experienced as stimulating.	*Nou dat er iets in de, dat de app iets mij geleerd heeft, wat ik van tevoren niet wist. Ik denk dat dat het meest, dat dat het positiefste is en dat het me ergens inzicht heeft gegeven dat ik denk ja [4]*	25/5/3
Competence	*Challenging*	The need to feel challenged and be able to experience mastery is met and experienced as stimulating.	*"Nou omdat je dan op een gegeven moment met dingen komt zeg maar die leerzaam zijn, die nieuw voor mij zijn hè. Want de inzicht in de technieken en het ook een keer toepassen zeg maar. En ik vind de ene techniek gewoon duidelijk wel veel nuttiger denk ik dan de andere techniek." [4]*	9/3/1
	Self-understanding	The need to gather self-understanding is met and experienced as motivating.	*"Wat wel duidelijk was aan mijn kant. Het was toch wel het herkennen van je, ja van je energie lekken. Je herkent wel van: oké hier verlies ik blijkbaar energie door. En hiervan krijg ik energie, dus dat vond ik wel heel mooi." [5]*	11/5/4
	Feeling Capable	The need to feel capable of achieving the outcome is met and is experienced as motivating.	*"En gewoon door het bewust mee bezig te zijn kun je inderdaad ook echt je hartritme omlaagbrengen, dus dat vind ik wel. Ik vond 't wel tof om te zien eigenlijk. Hoeveel effect dat kan hebben. En daarna ook qua gevoel dat je wel wat meer rust voelt."[1]*	11/5/1
Relatedness		The need to interact, feel connected and experience caring for others by using BringBalance is met and	*"Nou omdat ik jou ook wil helpen met je onderzoek."[4]*	7/4/1

		experienced as stimulating		
Psychological ability	*Knowledge*	The available knowledge was enough to understand the content, use BringBalance and this was experienced as motivating.	*"Nou ik vond ze wel heel helder, to the point." [2]*	20/7/3
	Cognitive capacity	The available cognitive capacity was enough to use BringBalance and this was experienced as motivating.	*"Ja ik was eigenlijk naar opzoek van he is er iets, want ik geloof er echt wel in dat je als je zaken opschrijft dat je er bewust van wordt en dat je d'r actief mee bezig kunt gaan. Want als je nooit benoemd, nooit reflecteert, kun je ook niet heel duidelijk een verbetering ingaan. Dus ja daarin vind ik het prettig om iets te hebben waar je iets kunt opslaan, kunt verwerken." [2]*	1/1/0
	Skills	The available skills were enough use BringBalance and this was experienced as motivating.	*"Nou, ik zeg met name die oefeningen, maar ja dan heb ik het met name over de Neutral oefening, die slaap oefening heb ik trouwens ook nog een aantal keren gedaan. Ja, nee die zijn prima."[6]*	11/6/2
Physical ability		The physical skills were enough to use BringBalance and were experienced as motivating.	*"Waarbij ik me echt verbaasde, want ik dacht dat mijn ademhaling goed was. Maar toen ik die ademhalingstest moest doen met die pieken opschrijven, toen dacht ik nou hij haalt echt wel veel te snel adem. Maar goed dat, daarvan dacht ik wel, oké weet je, dan merk je ook wel als je dat doet. Ja, weet je dit maakt me inderdaad wel iets rustiger daarna. Iets meer neutraal." [4]*	11/3/2
Social opportunity		Social factors outside of the individual that initiate or stimulate the motivation to use BringBalance		-
Physical opportunity	*Applicability*	The fit between BringBalance and daily	*"De lengte was ook wel goed. Want 't is er ook nog wel het moment dat je dat even tussendoor kunt doen" [2]*	10/4/1

		life was seen as motivating.		
	Trigger	The app was functioning as a trigger to go through the psychological process of working on stress and this was experienced as stimulating.	*"Kijk op het moment dat ik zelf ga zitten en ik gaan nadenken wat zijn voor mij stressbronnen, energiebronnen of juist dingen die me energie brengen hè. En ik ga er heel goed over nadenken en ik ga 't opschrijven en dan kom ik er ook wel achter, dit heeft mij een reden geven om het te doen."[4]*	14/5/1

*Amount of citations/number of participants/main stimulator for number of participants

Table B1.4.
Experiences – Stimulators for Technology and PSD-model

Code	Subcode	Description	Citation	Occurrence*
Technology		Technological aspects that motivate the user to use BringBalance. Easy to use, properly working technology.	*"Wat ik ook wel positief van de app is dat je sommige dingen heel snel kan invullen, dus een cijfer kan geven bijvoorbeeld of een optie kan selecteren." [4]*	4/3/0
PSD – Dialogue support	*Reminders*	Aspects of reminders that motivate the user to use BringBalance. Reminders remind users of their goal.	*"Nou ja op zich de de reminders van hé der staat iets voor je klaar, je kunt het nu doen. Hoe vervelend dat soort dingen ook af en toe zijn, het het is confronterend, maar het helpt je ook wel weer als reminder van oh ja ik moet nog iets doen."[2]*	11/4/0
	Liking	Aspects of the layout and visuality of BringBalance that motivated the user. A system that is visually attractive is likely more persuasive.	*"Nee. Nee, weet je, het is gewoon een een nette app, d'r staat wat er moet staan, denk ik. Nee ik heb daarin niet echt zaken gemist."[2]*	22/6/2

