How Reflective Automated eCoaching Can Help Employees Improve their Capacity for Resilience: A Mixed Methods Study

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Submitted to: JMIR Human Factors
on: October 18, 2021

Table of Contents

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Abstract

Background: An eHealth tool that guides employees through the process of reflection has the potential to support employees with moderate levels of stress to increase their capacity for resilience. Most eHealth tools that include self-tracking summarise the collected data for the users. However, users need to gain a deeper understanding of the data and decide upon the next step to take through self-reflection.

Objective: In this study, we aimed to examine: (1) the perceived effectiveness of the guidance offered by an automated eCoach during employees' self-reflection process in gaining insights into their situation and on their perceived stress and resilience capacities; and (2) the usefulness of the design elements of the eCoach during this process.

Methods: Of the twenty-eight participants, fourteen completed the six-week BringBalance programme that allowed participants to perform reflection via four phases (Gilbert and Trudel, 2001): 1) identification, 2) strategy generation, 3) experimentation, and 4) evaluation. Data collection consisted of log data, EMA questionnaires for reflection provided by the eCoach, in-depth interviews, and a pre-and post-test survey (including the Brief Resilience Scale and the Perceived Stress Scale). The post-test survey also asked about the utility of the elements of the eCoach for reflection.

Results: Although users did not perceive a beneficial effect on stress and resilience capacities, the automated eCoach did enable users to gain an understanding of factors that influenced their stress levels and capacity for resilience and to learn the principles of useful strategies to improve their capacity for resilience. Design elements of the eCoach reduced the reflection process into smaller steps to re-evaluate situations and helped them to observe a trend. However, users experienced difficulties integrating the chosen strategies into their daily life. Moreover, the identified events related to stress and resilience were too specific through the guidance offered by the eCoach and the events did not recur, which consequently left users unable to sufficiently practise, experiment, and evaluate the techniques during meaningful events.

Conclusions: Although participants did not report improvements to their stress and resilience capacities, they were able to perform self-reflection under the guidance of the automated eCoach, which often led towards gaining new insights. To improve the reflection process, more guidance should be offered by the eCoach that would aid employees to identify events that recur in daily life. Future research could study the effects of the suggested improvements on the quality of reflection via an automated eCoach.

(JMIR Preprints 18/10/2021:34331)
DOI: https://doi.org/10.2196/preprints.34331

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Background: An eHealth tool that guides employees through the process of reflection has the potential to support employees with moderate levels of stress to increase their capacity for resilience. Most eHealth tools that include self-tracking summarise the collected data for the users. However, users need to gain a deeper understanding of the data and decide upon the next step to take through self-reflection.

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reflection.

Results: Although users did not perceive a beneficial effect on stress and resilience capacities, the automated eCoach did enable users to gain an understanding of factors that influenced their stress levels and capacity for resilience and to learn the principles of useful strategies to improve their capacity for resilience. Design elements of the eCoach reduced the reflection process into smaller steps to re-evaluate situations and helped them to observe a trend. However, users experienced difficulties integrating the chosen strategies into their daily life. Moreover, the identified events related to stress and resilience were too specific through the guidance offered by the eCoach and the events did not recur, which consequently left users unable to sufficiently practise, experiment, and evaluate the techniques during meaningful events.

Discussion and conclusions: Although participants did not report improvements to their stress and resilience capacities, they were able to perform self-reflection under the guidance of the automated eCoach, which often led towards gaining new insights. To improve the reflection process, more guidance should be offered by the eCoach that would aid employees to identify events that recur in daily life. Future research could study the effects of the suggested improvements on the quality of reflection via an automated eCoach.

Keywords: Self-reflection, stress management, resilience, eHealth, self-tracking, eCoaching

Introduction

Sustainable employability is, for a large part, negatively affected by stress, with one-third of work-related absenteeism among employees caused by stress [1]. According to the EU compass for action on mental health and well-being, more should be done in the preventative phase to increase employees' capacity for resilience [2]. Tackling stress in the preventative phase is vital since stress can have negative consequences for health, wellbeing, and productivity [3]. To tackle stress in the preventative phase, it is necessary that employees cope effectively with the causes of the stress response (i.e., the stressors) and change their behaviour. Awareness about the stress response and the stressor is a prerequisite for employees to activate the desired behaviour change. Moreover, employees need to learn how to cope effectively with the stressor [4]. Resilience is achieved when an employee has dealt effectively with stress, and the employee's capacity for resilience is demonstrated after exposure to a stressor [5]. An employee's capacity for resilience, "the ability to bounce back after adversity" [6], is determined by the possession of several psychosocial and protective factors that influences the relationship between a stressor and the initial stress response. Examples of such factors are the employees' coping repertoire and emotion regulatory capacities [5].

Reflection is an important step for effective behaviour change in the context of resilience training. Reflection involves evaluating past experiences and learning from these experiences with the aim of optimising personal performance in future situations [7]. It can stimulate effective coping and increase the capacity for resilience [5, 8]. One of the ways in which reflection on stressful events improves resilience capacities is that it prompts the employee to search for ways to improve and adapt, or to recruit more coping strategies, and to activate available resources [5]. It is both useful to perform reflection soon after experiencing the situation that causes stress (reflection-in-action) as well as later in time (reflection-on-action) [9]. Stressful moments are opportune moments to perform a coping strategy, and a reassessment later in time can result in better recognition of stress or a stressor in future situations [5]. Another way in which reflection improves the capacity for resilience is that the negative event can be interpreted as less negative once time has passed and individuals know the outcome of the stressor, which is often less severe than expected. This can lead to the situation being reframed into something more positive and unnecessary to worry about [10].

In traditional coaching settings, reflective coaching has received a good deal of attention as an effective and essential method to help coachees better understand and learn how to improve their situation [11, 12]. The reflective coaching model [13], which is used nowadays in face-to-face coaching, includes four phases of reflection: (1) identification, (2) strategy generation, 3) experimentation, and 4) evaluation. *The identification phase* involves identifying issues worth

solving and understanding why each is an issue, *the strategy generation phase* involves searching for and choosing possible solutions for the issue, *the experimentation phase* involves experimenting with the chosen strategies, and *the evaluation phase* involves evaluating the effectiveness of the strategy as a solution for the issue [13]. In short, reflection includes (1) gaining awareness about the current situation and (2) learning how to deal effectively with the current situation or similar situations in the future.

Due to the number of employees experiencing stress, labour-intensive face-to-face reflective coaching sessions to improve the capacity for resilience in the preventative phase is simply not realistic [14]. eHealth technologies have the potential to guide the user through the process of reflection without human involvement [15]. In the identification phase, the self-tracking of stressful events and events related to resilience can result in awareness about the current situation [16]. Real-time measures of stress and resilience capacities (e.g., heart rate variability) can be collected using self-tracking devices, such as smartwatches [17, 18], or ecological momentary assessment (EMA) via smartphones. EMA "assesses individuals' current experiences, behaviours, and moods as they occur in real-time and in their natural environment" [19].

eHealth tools that include self-tracking often present the collected data in a graph for the user or as a simple summary. These persuasive technology features [20] can offer guidance during the first steps in the identification phase, namely these features can support users to observe their status and progress towards the required behaviour change, and this is helpful during the reflection process [15]. However, previous research on self-tracking of health behaviour indicates that awareness of one's healthy lifestyle via self-tracking alone is not enough to effectuate real behaviour change [16, 21-23]. Users need to gain a deeper understanding of their current situation and to decide on their own which behaviour change strategies to apply. Guidance during these essential parts of the reflection process is missing in current eHealth tools employing self-tracking and awareness via self-tracking is not followed by real behaviour change. In one study, end-users and other stakeholders expressed that more guidance during reflection, in addition to the collection and summarisation of data, was an important need for resilience training via eHealth technology [24].

Reflective automated eCoaching has the potential to provide this necessary guidance that will aid in transforming awareness into real behaviour change. In this study, automated reflective eCoaching is defined as supporting, advising, and guiding the user to evaluate past experiences and learn from these experiences for future improvement without the involvement of a human coach [7, 25]. An automated eCoach can: personalise the coaching strategy based on self-tracking data and input from

the user regarding their coaching needs, make use of persuasive features to motivate and stimulate behaviour change [20], and be accessed 24/7.

As we believe that reflective automated eCoaching can effectuate real behaviour change, we aimed to study how employees who are using an automated reflective eCoach perceive its *effectiveness* and *usefulness*. It is not only important to know the outcome of the guidance offered by the automated eCoach, i.e. effectiveness, but also to gain an understanding of how the use of the different design elements of the automated eCoach and the interplay between them contribute to the outcomes, i.e. usefulness of the design elements during reflection [26]. To our knowledge, no study has evaluated this before. Results on the perceived effectiveness and usefulness via reflective automated eCoaching can lead to implications for future designs in the context of resilience training. To explore this, we developed a prototype of the BringBalance app, as described in Section 2.