Praise	Aspects with regard to praise used in BringBalance that motivated the user. By offering praise, a system can make users more open to persuasion.		-
Suggestion	Aspect with regard to the suggestions given in BringBalance which motivated the user. Systems which offer fitting suggestions will have greater persuasive powers		-
Similarity	Aspects with regard to the similarity of BringBalance that motivated the user. BringBalance did remind the user of themselves or did integrate good in their daily life.	*"Ja, ja, ja zeker, zeker, nee, nee echt inderdaad om te gaan. Nee, nee, maar anders, weet je, als je echt je stressbron wil gaan aanpakken. Ja daar heb je hele andere gesprekken, dan moet je echt met mensen gaan praten erover en daar heb ik helemaal geen zin in. Nee, nee dan vind ik zoiets wel handiger inderdaad ja." [4]*	12/6/2

* Amount of citations/number of participants/main stimulator for number of participants

Table B2.1
Improvements – PSD-model dialogue support

Code	Subcode	Description	Citation	Occurrence*
Reminders	Random	Suggestions for improvement regarding the surprise effect of reminders that could motivate the user to use BringBalance.	*"Ja weet je de ene keer bijvoorbeeld om 9 uur 's ochtends of om 5 uur 's middags in plaats van hè.. Dat je niet op de vaste moment, nu wist je eigenlijk van oh dat soort momenten ga ik een berichtje krijgen. En dan wist je eigenlijk al van oh maar dat gaat niet in m'n agenda passen. Oh weer negativiteit, denk dat als je meer random krijgt en zelf het moment kan kiezen waarop je het invult. Dat dat wel prettiger is" [2]*	7/3
	Autonomy	Suggestions for improvement with regard to the freedom to choose reminders based on the personal preferences of receiving reminders, chosen times, chosen amounts etc.	*"Ja ik zou er geen bezwaar tegen hebben als dat op inderdaad in te stellen tijdstippen dat je dan, dat je het uit kunt zetten, maar dat je ook kunt zeggen van nou ja ik wil dat graag op zaterdag doen dus geef me dan maar een reminder. Dat je in kunt stellen wanneer je de volgende reminder wilt hebben."[6]*	14/6
	Content	Suggestions for improvement with regard to the content of the reminders.	*"Maar als je dan meteen even kijken, ik weet niet of ik ze er nog in had staan. En dan krijg je dus eigenlijk gewoon: There are some questions available for you. Da 's gewoon zo'n basis berichtje. Terwijl dat eigenlijk volgens mij, ik zou een reminder krijgen dat ik iets moest gaan doen en dan staat er dus een question is available. Ja, ik wil gewoon even weten van: denk eventjes aan je oefening."*	8/2
Liking		Suggestions for improvement with regard to aspects of the layoutand visuality of BringBalance that could motivated the user. A system that is visually attractive is likely more persuasive.	*"Ja kom ik weer op iets wat ik al zei, maar goed, meer dat je zo'n tijdlijn hebt. Maar dat is meer functioneel, laat 'k maar zeggen, maar dat kun je natuurlijk wel heel leuk, dat het er mooi uitziet." [6]*	30/7
Praise		Suggestions for improvement with regard to praise in BringBalance that could motivated the user. By offering praise, a system can make users more open to persuasion.	*"Als het meer adaptief zou zijn. En ja inderdaad zo zeggen van: hé, ik merk dat je veel dingen niet invult. Ja. Kop op. Probeer dit of dit." [3]*	5/2

Rewards	Suggestions for improvement with regard to rewards in BringBalance that could motivated the user. Systems that reward target behaviour may have greater persuasive powers.		-
Suggestion	Suggestions for improvement with regard to the suggestions given in BringBalance which could motivated the user. Systems which offer fitting suggestions will have greater persuasive powers	*"En wat ik me voor kan stellen dat heel goed kan werken is als je in die metingen, als je daar doorheen gepraat wordt. Ja ik heb zo'n soort meditatie app en dan word gewoon gezegd van oh ja doe dit, doe dat, van nou moest je dat zelf. Wat ook wel kan hoor, maar ik denk dat dat het wel veel gebruiksvriendelijker maakt, van als je op dat moment terwijl je aan het meten bent, weet wat je aan het doen bent of dat je daar doorheen gepraat wordt, ja."[6]*	10/3
Similarity	Suggestions for improvement with regard to the similarity of BringBalance that could motivated the user. This are suggestions to improve the match between the user and the app, to remind them more of themselves or for better integration in daily life.	*"ik heb daar meer zoiets van oké weet je ik ga 'm doorgronden. Op het moment dat ik 'm tegenkom, dan gaat er wel ergens bij mij een belletje van oké nu moet ik dit doen of al breng je adem weer even terug en ga dan het gesprek met elkaar aan. Dus als je die technieken eerder al uitgelegd krijgt kun je ze denk ik op een hele natuurlijke wijze al gaan toepassen." [2]*	57/7
Social Role	Suggestions for improvement with regard to the social role of BringBalance that motivated the user. If a system adopts a social role, users are more likely use it for persuasive purposes.	*Ja, weet je, als je tussendoor weet je wel al is het 1 keer in de week eventjes terug kan koppelen van: hé, ik loop hier of hier tegen aan en dat dan bijvoorbeeld of een coach of zo bij zou kunnen sturen. Dat dat misschien wel helpt om mensen toch even te motiveren van: doe het nog even en hij houdt dit doel voor ogen, weet je, aan het einde gaat dit en dit en dit je helpen. Denk ik, wel dat die sociale factor wel heel veel uit maakt.[3]*	6/2

* Amount of citations/number of participants

Table B2.2
Improvements – Components COM-B system, SDT and Technology

Code	Subcode	Description	Citation	Occurrence*
Autonomy	*Components*	Suggestions for improvement regarding the freedom to choose which parts and components the user want to do or don't want to do.	*"en dat je ook wat meer kunt kiezen hoe vaak je iets doet en welke blokjes daarvan wilt doen. Ja, het is wel dat het volgordelijk aangeboden werd, dat is wel goed van dat je kunt zeggen oh deze doe ik nou wel of die doe ik niet. En op die manier meer." [6]*	12/6
	Timing	Suggestion for improvement regarding the freedom to choose on which time moments the user want to use BringBalance or when the user want to start with a new phase.	*"maar ik zou het liefste gewoon dit soort dingen dat je het gewoon in je eigen tijd kunt doen." [6]* *"Ja. En dan niet een aantal keren per dag, maar misschien wel 3 keer in de week bijvoorbeeld. Of op bepaalde tijdstippen, wel een bepaalde tijdstippen sowieso niet wat er ook gebeurt niet, dus ik, ik ja, ik denk dat het wel zeker zou kunnen werken." [2]*	36/7
	Demanding	Suggestions for improvement regarding the freedom to use BringBalance and lower the demanding character of the application	*"En dan nog, er zijn mogelijkheden om een app dat wel te laten doen op het moment dat je agenda vrij is, dus je zou bijvoorbeeld je push kunnen koppelen aan lege momenten in je agenda."[4]*	4/3
	Stated goal	Suggestions for improvement regarding the need to act more in harmony with one's self and the related goals.	*"Dat dat misschien wel helpt om mensen toch even te motiveren van: doe het nog even en hij houdt dit doel voor ogen, weet je, aan het einde gaat dit en dit en dit je helpen."[3]*	2/1
Competence	*Increase challenge*	Suggestions for improvement in order to meet the need to feel challenged and be able to experience mastery.	*"We hebben natuurlijk tegenwoordig van we kunnen heel veel meten, dus we meten alles. Wat natuurlijk ook goed is om te kijken van of jezelf kunt voelen of iets met je hartslag goed doet, want dat zou ook wel interessant zijn om daar iets mee te doen." [6]*	7/5
	Maintenance	Suggestions for improvement in order to meet the need to maintain the feeling of competence after the intervention has ended.	*"Nou ja misschien voor een bepaalde periode zeg maar, maar dan wel in een veel minder frequent, zeg maar een call to action geven. Maar misschien dat blijven, blijven stimuleren zeg maar om zo nu en dan een soort van status update aan jezelf te geven, door een meting te doen*	1/1

			bijvoorbeeld, of even een call to action of een reminder. Ja ik denk dat dat wel nuttig zou kunnen werken."[4]	
Relatedness		Suggestions for improvement in order to meet the need to interact, feel connected and experience caring for others by using BringBalance.	*"Al is het gewoon 1 keer in de week even. Weet je, al skype je eventjes met 10 minuutjes met: hé, hoe gaat en? Hoe verloopt het en? Ja, weet je, dat diegene die ook bijvoorbeeld kan helpen van: oh, er zit heel veel over hoe kunnen we dit beter inpassen. Ik kan me voorstellen dat mensen zoals ik, zeg maar, die d'r tegenaan lopen van: oh, ik moet nog zoveel invullen en dan kan ik niet inpassen. Dat een coach vervolgens kan zeggen van: oh, misschien kun je proberen om het zo en zo aan te pakken? Iedere iedere dag eventjes en weet ik veel, in je agenda iets te plannen waar je nu niks voor kan plannen of. Weet je zoiets. Ja, waardoor je toch even op dat rechte pad gehouden wordt." [3]*	3/1
Psychological ability	*Knowledge*	Suggestions for improvement of the content of BringBalance in order to create a better match with the available knowledge of the user.	*"Ja, misschien dat de filmpjes vervangen door iets van stappenplannen of zo maar gewoon doorheen kan swipen. Want ik denk namelijk. Ik maak dan bijvoorbeeld e-learning. En als ik mensen iets uit wil leggen gebruiken ook heel vaak, in plaats van een video, juist stappen waar je gewoon door kan gaan. Ik denk dat dat ook best wel een goeie oplossing is en dan heb je minder. Hoe heet dat, nodig zeg maar om dat te doen." [3]*	5/4
	Cognitive capacity	Suggestions for improvement of the content of BringBalance in order to create a better match with the available cognitive capacity of the user.	*"En wat ik me voor kan stellen dat heel goed kan werken is als je in die metingen, als je daar doorheen gepraat wordt. Ja ik heb zo'n soort meditatie app en dan word gewoon gezegd van oh ja doe dit, doe dat, van nou moest je dat zelf. Wat ook wel kan hoor, maar ik denk dat dat het wel veel gebruiksvriendelijker maakt, van als je op dat moment terwijl je aan het meten bent, weet wat je aan het doen bent of dat je daar doorheen gepraat wordt, ja." [6]*	12/5
	Skills	Suggestions for improvement of the content of BringBalance in order to create a better match with the available skills of the user.	*"Andere vraagstellingen. Dus niet iedere keer dezelfde vraagstelling. Maar bijvoorbeeld ook een trigger van hé is de energielek van de ochtend misschien verbetert in de middag door een bepaalde handeling. Of. Want ik denk dat er wel altijd een een soort oorzaak gevolg relatie zit. […] En daar werd beperkt naar gevraagd. [...] Dus ik vond hem iets te simpel en te eenzijdig. " [2]*	9/4