The research questions that we aim to answer are:

1. *According to employees, what is the **perceived effectiveness,** of the guidance offered by the automated eCoach in the BringBalance app during their reflection on the self-tracking data and strategies to improve their capacities for resilience?*
    a. *To what extent did the employee gain insights into their current situation and strategies to cope effectively with current and future situations via the automated eCoach?*
    b. *What kind of changes are observed in pre- and post-test scores on perceived levels of stress and resilience capacities among employees using the automated eCoach in the BringBalance app?*
2. *What is the **usefulness** of the design elements of the automated eCoach in the BringBalance app to guide reflection by employees on the self-tracking data and strategies to improve the capacity for resilience?*
    a. *To what extent are the individual design elements of the automated eCoach in the BringBalance app, and the interplay between these design elements, useful during the process of reflection by employees?*
    b. *What stimulating and stagnating factors did employees experience during the use of the design elements of the automated eCoach in the BringBalance app during their reflection process?*

The BringBalance App

The BringBalance app is a product of ‘De Maar Training & Advies’ and is based on their face-to-face coaching programme *Working on Resilience*. Results from a pilot study on this face-to-face coaching programme indicated positive effects on stress reduction [27]. Besides the coaching programme Working on Resilience, results from earlier studies on self-tracking and eCoaching for resilience training were also used during the design of the BringBalance app [24, 25, 28]. Other sources for creating the design of the BringBalance app were provided by literature on reflection [9, 10, 13, 22, 29-31], coaching techniques [32-37], and persuasive design elements that can support the reflection process, such as visualisation and personalisation [15, 20, 38, 39].

The prototype of the BringBalance app was created with The Incredible Intervention Machine (TIIM), a tool of the Behavioural, Management and Social Sciences (BMS) lab at the University of Twente that supports building and testing eHealth interventions [40]. The BringBalance programme takes six weeks to complete. The design elements were offered to the user in Dutch through the BringBalance programme in the TIIM app and all the design elements together comprise the automated eCoach. The design elements appear in *italics* in the text below. See Figure 1 for screenshots a selection of the design elements and see Table 1 for an overview of the content of the BringBalance programme. A more in-depth description of the BringBalance programme, complying to the CONSORT-guidelines for the reporting of eHealth interventions, can be found in Multimedia Appendix A.

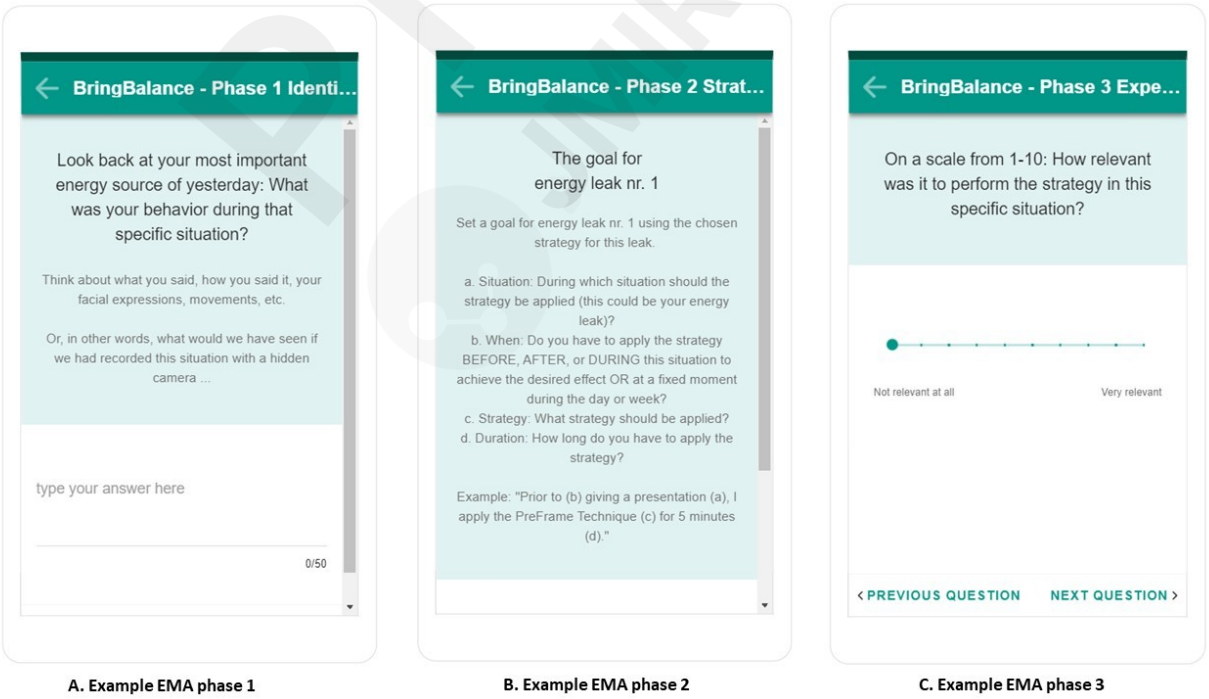


Figure 1. Screenshots of the BringBalance programme in the TIIM app, including a few EMA questionnaires.

Table 1. Content of the BringBalance programme

Phase	Duration	What?
Phase 1 – Identification	Week 1 - 2	Three times per day: • Filling in the EnergyBalance questionnaire (during the weekend once daily) Once daily: • Reflecting on the measurements of the day before End of phase 1: • Choosing the three most important energy sources and leaks *Result: Self-tracking data on the EnergyBalance for comparison with phase 3, list of energy sources and leaks and top three most important sources and leaks.*
Phase 2 – Strategy generation	Week 3 – 4	Every Monday, Wednesday and Friday: • Learning a new BringBalance technique The day after the introduction of the technique: • Practicing the BringBalance technique with the Inner Balance Trainer End of phase 2: • Choosing strategies for their three most important energy sources and –leaks • Setting implementation intentions and reminders for phase 3 *Result: Strategies were chosen for the top three energy sources and leaks, implementation intentions were set including the strategies for the energy sources and leaks, reminders were set with the implementation intentions*
Phase 3 - Experimenting	Week 5 - 6	Daily: • Receiving reminders at chosen moments with their implementation intentions • Experimenting with the chosen strategies (optional: using the Inner Balance sensor) according to implementation intentions • Evaluating the strategy with a strategy evaluation form after experimenting with a strategy • Filling in the EnergyBalance questionnaire once daily *Result: Data on the evaluation of the strategies, self-tracking data on the EnergyBalance for comparison with phase 1*
Phase 4 – Evaluation	End of week 6	At the end of the programme: • Receiving the data collected in phase 3 via visualisations in tables and graphs • Evaluating if the strategies helped to prevent

		or resolve energy leaks and helped to make more use of energy sources. • Evaluating if the energy balance improved. • Advice on how to continue working on their energy balance after completion of the programme *Result: Final reflection on the strategies and energy balance and advice on how to continue working on their energy balance*

The reflective coaching model with its four phases [13] was translated into a suitable format for the automated eCoach. During **the identification phase** (phase 1), the employee was stimulated to gain insights into situations (energy sources and leaks) related to stress and resilience in order to find opportunities for improvement. Data collection and reflection consisted of filling in three EMA *EnergyBalance questionnaires* per day (see Multimedia Appendix A for the EnergyBalance questionnaire), *reflecting on the collected data a day later*, and choosing *the three most important energy sources and leaks* at the end of phase 1 from *a list with an overview of the collected energy sources and leaks*

The term 'energy leak' was chosen to indicate bodily responses to stress that activates the sympathetic nervous system, such as a quickened heart rate and/or breathing pace, resulting in lower levels of energy [17]. Also, in the context of this study, energy leaks referred to situations that lead to low mental energy levels, i.e., a feeling of mental exhaustion. The term 'energy source' indicate those resources that activate the parasympathetic nervous system, lowering the heart rate and breathing pace, and are related to a more energetic feeling at the mental level. Energy sources can help one to regain balance in one's energy levels [41], i.e., enable a person "to bounce back after adversity"- the definition of the capacity for resilience [6]. An element in the app that was specifically added by the designers to stimulate in-depth reflection was the *4G scheme* [32]. This element helped user to reflect a day later and included questions asking the user to provide a more detailed description of the situation as well as their emotional state, cognitions, and behaviour during the situation. In addition, a *table* and *graph* with an overview of the collected data from the day before were presented to the user.

Phase 2, **the strategy generation phase,** consisted of learning the *six BringBalance techniques* via short clips. These BringBalance techniques are based on exercises from the HeartMath Institute [42] and entail being attentive to one's heart area and using one's imagination to breath in-and-out through it [27]. Every technique started with a breathing exercise, which could then be followed by evoking a positive emotion or by a framing exercise including: (1) framing a future event positively to reduce stress responses towards this event, (2) taking a moment to frame a current event in order to improve performance during this event, or (3) reframing a past event positively to reduce stress responses because of this event. In addition, a heart rate variability (HRV) sensor (the Inner Balance Trainer, HeartMath Institute), placed on the participant's earlobe, provided the participant with *biofeedback during training the techniques*. HRV biofeedback has been found to support self-

regulation capacities [43]. The HRV indices enabled the participants to see any immediate effect of the technique on their HRV levels, which they could then use to adjust their performance. Participants received *reminders to train the BringBalance technique* a day later. At the end of phase 2, users *decided upon helpful strategies for their three most important energy leaks and energy sources*. The strategies could be one of the BringBalance techniques, an energy source or a self-chosen strategy. While selecting a strategy, users could receive *guidance via the strategy database* with an overview of all BringBalance techniques and tips for application in daily life, or *via the eCoach's guiding questions*. Personal goals, including the strategies, were set in the form of *implementation intentions*, for example, statements like: "Whenever situation x arises, I will initiate the goal-directed response y!" [34].

In phase 3, **the experimentation phase**, the user received the implementation intentions via *reminders at self-chosen moments*. After applying the strategies in real-life, users were then asked to fill in the *strategy evaluation form* including questions about the effects of the strategy on their energy level and mood, and about stimulators and demotivators. Also, the user filled in the *EnergyBalance questionnaire* every day.

All *collected data from phase 3 were visualised in a graph and table* and presented to the user in phase 4, **the evaluation phase**. In phase 4, the user *evaluated* whether *the chosen strategies* were the right strategies for their energy sources and leaks and whether their *EnergyBalance* had improved.

Methods

Participants

Companies from a project, in which the Hanze University of Applied Sciences was involved, were recruited via email to participate. A software company with about 350 employees in the east of the Netherlands replied to our request. Participants were recruited via an email sent to all employees by the Human Resources (HR) department. The HR department informed the potential participants about the objectives of the study, the BringBalance app, data collection and management, and the amount of effort that was requested for employee participation. Employees willing to participate were asked to fill in an online questionnaire with the validated Dutch-version of the Perceived Stress Scale (PSS) [44-46] and an informed consent form. The inclusion criteria for participation was a score above 14 on the PSS, indicating a higher than average perceived level of stress [47, 48]. This inclusion criteria was based on earlier studies performed by the authors [24, 49] that showed employees with a certain level

of stress tend to have a higher motivation to complete the intervention due to a higher expected benefit in comparison to employees with lower stress levels. Finally, participants needed to own an Android (version 5.0 or higher) or iOS (version 10.0 or higher) smartphone.

A total of 45 participants filled in the questionnaire, a response rate of 13%. Since fifteen HRV sensors were available, thirty participants were invited to join-in either one of two sessions: November 2018 (n=15) or January 2019 (n=15).

Data collection and analyses

Data collection included (1) a pre- and post-test survey, (2) EMA questionnaires in the BringBalance app, (3) log data, and (4) in-depth interviews. The pre-test survey was filled in before the BringBalance programme, the EMA questionnaires and log data were collected during the BringBalance programme, and the post-test survey and in-depth interviews were taken after the BringBalance programme. Collected data included data on the perceived effectiveness (the gaining of insights (RQ 1A), stress, and capacity for resilience (RQ 1B)) and perceived usefulness (utility of the design elements (RQ 2A) and stimulating and stagnating factors during the use of the design elements for reflection (RQ 2B)). Besides, collected data included data on adherence to the intended use, drop-out, app usages, user motivation, usability, and the experience with the BringBalance programme in general. This data was used to confirm, explain, or nuance the results on the main outcomes of interest. See Figure 2 for a flowchart including an overview of the methods for data collection and integration of the data during collection and analysis. A data management plan was set up according to the General Data Protection Regulation, a regulation for the protection of personal data inside and outside the European Union. More information on the data management plan can be found in the section ‘Data management and ethical approval’.

The Pre-test Survey

The online pre-test survey was filled in using Qualtrics survey software (Provo, Utah and Seattle, Washington, US) seven to one days before the start of the BringBalance programme. The pre-test survey included: (1) demographic characteristics (age, gender, function, educational level), (2) the Dutch version of the Perceived Stress Scale (PSS) (range of possible scores: 0 – 40) [44-46], (3) the Dutch version of the Brief Resilience Scale (BRS) (range of possible scores: 1 – 5) [50, 51], and (4) ease of using a smartphone rated on a scale from 1 – 5. The latter question was self-developed and was included for an indication of the participant’s smartphone skills. The PSS [44-46] and the BRS [50-52] are both validated questionnaires . The PSS was used to check whether possible participants matched the

inclusion criteria. The pre-test PSS and BRS scores were used to gain insights into the study population and to compare against post-test scores to assess perceived effectiveness on stress and resilience capacities (see the blue box in Figure 2). However, no causal effect of the guidance offered by the automated eCoach can be deduced due to the study set-up. Data from the pre-test survey was uploaded in SPSS for the calculation of descriptive statistics.

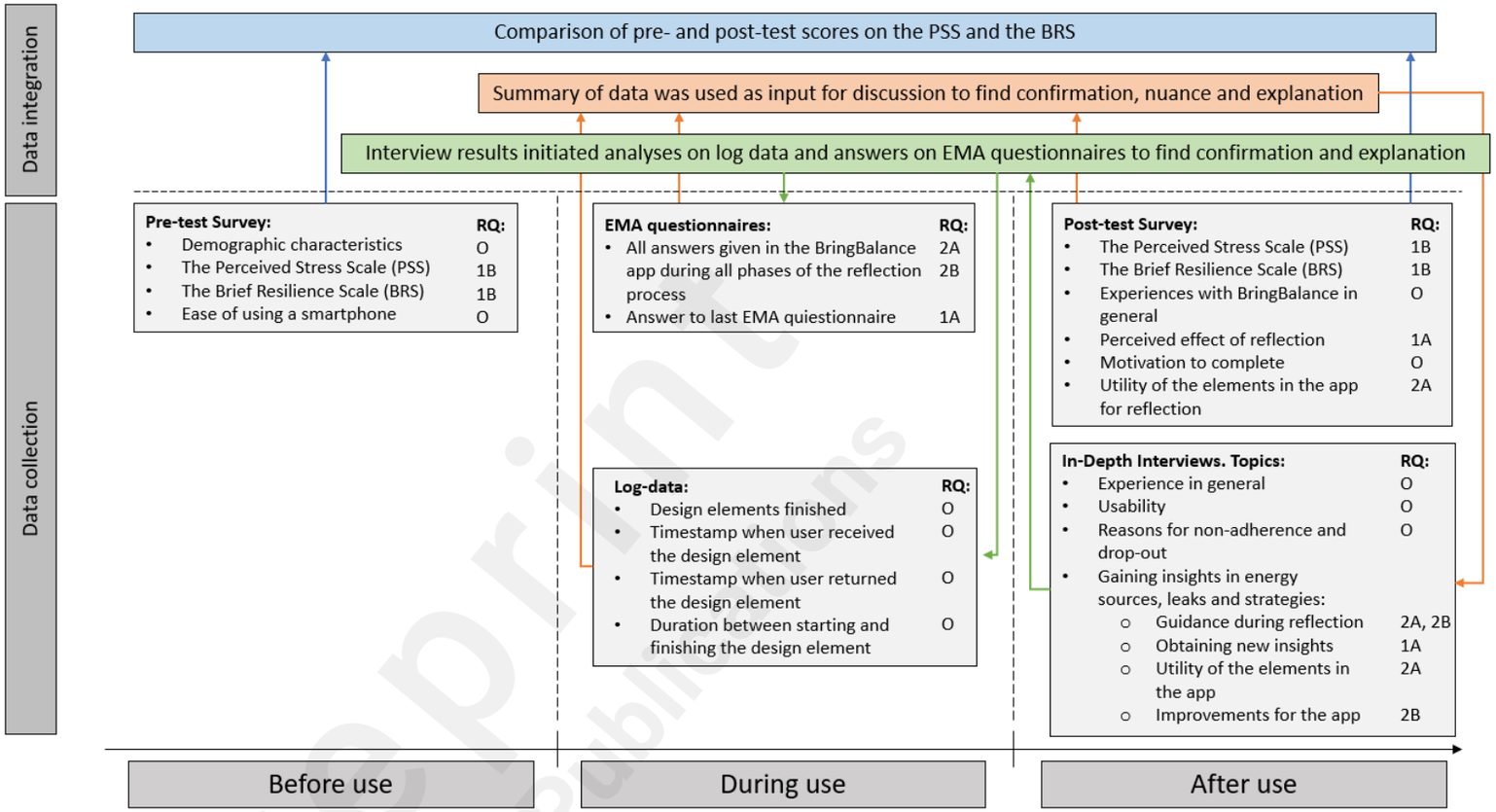


Figure 2. Flowchart of methods for data collection and data integration.
Note: RQ=Research Question, O=Other data to explain or nuance results

EMA questionnaires in the BringBalance app

During the BringBalance programme, participants were asked by the automated eCoach to complete several tasks throughout their reflection process. Participants were asked via a reminder on their smartphone to fill in EMA questionnaires related to a specific task. The app included seventeen different EMA questionnaires, each with their own content, doses, and timing. Some EMA questionnaires were released at fixed moments during the BringBalance programme while others were released based on a specific answer given in another EMA questionnaire. Multimedia Appendix A includes in-depth information on the set-up of the EMA questionnaires, based on the report checklist from Van Berkel and colleagues [53], along with examples of the EMA questionnaires in the app. Also, Figure 1 includes screenshots of a selection of the available EMA questionnaires in the app. The answers to the EMA questionnaires gave insights into the way the users completed the reflection phases. This data led to insights on the perceived utility of design elements for reflection and stimulating and stagnating factors during the use of the design elements during reflection. The last EMA questionnaire asked participants to report if they perceived a beneficial effect on their energy balance (yes/no) and if they had gained insights into their energy leaks and sources and strategies to improve their energy balance (yes/no). This data was used to answer if participants gained insights into their current situation and strategies to improve their situation. Energy balance was defined for participants as the balance between their mental and physical energy absorbing processes due to energy leaks and the processes that give them mental or physical energy from the energy sources [41]. Data were stored in the database of the BMS lab at the University of Twente and were retrieved via uploading the data in Excel files.