Physical ability		Suggestions for improvement of BringBalance in order to create a better match with the physical skills of the user.	*". Ik ben wel benieuwd zeg maar of zij zeggen van ja, nou ja, weet je dit is wel is belachelijk hoog of het is superslecht of misschien zou je hier wat meer kunnen werken, die feedback die mis ik wel een beetje." [4]*	7/3
Social opportunity		Suggestions for improvement in order to match BringBalance with the social factors outside of the individual.	*"Ja, het ziet er gewoon een beetje stom uit. Dus ik denk dat er zelfs inderdaad als je gewoon kan zeggen van nou ja ik ga die ademhalingsoefeningen even zonder een hartritme meter dat je dat ook kan doen. Dat je wel even ook je moment kan pakken en gewoon dat kan doen, want dat ziet ook niemand, dat hoeft niemand te zien. Tenminste ja dat is misschien een persoonlijke voorkeur bedoel, ik vond het wel fijn dat ja weet je niet wat een bepaalde concentratie dat je dat gewoon gaat volgen. Dus dat zou voor mij ook wel fijn zijn."[1]*	7/4
Physical opportunity	*Applicability*	Suggestions for improvement in order to match BringBalance with the environmental factors outside of the individual. Improvements that match BringBalance better to time-management.	*"Dan zou je bijna zeggen van oké en welke type heb je, en een activity tracker daar heb ik een hele simpele, maar er zijn heel veel mensen die een fitbit of wat dan ook hebben. Doe we het via de fitbit, sluit hem aan en dan is het al veel minder, dan kun jij al in een overleg of gewoon op kantoor, nu ging ik echt in een apart hokje zitten."[7]*	9/5
	Trigger	Suggestions for improvement in order to make BringBalance a trigger to start using the app and go through the intervention.	*"Terwijl als je ze gewoon divers door de dag heen krijgt. Dus verrast wordt wanneer, dat zou denk ik ook wel helpen." [2]*	8/2
Technology		Suggestions for improvement regarding the technological aspects of BringBalance that motivate the user to use BringBalance. Easy to use, properly working technology.	*"Het zou heel handig zijn op het moment dat je, dat het nodig is om uitgebreidere feedback te geven aan de app, dat er een desktop versie van is." [4]*	9/4
PSD – Social support		Suggestions for improvement with regard to social support.	*"Ja. Ik denk dat zo'n praatgroep of een coach in zekere zin wel motiverende kan werken inderdaad. Dus dat je het ook nog mondeling kan overleggen, maar ja, het moet natuurlijk geen verplichting zijn."[5]*	6/2

* Amount of citations/number of participants

Appendix C – Overview of results

Table C.1
Overview of Stimulators and Barriers for each component.

Component	Part	Subpart	Barrier/ Stimulator	Description	Citation	Occurrence*
Autonomy	Demanding	*Controlling*	Barrier	The need to feel the freedom to choose how BringBalance is used is not met. The application is experienced as controlling and creates a feeling of obligation	*"Ja. Voor mij voelt het vooral als een verplichting een beetje (Participant 5). "*	6/2
		Components	Barrier	The need to feel the freedom to choose which and how much components are filled in or performed is not met, such as questionnaires that are filled in.	*"Was nou volgens mij moest je 7 dagen lang 3 keer per dag, niet 7 dagen, 5 dagen 3 keer per dag aangegeven wat die energielekken en die dingen waren van uh.. En voor mij was dat na 2 keer eigenlijk wel genoeg geweest (Participant 6)."*	4/3
		Timing	Barrier	The need to feel the freedom to choose the own time moments for using BringBalance is not met.	*"Ja dat ik het niet kon doen op tijden dat ik het zelf wilde, of ik het gevoel had dat ik het niet kon doen op tijden dat ik het zelf wilde (Participant 6)."*	6/2
		Reminders	Barrier	The reminders lower the freedom to make own choices regarding the use of BringBalance.	*"Veel minder pushy berichten (Participant 4)."*	5/3
	Harmony with one's self and personal goals	*No additional value*	Barrier	BringBalance is not of additional value for the user.	*"Op zich wel, ik vond de app inderdaad voor mij was het echt niet, wat ik, wat ik er eventueel van dacht. Misschien aan te hebben maar dat maakt niet zoveel uit (Participant 7)."*	2/0