The EMA data were used when it was needed to further explore and interpret a result from the analyses of the interview data (see the green box in Figure 2). For example, when participants mentioned having difficulties with the interpretation of a question from the automated eCoach, answers given on EMA questionnaires provided insights into the way users interpreted the question. In addition, EMA data were used as input for discussions during interviews (see the orange box in Figure 2).

Answers to open questions were gathered in Word documents and uploaded into Atlas.ti for analyses by way of open, axial, and selective coding. Numeric scores were uploaded in SPSS via Excel files for the calculation of descriptive statistics.

Log data

Log data was collected via the TIIM app during the BringBalance programme, and included the following data for each participant: (1) which design element was completed, (2) a timestamp when the design element was delivered to the user, (3) a timestamp when the design element was returned by the user, and (4) the duration of completing the design element. Log data was used to confirm, explain or nuance the results on the main outcomes of interest (perceived effectiveness and usefulness). First, log data was used to analyse adherence to the intended use and drop-out. The intended use was set-up by one of the researchers (AL) and is based on the minimum expected necessary usage to be able to go through the phases of reflection. See Table 2 for the intended use. Insights into adherence to the intended use and drop-out were necessary to gain understanding if perceived effectiveness (perceived effect on stress, resilience capacities or the gaining of insights) may have been affected by other factors than the design elements of the automated eCoach, such as a lack of ease of use, user motivation or personal reasons for non-adherence or drop-out. Elaboration on reasons for non-adherence and drop-out during interviews helped to explain the perceived effectiveness of the automated eCoach and could reveal results on perceived utility of design elements and stimulating and stagnating factors during the use of the design elements for reflection. Moreover, an overview of log data per participant was used during interviews to discover the perceived utility and stimulating and stagnating factors during the use of different design elements (see the orange box in Figure 2). For example, when a participant never used the element *reflection on the day before,* this could say something about the perceived utility of this design element during reflection. Also, log data was more deeply analysed when post-test survey and interview data at the group level identified a result that needed to be further explored (see the green box in Figure 2). The data was stored in the database of the BMS lab at the University of Twente and could be retrieved in Excel files. Excel files were uploaded in SPSS and descriptive statistics were calculated, such as frequencies of adherence to the intended use per phase.

Table 2. Intended use for adherence

Phase of BringBalance	Intended use
Phase 1 - Identification	1. The user completed 80% of the design elements ‘EnergyBalance’ and ‘Reflection on the day before’ 2. The user finished the design element ‘Top three most important energy leaks and sources’

Phase 2 – Strategy generation	1. The user views 80% of the short clips about strategies 2. The user chooses strategies for at least two energy leaks and two energy sources 3. The user sets implementation intentions for at least two energy leaks and two energy sources
Phase 3 – Experimentation	1. The user completes 80% of the EnergyBalance questionnaires 2. The user filled in at least two 'strategy evaluation forms' per strategy
Phase 4 - Evaluation	1. The user evaluates two strategies for energy leaks and two strategies for sources. 2. The user evaluates the energy balance.

Post-test survey

Participants were asked to fill in the online post-test survey via Qualtrics after they finished the BringBalance programme and before they participated in the interviews. A few participants did not follow-up on this due to time constraints. The full survey can be found in Multimedia Appendix B. The set of questions in the post-test online survey explored the following issues and was based on a survey used in an earlier study about the utility of persuasive design elements in an app for reflection [15]:

- The Perceived Stress Scale
- The Brief Resilience Scale
- Experience with BringBalance in general
- Motivation to complete BringBalance
- Perceived effect of the guidance offered by the automated eCoach on reflection outcomes: gaining insights into their energy balance and strategies to improve their energy balance
- The utility of the elements in the BringBalance app for reflection

The participants reported on their experience of using BringBalance in general by rating the BringBalance app on several aspects (scale 1 – 10), such as usability, appeal, and integration into their daily life [54], as well as responding to three questions asking them to elaborate on their given ratings. In addition, the survey included two statements on their motivation for completing the BringBalance programme. An example of a statement was *"The BringBalance programme motivated me to reflect on my energy leaks and sources"*. Insights into participants' experiences with the technology and their motivation to use the technology were used to explain the underlying reasons for perceived effectiveness and usefulness of

reflection design elements [26, 38].

Perceived effectiveness of the automated eCoach on reflection outcomes was measured in the post-test survey by three statements (five-point Likert scale from strongly disagree to strongly agree): (1) *"The eCoach has given me a clear overview of my most important energy leaks and energy sources."* (2) *"Thanks to the eCoach, I know what I could do in the future to prevent or resolve energy leaks."* (3) *"Thanks to the eCoach, I know what I could do in the future to take more advantage of my energy sources."*

The main part of the survey consisted of questions regarding the experienced utility of the reflection design elements of the automated eCoach in the BringBalance app. Participants were asked to score the utility of each design element of the automated eCoach that they received during the BringBalance programme on a scale from 1 – 5. An example: *"On a scale from 1 – 5, to what extent has the EnergyBalance questionnaire helped you gain insights into your energy leaks and energy sources? (1= not at all, 5=very much)"*. Each set of questions that related to one phase of the BringBalance programme ended with a blank space for participants to freely comment on the design elements of the automated eCoach.

The results of the post-test survey were used as input during the interviews (see the orange box in Figure 2). For example, the interviewee was asked to elaborate on low scores given to design elements of the automated eCoach. Post-test survey data was uploaded in SPSS and descriptive statistics were reported for: the group in total, the completers of the BringBalance programme, and the non-completers. No statistical analysis was performed due to the small sample size (n=28).

In-depth interviews

Interviews took place one-on-one by one researcher (AL) in person or via Skype after the participants completed the BringBalance programme. Interviews were performed via Skype to minimize time between completing the programme and the interview in order to reduce to change of recall problems when planning the interview was difficult. Recordings of the interviews were between 23 and 48 minutes.

In-depth interviews were held for confirmation, explanation and to find nuance behind answers given in the EMA questionnaires, the collected log data, and answers on the post-test survey (see the orange box in Figure 2). In addition, interviews were held to gain an understanding of the experiences, the usability of BringBalance app, the perceived effectiveness of the automated eCoach, and how the process of reflection via the automated eCoach proceeded. The interview scheme was set-up by one member of the research team

(AL) and finalized by all members of the research team (HO, HV, LvG). Topics in the interview scheme were the user's experiences in general, the usability of the app, reasons for non-adhering to the indented use and dropping-out, the process of gaining insights into energy sources and leaks, and the process of gaining insights into when and what strategies to use. Subtopics for the process of reflection included the design elements of the automated eCoach. The first three topics were discussed to obtain a sense of the experiences with the app as experiences can affect the desired outcomes[26, 55]. Elaboration on these topics by participants may also reveal perceived utility of the design elements and stimulating and stagnating factors. The latter two topics were discussed in relation to the perceived effectiveness on reflection outcomes (i.e., users insights into energy leaks and sources and strategies to improve their situation), utility of the design elements of the automated eCoach and stimulating and stagnating factors during the use of the design elements. Results from EMA questionnaires, the post-test survey, and log data were used as input during interviews (see the orange box in Figure 2). Participants were strongly encouraged to give examples.

Recordings of the interviews were transcribed verbatim. The transcripts were uploaded into Atlas.ti for qualitative data analysis. The code scheme was created via inductive and deductive coding. Deductive codes came from the literature on reflection [13, 29] and persuasive design elements [20], and included the design elements in the BringBalance app. Deductive codes for the gaining of insights by participants were based on the level of reflection described by Durall and colleagues: no new insights, no reflection, recognition and reflection [29]. No new insights refer to insights that are a confirmation of what is already known and recognition refers to quotes in which the user understands the data but acknowledges only what is expressed in the visualization of the data. Reflection involves the gaining of new insights via behaviours clearly associated with reflection: being surprised by the new insights, linking the insights to other experiences or situations in their daily life, or the insights affect beliefs or behaviour of the user. No reflection refers to not obtaining insights at all [29]. Open coding was performed for quotes that could not be labelled by deductive coding. Axial coding led to organising codes into categories, removing synonyms and splitting codes when necessary [56]. This, for example, resulted in the categories gaining of insights (no new insights, recognition and reflection) and not gaining insights (no reflection). The initial coding scheme resulting from coding two transcripts was tested for intercoder consistency [57]. Two researchers (AB, mentioned in the acknowledgements section, and AL) coded two transcripts independently and discussed the differences until consensus was reached. Discussions resulted in sharper descriptions of codes. Finally,

selective coding was performed to identify themes that answered the research questions. During the process of selective coding, special attention was placed on finding contradicting quotes and differences between groups of participants, for example between study's non-completers and its completers) [56].

Mixed methods analyses

All types of data collected were separately analysed. As described above, some results from the analyses of one data source were input during the collection of another data source (for example, an overview of the log data per participant was used during interviews). Moreover, the results from different data sources per outcome of interest were compared to identify discrepancies and similarities between the results [58]. For example, results on utility of the design elements during reflection came from EMA questionnaires, the post-test survey and the interviews. This approach led to stronger evidence when similarities were observed or implications for further research when discrepancies were observed. Moreover, results from the analyses on one data source were often used to explain or nuance the results found during analyses of the other data source.