		Additional value	Stimulator	BringBalance is an additional value for the user.	*"Nou ja, goed ja, ja, weet je, ik ben niet altijd even positief geweest, ben best wel kritisch, maar achteraf terugdenkend, zeg maar, het is wel iets, het is me wel iets waard geweest in ieder geval (Participant 4)."*	4/3
		No Match with normal stress approach	Barrier	BringBalance does not match or is not an addition to the normal stress coping strategies of the user.	*"Helemaal niet. Met ademhalen en zo is iets wat ik nooit doe. Ik doe dat maar een beetje hè (Participant 3)."*	3/0
		Match with normal stress approach	Stimulator	BringBalance does match or is an addition to the normal coping strategies for stress.	*"Nee, nee, maar anders, weet je, als je echt je stressbron wil gaan aanpakken. Ja daar heb je hele andere gesprekken, dan moet je echt met mensen gaan praten erover en daar heb ik helemaal geen zin in. Nee, nee dan vind ik zoiets wel handiger inderdaad ja (Participant 4)."*	3/0
		No match with program outline	Barrier	The program outline and structure of BringBalance does not match the user.	*"Ik had eigenlijk meer de verwachting dat het voor zichzelf zou spreken. In de zin, dat er meer qua user experience of meer voor de gebruiker: oke, prima, ik weet wat ik ga doen of wat wat de bedoeling is. Zonder dat je al die fases en stappen door hoeft te lopen (Participant 5)."*	6/0
Competence	Capable in achieving outcomes	*Feeling incapable through accumulation*	Barrier	The need to feel capable of controlling and achieving the outcome is not met through an accumulation of exercises.	*"Heb je ook gelijk 't idee van oh, ja 'k loop gelijk al achter de feiten aan te rennen hè (Participant 6)"*	5/1
		Feeling incapable through the lack of useful tools	Barrier	The need to feel capable of controlling and achieving the outcome is not met through a lack of a useful tool set.	*"Ik heb niet nu een pakket kant en klare tools die ik in mijn dagelijks leven zo in kan richten dat ik daar, dat ik daar beter van wordt (Respondent 4)."*	1/0

		Feeling capable of handling stress	Stimulator	The need to feel capable of achieving the outcome is met and is experienced as motivating.	*"En gewoon door het bewust mee bezig te zijn kun je inderdaad ook echt je hartritme omlaagbrengen, dus dat vind ik wel. Ik vond 't wel tof om te zien eigenlijk. Hoeveel effect dat kan hebben. En daarna ook qua gevoel dat je wel wat meer rust voelt (Participants 1)."*	5/1
	Challenged	*Insufficient challenge through previous experiences*	Barrier	The need to feel challenged and be able to experience mastery is not met. Users are not challenged through previous experiences with the content.	*"Nou het was nu heel, natuurlijk is misschien ook logisch, heel veel nadruk op onderzoek en het in kaart brengen en dat had ik natuurlijk allemaal al gedaan, hebben wij daar heel veel tijd mee bezig en toen ook nog die technieken dat kost heel veel tijd. Terwijl ik dat ook allemaal had gehad (Participant 7)."*	3/2
		Insufficient challenge through program content	Barrier	The need to feel challenged and be able to experience mastery is not met. Users have enough capability but are not challenged enough through the content	*"Of de coherence, want daar gaat het dan vooral om. Ja bij mij was die altijd super hoog. Denk ja, ik had altijd eigenlijk altijd alles groen en ik denk nou, het zal wel (Participant 4)."*	6/2
		Challenged by program content	Stimulator	The need to feel challenged through the program content and be able to experience mastery is met and experienced as stimulating.	*"Nou omdat je dan op een gegeven moment met dingen komt zeg maar die leerzaam zijn, die nieuw voor mij zijn hè. Want de inzicht in de technieken en het ook een keer toepassen zeg maar (Participant 4)."*	3/1
		Challenged by gaining self-understanding	Stimulator	The need to gather self-understanding is met and experienced as motivating.	*"Het was toch wel het herkennen van je, ja van je energie lekken. Je herkent wel van: oké hier verlies ik blijkbaar energie door. En hiervan krijg ik energie, dus dat vond ik wel heel mooi (Participant 5)."*	6/4
Relatedness	Interaction with others	*Lack of interaction*	Barrier	The need to interact, feel connected and experience	*"Ja, dat dat misschien al wel zou helpen, maar ik denk ook wel heel erg die sociale*	1/0