Results

Demographic characteristics

Twenty-eight participants started using the BringBalance programme of which 21 were male and seven female, with a total average age of 36.5 (SD=9.7). Average PSS scores were 16.8 (SD=5.0) and BRS scores were 2.9 (SD=0.8). Participants found it easy to use a smartphone (M=4.6, SD=0.5, scale from 1 – 5). See Table 3 for an overview of the demographic characteristics of the participants.

Table 3. Demographic characteristics of participants and their ease of using a smartphone[a]

	Study non-completers (n=14)	Completers (n=14)	Total (n=28)
Gender (n (%))			
Male	8 (57.1)	13 (7.1)	21 (75)
Female	6 (42.9)	1 (7.1)	7 (25)
Age (M (SD))	37.4 (11.2)	35.6 (8.3)	36.5 (9.7)
Educational level (n (%))			
University of applied sciences	10 (71.4)	8 (57.1)	18 (64.3)
University	4 (28.6)	6 (42.9)	10 (35.7)
PSS score (M (SD))	16.4 (4.9)	17.1 (5.2)	16.8 (5.0)
BRS score (M (SD))	3.2 (0.8)	2.7 (0.7)	2.9 (0.8)
Ease of using a smartphone (M (SD)	4.6 (0.5)	4.6 (0.5)	4.6 (0.5)

[a] *n=number of participants, M=average score, SD=standard deviation. Range of possible scores on PSS is 0 –*

40, BRS is 1 – 5, and ease of using a smartphone is 1 – 5.

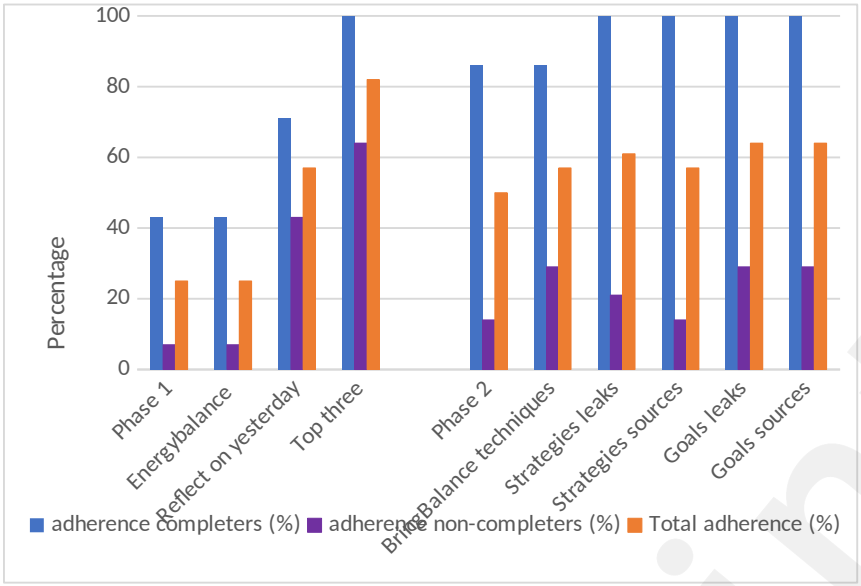
Characteristics of participants not taking part in interviews

Seven of the 28 participants did not take part in the interview due to practicalities. Five of these participants dropped-out, of which 1 participant adhered to the intended use until dropping out. These participants were asked by email to report on the reason for their dropping out (described in the next section). Other drop-outs did not adhere to the intended use during all phases. The remaining two participants completed the BringBalance programme and adhered to the intended use in phase 2. The average PSS score of the participants that did not take part in the interviews was 17.9 (SD=3.0) and the average BRS score was 3.0 (SD=0.6).

Adherence and drop-out

Log data reflected that none of the participants adhered to the intended use. According to the participants during interviews, the main cause was their difficulties integrating the app into their daily life. The adherence rate based on log data was 25% in phase 1, 50% in phase 2, 0% in phase 3, and 21% in phase 4. The lowest adherence score in phase 3 – experimentation – can be explained via interview data by a loss of overview by participants or their low-quality input in earlier steps of the reflection process. According to participants, the latter was a result of the guidance by the eCoach that steered them in a direction that was too specific (described below in further detail), a lack of available time experienced by participants, or the low priority participants gave to the app. See Figure 3 for adherence rates among completers, study non-completers, and the total group of participants.

Fourteen participants eventually completed the BringBalance programme. Most participants dropped-out in phase 2 (n=11). From interview data and reported via email, the primary reason for dropping out was the programme's difficult integration into the daily life of participants due to their full schedule (n=5), followed by the eCoach asking too much of their attention and time (n=3), personal circumstances (n=3) or loss of interest in the programme (n=3). Study non-completers were more often female and tended to have somewhat lower scores on the PSS and higher scores on the BRS than completers (no statistical analyses were performed due to the low number of observations, see Table 3).



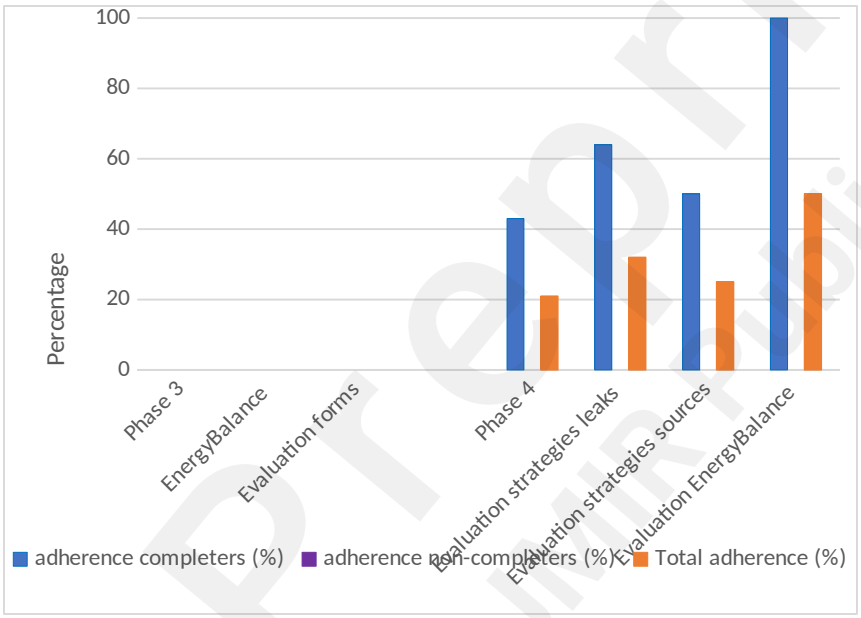


Figure 3. Adherence to intended use

Experiences in general and motivation to complete the BringBalance programme

In the post-test survey, participants rated the BringBalance programme in general a score of 6.5 out of 10 (SD=1.0) on average. Users experienced the programme as informative (M=7.4, SD=1.1). The BringBalance programme scored lowest on usability (M=5.3, SD=1.5) and on integration in daily life (M=4.3, SD=1.4). Completers tended to be more positive than study non-completers about the BringBalance programme. Participants mentioned during interviews that they were stimulated to use the app by the programme's logical set-up. Participants reported in the post-test survey a higher score on motivation to reflect on energy sources and

leaks in comparison to motivation to reflect on strategies (M=3.3, SD=1.0 vs. M=2.7, SD=0.7). For an overview of the experiences of participants with the BringBalance programme in general and their motivation to complete the BringBalance programme as determined by their scores in the post-test survey, see Table 4.

Table 4**.** Results of the post-test survey on participants' experiences with the BringBalance programme in general, their perceived effectiveness of the eCoach in the BringBalance programme, and their motivation to complete the programme.

Question	Non-completers (n=14) M (SD)	Completers (n=14) M (SD)	Total (n=28) M (SD)
BringBalance app in general (Scale 1-10)			
Score BringBalance in general	6.2 (0.8)	6.9 (1.2)	6.5 (1.0)
Appeal of the content of the app?	6.8 (1.2)	6.9 (1.0)	6.9 (1.1)
Perceived utility of the app?	5.6 (1.5)	7 (1.0)	6.3 (1.4)
Usability of the app?	5.5 (1.3)	5.1 (1.6)	5.3 (1.5)
Integration in daily life?	3.6 (1.5)	4.9 (1.1)	4.3 (1.4)
Informative?	6.7(1.4)	7.6 (0.8)	7.4 (1.1) n=20
Advise the app to a colleague?	Yes = 43% No = 57%	Yes = 71% No = 29%	Yes = 57% No = 43%
Scale 1-10: BringBalance met my expectations.	5.4 (1.7)	7.1 (1.1)	6.3 (1.6)
Perceived effectiveness of the eCoach on reflection outcomes: (1= strongly disagree, 3=neutral, 5= strongly agree)			
The eCoach has given me a clear overview of my most important energy leaks and sources	3.4 (0.6)	4.0 (0.6)	3.7 (0.7)
Thanks to the eCoach, I know what I could do in the future to close my energy leaks	3.1 (0.7)	4 (0.4)	3.6 (0.7)
Thanks to the eCoach, I know what I could do in the future to make more use of my energy sources	3.2 (0.6) n=13	3.8 (0.6)	3.5 (0.6)
Motivation: (1= strongly disagree, 3=neutral, 5= strongly agree)			
The BringBalance programme motivated me to reflect on my energy leaks and sources.	2.9 (0.9) n=13	3.8 (1.0)	3.3 (1.0)
The BringBalance programme motivated me to reflect on chosen strategies for my energy leaks and sources.	2.4 (0.5) n=13	3.1 (0.7)	2.7 (0.7)

Perceived effectiveness of reflection

Pre- and post-intervention scores on the PSS (M=17.1, SD=5.2 before vs. M=16.9, SD=3.5 afterward) and the BRS (M=2.7, SD=0.7 before vs M=2.9, SD=0.6 afterward) remained rather similar among completers. Ten out of the fourteen completers reported in the last EMA questionnaire that they had improved their energy balance. The remaining four reported that they did gain insights into their energy balance. Moreover, completers scored the gain of insights into their most important energy sources and leaks by the eCoach via the post-test

survey with a 4.0 (SD=0.6) and study non-completes with a 3.4 (SD=0.6; five-point Likert scale from strongly disagree (=1) to strongly agree (=5); see Table 4). Log data showed that completers were more active in phase 1 than study non-completers. This can also be deduced from Figure 3 showing adherence rates per phase.

Interview data showed that participants gained insights regarding their energy sources and leaks (level of reflection: reflection). Some participants wondered whether they were on the right track with their reflective process (level of reflection: recognition). *"Am I now thinking in the wrong direction or do I make it bigger than it actually is?"* (Respondent#1, study non-completer). On a scale from 1 – 5, gaining insights into what to do in the future to prevent or resolve energy leaks received a mean score of 4.0 (SD=0.4) by completers and 3.1 (SD=0.7) by study non-completers. Moreover, gaining insights into what to do in the future to take more advantage of energy sources received a main score of 3.8 (SD=0.6) by completers and 3.2 (SD=0.6) by study non-completers (see Table 4). Reflected in log data, most study non-completers did not finish all the steps of this reflection process suggested by the automated eCoach and their adherence rates were low (see Figure 3). The interview data demonstrated that many participants gained insights into adaptive coping strategies and had an idea of when to use the techniques in daily life. However, the actual integration of the techniques in daily life was experienced as challenging by many participants due to difficulties while learning the techniques (level of reflection: recognition). Elaboration on the difficulties encountered during this integration process are described below.

Usefulness of design elements during reflection

Multimedia Appendix C includes the scores of each design element of the automated eCoach on its utility for reflection. Utility scores are described below when participants perceived high or low utility of the element during reflection. Also, utility scores are described for elements that were discussed intensively by users during the interviews.

Multimedia Appendix D provides an overview of the identified stimulators and stagnating factors according to the participants per phase of reflection and the specific design element of the eCoach. The most important ones for reflection on self-tracking data and strategies are described below. The design elements of the automated eCoach are placed in *italic* in the text below.

Phase 1 - Identification

According to participants during interviews, the first phase of the BringBalance app was easy to complete independently. Most participants mentioned that they were able to gain an understanding of their energy balance during their reflection as guided by the eCoach. Deduced from interview data, an understanding of their energy balance was mostly obtained via *the list with collected sources and leaks* at the end of phase 1 in which the most common sources and leaks were often perceived as the most important ones for their energy balance. This design element also received the highest utility score of the design elements in phase 1 (M=3.7, SD=0.8). *The table* with a visualisation of the collected data from the previous day received a higher score in the post-test questionnaire (M=3.6, SD=0.8) than *the graph* (M=2.9, SD=1.1), and this result is also reflected in the interview data. Contextual information about the situation related to the energy source or leaks was necessary in order to reconstruct the situation from the previous day, especially when the user's data showed little variance.

During interviews, five participants mentioned that *the 4G scheme questions* was perceived as superfluous. Another group of participants found the element useful. The average utility score of the 4G scheme was 3.3 (SD=1.0) on a scale from 1 – 5. The participants who found it useful described that reflection later in time led to the observation of more relevant aspects than reflection in close occurrence to the situation. In addition, participants experienced that the questions stimulated an in-depth reflection on the source or leak. Four participants had difficulties with recognizing indicators for energy sources and leaks and therefore with filling in *the 4G scheme questions*. Some participants experienced that filling in *the 4G scheme questions* made them understand their indicators for energy sources and leaks and enabled them to be aware of when an energy source or leak occurred. *"Over time, you become more and more aware that your body reacts in a certain way" (Respondent #17, study non-completer).*

Three participants mentioned that the guidance offered by the eCoach led to the identification of sources and leaks that were too specific. *"The tool only focuses on such a micro-moment, and it will not zoom out to a category or something" (Respondent #21, completer).* Some participants believed that they could have gained a higher level of reflection if they could have reflected on their self-tracking data in dialogue with another person.

Phase 2 – Strategy generation

According to completers, the design element *learning the BringBalance techniques* including short clips scored on average 4.1 (SD=0.6) on a scale from 1 – 5 and, as mentioned during interviews, was perceived as helpful in the process of understanding when and what strategies to use. Study non-completers scored this element lower (M=2.6, SD=1.0). Users mentioned during interviews that they were able to learn the principles of the techniques.

Reflected in interview data, *practicing the techniques* was perceived as a crucial part in understanding which techniques are useful for their situation. However, practicing the techniques in daily life was experienced as somewhat difficult without the presence of a relevant situation in which the technique might be useful. *"Usually, the conditions were not right for the technique to work. I would call it 'dry swimming'. […] Then you rush while practicing the technique and you don't really practise anymore" (Respondent#16, completer).* Being attentive to indicators of sources and leaks, identified through *the 4G scheme* in phase 1, was mentioned by a few as a prerequisite to understanding when to apply the techniques in daily life. To master the techniques, many perceived two weeks as too short a time span.

Of the participants, 65% reported in the post-test survey that they found it useful to receive *biofeedback via the Inner Balance Trainer* while practicing the strategies. It convinced participants on a regular basis on the potential effect of the technique on physiological stress reactions in future stressful situations, which was reflected in interview data. Some participants had difficulties interpreting the results, were uncertain when to perform the measurements with the sensor or saw no change in scores before and during practicing as the scores were indicated as good from the start.

Often, users mentioned that *connecting strategies to the most important leaks and sources* stimulated their mental process on how to integrate the techniques into their daily life. Most participants said they were able to choose the strategies with the tools in the app. Log data showed that 11 people chose *the strategy-database* as a tool to help them decide upon a strategy and gave this element a mean utility score of 3.6 (SD=0.8). In addition, five people chose the *help via the eCoach* and gave this element a mean score of 4.7 (SD=0.6). One participant remarked on the specific tool *help via the eCoach*: *"Those questions helped to think a bit more towards a certain direction. That made me think: 'What was my energy leak about?' And based on that, I started searching for a technique in that direction" (Respondent#6, completer).* A few participants expressed doubts if the strategies that they had chosen were the right ones for their sources and leaks.

Participants mentioned that poor input from previous phases made the step of deciding upon strategies sometimes irrelevant or difficult. Three participants mentioned that the identified leaks and sources were not relevant anymore and six participants mentioned that they did not master the techniques in this phase. Additionally, participants missed discussing this step with someone else who might have helped them determine whether they had made the right choice or advised them on other possible options to consider.

Most participants found that the element *setting implementation intentions* stimulated their intention and mental process to integrate the techniques into their daily life, although some found that the element steered them too much towards goals that were too specific.

Phase 3 - Experimentation

Based on the interviews, many participants experienced difficulties during the experimentation phase. Although the steps were experienced as logical in theory, they mentioned that leaks and sources did not recur anymore during the period of phase 3 and that the duration of phase 3 was too short to experiment. *"It is very difficult to get there within a week and a half. […] You ask yourself, did that technique help? And you don't know for sure, and think: Maybe it was only a coincidence that the conversation went a little better"* (Respondent #24, study non-completer). Log data showed that many started this phase later than planned which left little room to experiment.

Personally set reminders along with the *set implementation intentions* scored rather low on utility (M=2.4, SD=0.8, n=12). During interviews, participants mentioned that reminders related to leaks and sources that occurred randomly over time did not trigger their application of a strategy as the reminders were not 'just-in-time'.

The evaluation of strategies began in phase 3 by evaluating every moment that they performed a strategy with *the strategy evaluation form* (utility score on post-test survey: M=2.7, SD=0.8). Some participants experienced these forms as too repetitive and generic. *"I can imagine that with the Zzleep or Flex technique, different questions come in handy" (Respondent#6, completer).* Depending on the specific strategy or situation, some participants said that they did not find it necessary to fill in *the strategy evaluation form* each time. For others, *the evaluation forms* were a trigger to start the evaluation process.

Phase 4 - Evaluation

Half of the participants that went through the elements of evaluation acknowledged the utility

of the evaluation of strategies as a wind-up of the BringBalance programme. However, almost all participants mentioned that they had too little data collected in phase 3 to perform a comprehensive evaluation of the strategies and their energy balance. Participants would have filled in more strategy evaluation forms in phase 3 if they had known in advance that they would later receive these strategy evaluations as *visualisations of the collected data from phase 3*.