				caring for others by using BringBalance is not met.	*factor, omdat als je echt met iemand spreekt dan heb je denk ik toch meer. Hoe noem je dat? Je legt een soort van commitment af (Participant 3).”*	
		Commitment to researchers	Stimulator	The need to experience caring for others by using BringBalance is met and experienced as stimulating	*“Nou omdat ik jou ook wil helpen met je onderzoek (Participant 4).”*	4/1
Capability	Program structure	*Misunderstanding of introductory information and program structure*	Barrier	The available knowledge, cognitive capacity and skills did not match or were not enough to understand the program structure and the introductory information.	*“Dat was dus eigenlijk helemaal niet duidelijk, hoe die fases er dan precies eruit zouden zien. Van het oefenen (Participant 7).”*	7/0
	Program content	*Mismatch between program content and user abilities*	Barrier	The available knowledge, cognitive capacity and skills did not match or were not enough to understand the program content.	*“Neutraal vind ik gewoon te neutraal, hier zou ik dan een grotere schaal, want voor mij was het dus niet makkelijk om dan vervolgens de meeste, de top, zeg maar, te bepalen uiteindelijk (Participant 7).”*	5/3
		Match between program content and user abilities	Stimulator	The available knowledge, cognitive capacity and skills were enough to understand the program content.	*“Nou ik vond ze wel heel helder, to the point (Participant 2).”*	7/3
	Breathing techniques	*Difficulties with practice of techniques or HeartMath sensor.*	Barrier	The available knowledge, cognitive capacity and skills did not match or were not enough to perform the breathing techniques or use the HeartMath sensor.	*“Ik heb geprobeerd om, zeg maar, voor een bepaalde gebeurtenis waar je, wat je spannend vondt of in ieder geval waar je moeite mee had, heb ik geprobeerd. Maar ik heb wel moeite om me dan in te leven in die situatie. Dus dat ja, dat vond ik wel lastiger heb ik wel geprobeerd, maar dat lukte niet echt, dus die heb ik daarna ook gewoon niet meer gebruikt (Participant 1).”*	4/0

		Additional value of HeartMath sensor	Stimulator	The available knowledge, cognitive capacity and skills were enough to understand the HeartMath sensor and experiencing this as stimulating.	*"Ja, wel handig inderdaad. Dat zal wel iets zijn waarvan ik me ook bewust dan, hè op momenten dat ik dan denk ik: Fuck wat is die dag druk. En dan even dat moment even wat rust, dan het ook wel goed willen doen. Ik heb het geprobeerd met m'n stopwatch. Dat is toch anders. Om die flow zeg maar. Ik denk dat het voor mij. dat visueel, dat maakt het wel erg toepasbaar (Participant 4)."*	5/2
		Effectiveness of breathing techniques	Stimulator	The available knowledge, cognitive capacity and skills were enough to perform the breathing techniques and experiencing the effects.	*"Waarbij ik me echt verbaasde, want ik dacht dat mijn ademhaling goed was. Maar toen ik die ademhalingstest moest doen met die pieken opschrijven, toen dacht ik nou hij haalt echt wel veel te snel adem. Maar goed dat, daarvan dacht ik wel, oké weet je, dan merk je ook wel als je dat doet. Ja, weet je dit maakt me inderdaad wel iets rustiger daarna. Iets meer neutral (Participant 4)."*	3/2
Opportunity	Applicability	*Physical difficulties with integration in daily life*	Barrier	Environmental factors outside of the individual that reduce or obstruct the motivation to use BringBalance.	*"Alleen daarin, ja soms is het dan lastig want op je telefoon, dan zet je het geluid dus hard aan. Ik zit hier op open werkvloeren. Dus dat is niet handig en als ik dan m'n oortjes vergeten was dan (Participant 2)."*	6/0
		Social difficulties with integration in daily life	Barrier	Social factors outside of the individual that reduce or obstruct the motivation to use BringBalance	*"Nu ging ik echt in een apart hokje zitten. Omdat ik dacht: ja, zit ik nu een beetje met dat ding aan m'n oor. Iedereen die in een kantoortuin zitten. Mensen zien me aankomen met een dingetje aan aan mijn oor (Participant 7)."*	4/0
		Difficulties with time-management	Barrier	The environmental factor time reduce or obstruct the motivation to use BringBalance. During a	*"Soms vond ik ook wel dat toch stiekem wel tijdrovend was (Participant 2)."*	6/3

				workday no or not enough time is available for using BringBalance, BringBalance is experienced as time-consuming.		
		Aspects for a good integration in daily life	Stimulator	Aspects of BringBalance that made it a good integration for in daily life which was seen as stimulating.	*"De lengte was ook wel goed. Want 't is er ook nog wel het moment dat je dat even tussendoor kunt doen (Participant 2)."*	4/1
	Trigger	*No trigger*	Barrier	Reminders and other triggers in BringBalance did not motivate (enough) to use BringBalance	*"Nu wist je eigenlijk van oh dat soort momenten ga ik een berichtje krijgen. En dan wist je eigenlijk al van oh maar dat gaat niet in m'n agenda passen. Oh weer negativiteit (Participant 2)."*	5/1
		Positive trigger	Stimulator	The app was functioning as a trigger to go through the psychological process of working on stress and this was experienced as stimulating.	*"Kijk op het moment dat ik zelf ga zitten en ik gaan nadenken wat zijn voor mij stressbronnen, energiebronnen of juist dingen die me energie brengen hè. En ik ga er heel goed over nadenken en ik ga 't opschrijven en dan kom ik er ook wel achter, dit heeft mij een reden geven om het te doen (Participant 4)."*	5/1
Technology and Layout	Functioning	*Not properly functioning*	Barrier	Technological aspects that demotivate the user to use BringBalance. Not easy to use, not properly working technology.	*"Ja en bij 1 techniek kon ik gewoon niet door de vragen heen komen, dus dat vond ik jammer. Dus dat werkt dan ook niet om je motivatie te doen (Participant 6)."*	7/1
		Appropriate functioning	Stimulator	Technological aspects that motivate the user to use BringBalance. Easy to use, properly working technology.	*"Wat ik ook wel positief van de app is dat je sommige dingen heel snel kan invullen, dus een cijfer kan geven bijvoorbeeld of een optie kan selecteren (Participant 4)."*	3/0

Lay-out	*Lay-out is chaotic and unclear*	Barrier	Aspects of the lay-out that demotivate the user to use BringBalance	*"Want ik vond het ook niet, dat vond ik ook niet altijd overzichtelijk wat er nou nog verwacht werd eigenlijk (Respondent 6)"*	4/1
	Lay-out was clear	Stimulator	Aspects of the lay-out that motivates the user to use BringBalance.	*"Weet je ik vond hem, ik vond hem goed, hij was wel intuïtief in ieder geval. Dus de... Ik heb geen 1 keer afgevraagd waar zou ik dat dan nou moeten invullen (Respondent 4)?"*	2/0

* Number of participants mentioned/Number of main barrier or stimulator.

Table C.2
Overview of improvements based on the persuasive features of the category dialogue support of the PSD-model

Persuasive Feature	Part	Subpart	Description	Citation	Link with Component(s)	Occurrence
Reminders	Customized		Suggestions for improvement with regard to the freedom to choose reminders based on the personal preferences of receiving reminders, chosen times, chosen amounts etc.	*"Ja ik zou er geen bezwaar tegen hebben als dat op inderdaad in te stellen tijdstippen dat je dan, dat je het uit kunt zetten, maar dat je ook kunt zeggen van nou ja ik wil dat graag op zaterdag doen dus geef me dan maar een reminder. Dat je in kunt stellen wanneer je de volgende reminder wilt hebben (Participant 6)."*	Autonomy	6
	Trigger	*Random*	Suggestions for improvement of the timing of reminders to create a better trigger to use BringBalance	*"Nah ik denk dat random ook wel af en toe het het verrassingseffect is van, want anders wordt het ook een ingestudeerd kunstje (Respondent 2)."*	Opportunity	2
		Content	Suggestions for improvement of the content of reminders to create a better trigger to use BringBalance	*"En dan krijg je dus eigenlijk gewoon: There are some questions available for you. Da 's gewoon zo'n basis berichtje. Terwijl dat eigenlijk volgens mij, ik zou een reminder krijgen dat ik iets moest gaan doen en dan staat er dus een question is*	Opportunity	1

				available. Ja, ik wil gewoon even weten van: denk eventjes aan je oefening (Participant 7).”		
Similarity	Freedom to choose	*Time-moments*	Suggestions for improvement regarding the freedom to choose when the user want to use BringBalance.	*“Ja. En dan niet een aantal keren per dag, maar misschien wel 3 keer in de week bijvoorbeeld. Of op bepaalde tijdstippen, wel een bepaalde tijdstippen sowieso niet wat er ook gebeurt niet, dus ik, ik ja, ik denk dat het wel zeker zou kunnen werken (Participant 4).”*	Autonomy, Opportunity	7
		Components	Suggestions for improvement regarding the freedom to choose which parts and components of BringBalance the user want to do or don’t want to do.	*“En dat je ook wat meer kunt kiezen hoe vaak je iets doet en welke blokjes daarvan wilt doen. Ja, het is wel dat het volgordelijk aangeboden werd, dat is wel goed van dat je kunt zeggen oh deze doe ik nou wel of die doe ik niet. En op die manier meer (Participant 6).”*	Autonomy, Competence	6
		Start new phase	Suggestions for improvement regarding the freedom to choose when the user want to start a new phase in BringBalance.	*“Eigenlijk duurt het juiste te lang (phase 2), je moet gewoon door, kunnen zeggen van oké. Ik ga ervoor zitten en ik kijk die filmpjes af, dit zijn technieken. En ik ga ze dan koppelen (Respondent 7).”*	Autonomy, Competence	4
	Content Changes	*Questions*	Suggestions for improvement of the questionnaires in order to create a better match between BringBalance and the abilities of the user.	*“Andere vraagstellingen. Dus niet iedere keer dezelfde vraagstelling. Maar bijvoorbeeld ook een trigger van hé is de energielek van de ochtend misschien verbetert in de middag door een bepaalde handeling. Of. Want ik denk dat er wel altijd een een soort oorzaak gevolg relatie zit. […] En daar werd beperkt naar gevraagd. [...] Dus ik vond hem iets te simpel en te eenzijdig (Participant 2).“*	Capability	5
		Challenge	Suggestions for making the content of	*“We hebben natuurlijk tegenwoordig van we kunnen heel veel meten, dus we meten alles. Wat*	Competence	2