Discussion

Main findings

To improve the capacity for resilience through self-reflection, this study's main aim was to examine the *perceived effectiveness* of the guidance offered by the automated eCoach in the BringBalance app during the reflection process on stress and resilience capacities among employees. In addition, this study's goal was to determine the *usefulness* of the design elements of the automated eCoach for the purpose of reflection.

Perceived effectiveness

Pre- and post-test scores on perceived stress and resilience capacities remained rather similar among completers of the BringBalance programme. However, most completers did report an improved energy balance and insights into their principal energy leaks and sources as well as effective strategies for improving their situation. The reflection outcome 'linking these insights to other experiences or situations' through integrating the techniques in their daily lives was often not achieved.

Usefulness of design elements for reflection

Participants were easily able to self-reflect on self-tracking data and decide upon their most important energy leaks and sources with the design elements of the eCoach. Participants experienced difficulty integrating strategies relevant to their energy leaks and sources into their daily life and reflecting on whether their chosen strategies were the right ones with the design elements of the eCoach.

Important stimulators for the process of reflection on self-tracking data were the design elements of the automated eCoach that stimulated the re-evaluation of situations and the observation of trends in the collected data through reduction of the reflection process into

smaller steps and through visualisations, including *a table with an overview of sources and leaks from the previous day* and *a list of sources and leaks at the end of phase 1*. Some of the participants experienced that the re-evaluation later in time led to the ability to gain a larger perspective, leading to their understanding more relevant details of a situation. In addition, contextual information added to the visualisations about the situation related to the energy source or leaks was necessary to be able to re-evaluate the situation later in time.

A stagnating factor for some participants was that the guidance offered by the eCoach led to the identification of sources and leaks that were too specific. Although most participants most found it easy, some had difficulties in recognising physiological, mental and emotional indicators of sources and leaks. These indicators were requested in *the 4G scheme.*

Important stimulators for the process of reflection on strategies were: (1) *the short clips* in which the participants learned the principles of the techniques, (2) the heart rate variability *biofeedback* to help them understand the principles and simulate the effect of the BringBalance techniques on physiological stress reactions, (3) design elements that stimulated *practicing the techniques* because this rehearsal was perceived as a crucial step in the reflection process, and (4) *the tools to help them decide upon the strategies* and *set-up implementation intentions* as these elements stimulated the user's mental process on how to integrate the strategies into their daily life. Participants found it useful to link the strategies to the sources and leaks, although, in practise, this did not bring about desired results.

The most important stagnating factor for this lack of success was low-quality input from previous steps in the process, such as the very specific energy sources and leaks identified in phase 1. The design elements *to set-up implementation intentions* and *reminders* tended to excessively lead participants toward a specific context in which the strategy should be performed. In practise, this left little room for experimentation as the situation often did not recur. Also, many participants experienced a lack in mastering the techniques in their daily life due to perceived time constraints, no relevant situations in which to practise, and doubts about performing the techniques in the right manner. These factors led to little experimentation and data collection in phase 3 and, therefore, to difficulties for evaluation in phase 4, which involved answering the question as to whether the strategies were the right ones for dealing with the participant's energy sources and leaks.

Comparison with the literature

Perceived effectiveness

In contrast to this study's results indicating no changes in perceived stress and resilience, Rijken and colleagues did observe a tendency towards improvement on stress-related outcomes for the face-to-face programme on which BringBalance was partly based [27]. It should be noted that no statistical analysis could be performed in this study due to the small sample size. Also, the prototype of the BringBalance programme used in this study scored rather low on usability and integration in daily life, which likely affected the effectiveness of the guidance offered by the automated eCoach in the BringBalance app during participants' reflection process [55, 59]. Still, there is a possibility that the element of reflection via a human dialogue has played a role in the differences observed in effectiveness on stress-measures between the results of Rijken and colleagues [27] and this study, as this element was an important difference between the two programmes. Some participants also mentioned the potentially stimulating role of human dialogue during reflection. Elaboration on how to deal with this issue in future design is further discussed below.

Usefulness of the design elements for reflection

An important design element in the reflection process guided by the eCoach seems to be the reduction of the reflection process into smaller steps. These steps seemed to trigger participants to rethink their situation which led to the observation of trends and a deeper understanding of their indicators of stress and resilience. The same process is observed in a study of Isaacs and colleagues [10] who found that participants defined as recorders (those who reported the event once) and those defined as reflectors (those who reflected on the event multiple times) both benefitted from their reflections, although reflectors were more likely to observe patterns and to learn from these events so as to improve future performances.

Three important stagnating factors during the reflection process were: (1) difficulties participants had in recognising indicators for the presence of energy sources and leaks, (2) the identification of too specific energy sources, leaks, and implementation intentions as guided by the eCoach, and (3) a perceived lack of available time. Although these stagnating factors were not experienced by all participants, targeting these factors can highly impact reflection outcomes in a positive way for participants that did experience these stagnating factors.

Firstly, participants in this study elaborated on the positive effect of being consciously aware of physiological, mental and emotional indicators for their sources and leaks, including:

(1) being better able to recognise the presence of a source or leak in the future and (2) to identify opportunities for applying a strategy, known as 'trigger identification' in the Systematic Self-Reflection Model of Resilience. This model emphasises the importance of self-reflection in the process towards resilience [5]. Moreover, reflection on cognitions and emotions can help to explain the behaviour of the participant in the situation of interest and can lead to a higher level of understanding of their situation [32]. However, some participants in this study were not consciously aware of their indicators during the situation, i.e. reflection-*in*-action, or found it difficult to reproduce the physiological, mental, emotional, and behavioural indicators in relation to the situation when it occurred the next day, i.e. reflection-*on*-action. This difficulty can impact their reflection outcomes negatively [32].

In order to identify the indicators effectively, both reflection-in-action and reflection-on-action are of importance [9]. Difficulties with reflection-in-action can be the limited ability of the employee to perform reflection under high levels of stress [5] or the concept of alexithymia as not everyone is able to recognize emotional responses [60]. Alexithymia can also explain difficulties with reflection-on-action as attention increases the likelihood to recall the situation later [61]. Also other factors that negatively affect recall can explain difficulties with reflection-on-action, such as motivation or fatigue [62]. Proper guidance during reflection-in-action can solve problems with reflection-on-action and the other way around. For example, problems due to alexithymia or recall may be solved by notifying the user just-in-time that stress is present and stimulate them to pay conscious attention to triggers in-action [63]. Moreover, as mentioned by participants, contextual information is necessary to recall the situation a day later and making notes in close occurrence is one method that seems to deal effectively with recall problems [9]. In this study, reflection-on-action was perceived useful by participants as it enabled them to observe more details later in time. Reflection-on-action can also positively affect one's overall reflection as one's initial intensive stress response is diminished [5].

Secondly, the automated eCoach in the BringBalance app stimulated participants' intention to do something about the situation. However, a loss in relevance to continue behaviour change was experienced when the identified sources and leaks were too specific. The problem of limited applicability from previously collected data on well-being to current situations has been observed more often [22]. One way to maximize the applicability of the specific situations to current situations might be to start choosing a strategy based on the underlying values and personal goals of the identified sources and leaks [5]. Situations which involve a mismatch between the current coping strategy and the personal values and goals

increases the need to do something about the situation [5]. Therefore, underlying goals and values might serve as trigger points to perform an adaptive coping strategy. The increased chances of recurrence can also lead to more opportunities to practise the techniques, which was mentioned by participants as a crucial step and is acknowledged in the literature as well: "The strengthening of resilience is a process of experiential learning and more specifically learning through reflection on doing" [64].

Thirdly, it is unlikely that participants were constrained by the actual time needed to interface with the BringBalance programme, which was about fifteen minutes per day. This response was more likely a result of perceived time constraints caused by their busy daily schedules. This conclusion is based on the low scores given by participants on the integration of the BringBalance programme into their daily life.

Strengths and limitations

Firstly, our study population consisted of participants with a high educational level. As reflection relies on the analytical skills of a participant [65], it might be that the performance during the reflection process and the needs for guidance from the automated eCoach by our study's participants are different for the overall working population.

Secondly, the sample size was too small to conduct statistical analysis on pre- and post-test scores on perceived stress and resilience capacities and differences in scores given by study non-completers and completers on the utility of design elements. This limitation restricted the strength of some of our conclusions drawn. Although the statistical power was low, this study's results did meet the primary aim of this study, namely to explore the potential of guidance offered by an automated eCoach during the participant's reflection process for resilience training and to ascertain implications for future design based on the results, and as such, valuable insights that can support future design were obtained.

Thirdly, although low adherence rates are common for prototype versions of eHealth technology, none of the participants adhered to the intended use. On the one hand, low adherence distracted the user from the original goal of the programme, which is to reflect to improve resilience capacities, and likely affected the effectiveness. On the other hand, reasons for low adherence did reveal important stagnating factors for reflection guided by the automated eCoach, such as the loss of relevance to continue due to too specific energy leaks and sources. Moreover, it should be noted that the set-up of adherence to the intended use was based on one researcher's expectations of the minimum necessary usage by the user. This

expectation may have been too ambitious as no participant adhered to the intended use and results indicated that most participants did gain insights into their energy leaks and sources and strategies to improve their energy balance.

As a final limitation, seven participants were not involved during interviews due to practicalities, and this might have affected the validity of the qualitative results. A relatively higher number of study non-completers were observed among non-interviewees, and the non-interviewees' PSS scores tended to be somewhat higher in comparison to the interviewees. However, similar characteristics were observed among interviewees as nine were study non-completers and seven scored higher than the average PSS score of the non-interviewees. This gives the impression that the validity of the qualitative results was not influenced to a large extent.

Regarding the strengths of this study, the first is that the BringBalance programme's design was strongly based on the literature and in close collaboration with stakeholders. These two aspects increased the chances of improving uptake and creating an impact with the eHealth technology [55]. The design decisions made for the content in the app were perceived as logical and interesting by participants. The usability of the app and integration in daily life were points of attention. This can be explained by limited options in the way the prototype could be developed. The usability and integration issues can be overcome when the app is developed with a higher level of fidelity [59].

Secondly, a mixed methods approach was used in this study. Results from one data source were used during the collection of another data source (for example, log data were used as input during interviews) or results from one data source were a trigger to explore more profoundly into the data from another source (for example, to review the log data in order to explain the lower scores given on the guidance offered by the eCoach by study non-completers in comparison to completers). This enabled us to confirm or question results from one approach to another. In addition, it enabled a deeper interpretation of results by finding nuances in the data from the other approaches.

Implications for future design and research

This study is the first, to our knowledge, to provide insights into design elements of an automated eCoach that can simulate the self-reflection process, from the identification of relevant events to the evaluation of strategies [13], without support from a human coach. Future design and research can begin by focusing on the effects of making more and better

use of persuasive features during the reflective automated eCoaching process based on the three stagnating factors described above.

The persuasive system design model of Oinas-Kukkonen and Harjumaa [20] has high potential to improving the reflection process via the automated eCoach based on the current stagnating factors described in the previous section. The persuasive system design model includes persuasive features to stimulate the motivation of users for behaviour change, and these persuasive features are shown in *italics* in the discussion below.

Firstly, as described above, trigger identification is an important aspect in the reflection process and can be the result of both reflection-in-action and reflection-on-action. Continuous biofeedback, a form of *self-tracking*, creates the unique opportunity to receive timely external feedback [66] when stress is present. Moreover, biofeedback can be used to check when the intensity of the stress response is diminished to some extent, which could have a positive effect on the quality of one's reflection [5]. Several commercially available wearable devices are capable of continuous measurements of the physiological responses related to stress and resilience capacities, such as HRV measurements [17, 67]. The measures can give an indication within minutes that stress is present or when stress is decreased and, hence, signal to employees their capacity for resilience [67].

Secondly, the automated reflective eCoach should offer guidance to translate specific events into overarching goals and values that recur in daily life. The eCoach can help the user split the complex behaviour into a higher perspective that oversees over the collected data and breaks the data into short and simple tasks, which is related to the persuasive feature *reduction* [20]. For example, the eCoach can ask the user to answer additional questions regarding their underlying opinions, values, qualities, and drivers to learn and understand their goals and values in daily life [65]. This implication for future design can also improve the technology's effectiveness on the desired behaviour change and user motivation. For technologies to support the full behaviour change process with success, they need to best suit the user's context of working and living [20, 24]. Hence, the content should match their goals and values on a personal level. Besides, the user's perception of autonomy may improve as the user decides how to integrate the technology into daily life. An autonomous perception stimulates user motivation [68].-

Thirdly, we propose a more dynamic process in which users can decide upon the pace of completing a phase, related to the persuasive feature of *personalisation*, and thereby avoid poor input from previous steps in the reflection process due to perceived limitations in time.

Finally, some participants believed that reflection in a dialogue with another person would

have led to higher levels of reflection. This dialogue was also desired by participants to eliminate personal doubts about the individual reflection process. Two implications for future design are suggested to facilitate a dialogue without the involvement of professionals: one focuses on the context in which the technology will be implemented and another on the design elements in the technology itself. After all, successful implementation is an interplay between factors related to the context, the technology and the people [69]. Moreover, the involvement of a professional coach would limit the scalability of the programme. As an implication for the implementation context, peer-groups within organisations could facilitate the dialogue. These peer-group can be organized by the persuasive feature of *social facilitation*. Via this feature, users can contact peers via the app [20]. Previous literature found that peer guidance during reflective practices improves the reflective process [70, 71]. With regard to implementing a dialogue feature within the technology itself, the automated eCoaches could match a human-to-human dialogue to a greater extent. This technological development is on the current research agenda [72, 73]. To match a human-to-human dialogue, the eCoach should have high *surface credibility* via a fluent dialogue and the user must experience the eCoach as a real human, an achievement that still requires considerable research and testing. However, some persuasive features that are rather easy to implement can improve the *surface credibility* of the currently available automated eCoaches by applying a high level of *personalisation*, for example by regularly selecting coaching messages based on previous input given by the user or repeating this input in messages, and the eCoach should adopt a *social role*, for example by greeting the user by name [20, 72, 73].

A follow-up study using an updated prototype of higher fidelity including these aspects can be performed to test the effects of the guidance offered by the automated eCoach on stress, resilience capacities and the gaining of insights on a larger scale, including employees with lower educational levels. Again, a mixed methods approach should be applied to study both the effectiveness of the automated eCoach on stress, resilience and reflection outcomes and to understand what design elements contribute to effectiveness and why.

Specifically, future research can, for example, combine log data of the continuous biofeedback (e.g., when did the eCoach offer guidance to perform reflection-in-action and reflection-on-action) with the participant's answers to the EMA questionnaires to study the output of the reflection process during moments that are in close occurrence to the stressful situation and during moderate levels of stress.

Conclusions

This study's results provide insights into the potential of automated eCoaching to guide employees during the reflection process for the purpose of resilience training. Although no improvements on stress and resilience capacities were observed, results indicate that an automated eCoach can guide employees during the reflection process on self-tracking data towards a deeper understanding of their situation and possible strategies to improve their situation. Design elements that stimulated the re-evaluation of situations and the observation of trends were stimulating for the reflection process. More difficult was guiding the employee via the automated eCoach to integrate the strategies into daily life and reflect on whether the chosen strategies were the right ones. Future design of the automated eCoach should make more and better use of persuasive features to support and motivate behaviour change. Future research should focus on testing the effects on the reflection process by equipping the automated eCoach with more and improved persuasive features as suggested above.

Acknowledgements

The contributions of the authors were as follows: AL, HO, HV, and JVGP together decided upon the study design. When the study design was final, AL executed the study design and collected the data with help from Anouk Burgler, mentioned below. Transcribing the recordings was carried out by AL and AB and coding schemes were discussed. Further analysis was done by AL. AL wrote the content of the article, which was then revised for intellection content and structure by all authors. All authors read and approved the final manuscript.

We would like to thank Ewold de Maar, owner of De Maar Training & Advies, for his help and enthusiasm during the preparations of this study. Together with Ewold, the BringBalance programme was developed. His original coaching programme 'Working on Resilience' (Werken aan veerkracht) was used as a basis for the BringBalance programme and was translated together with AL to a smartphone version including reflective automated eCoaching. In addition, we would like to thank the BMS lab of the University of Twente for their support during the development of the prototype version of BringBalance using The Incredible Intervention Machine application and the consultation and problem-solving services offered during the execution of the study. In addition, we extend our gratitude to Anouk Burgler who offered her help during the execution of the study as part of her internship. Last but not least, many thanks to the HR department of the organisation where the

study took place for their help during the recruitment of participants and a special thanks to all the participants who partook in this study. This study is partly funded by Menzis. Menzis was not involved in the study's design, execution, or reporting.

Conflicts of interest

The authors declare that they have no conflict of interest. De Maar Training & Advies was mainly involved in the design of the BringBalance programme and had limited involvement in the study's design. During the study's design, some questions were added to the post-test survey in which De Maar Training & Advies was especially interested in order to decide whether the investment into a full version of the BringBalance app might be worthwhile.

Data management and ethical approval

The data management plan was made in DMPonline and in collaboration with experts on data management by the Department of Behavioural Management and Social Sciences (BMS), University of Twente, to ensure that data collection and storage was performed according to the General Data Protection Regulation. Ethical approval was gained via the Ethical Committee of the University of Twente (reference number P-1531727676).

Availability of data and material

The datasets used and/or analysed during the current study are not publicly available due to the fact that no consent was provided by the respondents of this study before data collection took place. Datasets are available via the corresponding author upon reasonable request.

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Abbreviations

BRS: Brief Resilience Scale

HR: Human Resources (HR)

HRV: Heart Rate Variability

BMS lab: Behavioural, Management and Social Sciences lab

EMA: Ecological Momentary Assessment

PSS: Perceived Stress Scale

TIIM: The Incredible Intervention Machine

Supplementary Files

Multimedia Appendixes

Description of the BringBalance app according to the consort guideline on reporting eHealth.
URL: http://asset.jmir.pub/assets/33e69ec362bcd736dc2444158fec5fb2.docx

Post-test survey.
URL: http://asset.jmir.pub/assets/bfa27ab35072048030baf84664815106.docx

Scores on the utility of the elements of BringBalance for the reflection process.
URL: http://asset.jmir.pub/assets/918dea78bcdcdce5a7901c14c9653b6d.docx

Summary table of the stimulators and stagnating factors for reflection per phase of reflection.
URL: http://asset.jmir.pub/assets/29b47d76b56eb0ed0670e8f8468c950e.docx