			BringBalance more challenging for the user.	*natuurlijk ook goed is om te kijken van of jezelf kunt voelen of iets met je hartslag goed doet, want dat zou ook wel interessant zijn om daar iets mee te doen (Participant 6).”*		
	Technical Changes	*Watch*	Using a watch instead of the existing HeartMath sensor in order to create a better match between BringBalance and the user	*“Dan zou je bijna zeggen van oké en welke type heb je, en een activity tracker daar heb ik een hele simpele, maar er zijn heel veel mensen die een fitbit of wat dan ook hebben. Doe we het via de fitbit, sluit hem aan en dan is het al veel minder, dan kun jij al in een overleg of gewoon op kantoor, nu ging ik echt in een apart hokje zitten (Participant 7).”*	Opportunity	2
		Pacer without sensor	Using only the pacer of the Innerbalance app without the connection with the HeartMath sensor in order to create a better match between BringBalance and the user	*“Ja, het ziet er gewoon een beetje stom uit. Dus ik denk dat er zelfs inderdaad als je gewoon kan zeggen van nou ja ik ga die ademhalingsoefeningen even zonder een hartritme meter dat je dat ook kan doen. Dat je wel even ook je moment kan pakken en gewoon dat kan doen, want dat ziet ook niemand, dat hoeft niemand te zien (Participant 1).”*	Opportunity	2
		Desktop	Using BringBalance on a desktop would be an improvement to create a better match between BringBalance and the user.	*“Het zou heel handig zijn op het moment dat je, dat het nodig is om uitgebreidere feedback te geven aan de app, dat er een desktop versie van is (Participant 4).”*	Opportunity	2
Liking	Overview	*Time-line*	Suggestions for improvement of the lay-out in order to create a better match between BringBalance and the user	*“Dat je zo’n tijdlijn hebt. Maar dat is meer functioneel, laat ‘k maar zeggen, maar dat kun je natuurlijk wel heel leuk, dat het er mooi uitziet (Participant 6).”*	Autonomy, Technology and Lay-out	5

	Visuality	*Questions*	Suggestions for improvement of the visuality of the questions to make the content of BringBalance more stimulating.	*"Maar je zou bijvoorbeeld wel iets simpels kunnen indrukken van wat is je gemoedstoestand? Slecht, goed, beter of hoe.. Hè met een smileys of stoplicht systeem, dergelijke. Dat je daar diversiteit in komt en dat je daardoor uiteindelijk in je overzicht van de dag krijgt. Wat niet alleen uit de staafjes en tekst bestaat, maar net even iets meer. Dat het al meer een heel verhaal is (Participant 2)."*	Capability, Opportunity	2
		Graph	Suggestions for improvement of the visuality of the graph to make the content of BringBalance more stimulating.	*"In een soort van weegschaal of zo. Dat je kan zien van: oh, je was deze dag toch best wel positief en dat je dat zeg maar visueel ook heel duidelijk ziet zeg maar (Participant 3)."*	Capability	1
		Movies	Suggestions for improvement of the visuality of the movies to make the content of BringBalance more stimulating.	*"Ja, ik denk wel dat het wel iets zou helpen, zeg maar, als je als je dezelfde beelden zou gebruiken maar met een stem daarachter die gewoon: dat heel vlot verteld. Denk ik wel dat wel een verschil maakt (Participant 3)."*	Capability, Opportunity	3
Suggestion		*Additional suggestions on physical data*	Suggestions for improvement of the suggestions given in BringBalance as feedback on physical data.	*"Ja, ja, ja, weet je dat je continu, dat je ook de feedback krijgt zeg maar, ook van een systeem. Dat je ook gewoon weet hoe dingen zitten en daar zou je misschien op kunnen sturen door misschien vaker techniek toe te passen of niet. Of misschien andere manier der over na te denken (Participant 4)".*	Capability	1
		Additional support Breathing Techniques	Suggestions for improvement of the suggestions during learning the breathing	*"En wat ik me voor kan stellen dat heel goed kan werken is als je in die metingen, als je daar doorheen gepraat wordt. Ja ik heb zo'n soort meditatie app en dan word gewoon gezegd van oh ja doe dit, doe dat, van nou moest je dat zelf. Wat*	Competence, Capability	1

		techniques in BringBalance.	*ook wel kan hoor, maar ik denk dat dat het wel veel gebruiksvriendelijker maakt, van als je op dat moment terwijl je aan het meten bent, weet wat je aan het doen bent of dat je daar doorheen gepraat wordt, ja (Participant 6).”*		
	Personal suggestions	Suggestions for improvement of the personal suggestions given in BringBalance.	*“Dat dat misschien wel helpt om mensen toch even te motiveren van: doe het nog even en hij houdt dit doel voor ogen, weet je, aan het einde gaat dit en dit en dit je helpen (Participant 3).”*	Autonomy, Competence	1
Praise		Suggestions for using praise in BringBalance to motivate the user.	*“Als het meer adaptief zou zijn. En ja inderdaad zo zeggen van: hé, ik merk dat je veel dingen niet invult. Ja. Kop op. Probeer dit of dit (Participant 3).”*	Competence	1
Social Role		Suggestions for improvement with regard to the social role of BringBalance that motivated the user.	*“Ja, weet je, als je tussendoor weet je wel al is het 1 keer in de week eventjes terug kan koppelen van: hé, ik loop hier of hier tegen aan en dat dan bijvoorbeeld of een coach of zo bij zou kunnen sturen. Dat dat misschien wel helpt om mensen toch even te motiveren van: doe het nog even en hij houdt dit doel voor ogen, weet je, aan het einde gaat dit en dit en dit je helpen. Denk ik, wel dat die sociale factor wel heel veel uit maakt (Participant 3).”*	Autonomy, Relatedness, Opportunity	2