Students' outcome expectancies towards different aspects of a stress-reduction app and their impact on app usage.

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Abstract

Especially in the mHealth sector a high motivation of users is important, because the daily decision to use a gadget has to be made. Important factors that contribute to peoples' motivation are outcome expectancies. Outcome expectancies are peoples' believes whether an action leads to a goal. Therefore, this study researched university students' outcome expectations towards different elements of a stress-reduction app. Subjects' impressions were assessed via semi-structured questions and think-aloud protocols. In a first session, subjects explored the existing app Kenkou. For the second session a prototype for an improved version of the app was constructed, based on participants' feedback in the first session. Results show that outcome expectancies were not influenced by a few single factors, but that many different aspects were mentioned by participants to evoke outcome expectancies. Participants had positive outcome expectancies towards the relaxation exercises in the app Kenkou, the calming design of the app and motivating features like the reminder and a streak. Also, more options for choices, for instance in the settings, or more diversity of exercises such as problem-solving methods, were associated with more positive outcome expectancies. Additionally seen as effective was information that enables to choose tasks, like descriptions of content and task duration. The findings imply that research could focus on a large range of aspects rather than on single predictors for outcome expectancies. Additionally, developers of mHealth interventions could use outcome expectancies as additional design criterion.

Introduction

Students' Stress

Stressed students are the norm rather than the exception. A study yielded that 77.6% of students in a sample experienced moderate stress and 10.4% of the students reported to experience serious stress (Abouserie, 1994). Some more recent studies report even higher levels of stress: 63% medicine students reported being stressed and 25% of the students reported feeling severely stressed (Abdulghani, AlKanhal, Mahmoud, Ponnamperuma & Alfaris, 2011). A study about American graduate students also reported that almost half of the students feel stressed and about one quarter of the students feeling very stressed (Owalt & Riddock, 2007). Conclusively, several studies reported prevalence rates of approximately 50% or more stressed students, with severely stressed students ranging from one out of 10 to one out of four students. Also, a recent study at the University of Twente yielded that its students are stressed with a mean value that indicates a high stress level on the Perceived Stress Scale (Kelders, Oberschmidt & Bohlmeijer, 2019) Thus, students are stressed commonly.

Research investigated the causes of students' stress. A review showed that the causes are versatile (Robotham & Julian, 2006). University demands lead to a high workload that can cause pressure and a lack of free time in students (Abouserie, 1994; Misra et al., 2000). Additionally, most students experience stress related to living at a foreign place. In some cases students live independently for the first time, which is one of the factors that increases their responsibility (Fisher, 1994). To be able to cover their living expenses many students work (Unite Students, 2004), which can be an additional stressor itself and increases students' time-pressure. The lack of time was found to lead to a sleep deficiency, which in turn reduces the resilience against stress (Hardy, 2003). To conclude, students' stress can be caused by a variety of factors that embrace all areas of life.

Although stress is ordinary nowadays, the impact of stress can lead to detrimental consequences. Stress can be linked for instance to a reduction of immune system function (Sarid, Anson, Yaari & Margalith, 2004) and other damages to physical health, such as faster aging (Graham, Christian & Kiecolt-Glaser). In addition to that, stress can increase neurodegenerative diseases and mental diseases, for example anxiety, depression, and psychoses (Esch, Stefano, Fricchione & Benson, 2002). In summary, stress can impair physical as well as psychological health long-lasting.

Other negative effects can be caused by students' reactions in order to deal with stress. To reduce stress quickly, unhealthy behaviors are effective due to their pleasurable

effects (Krueger & Chang, 2008). Students might make use of harmful methods to find fast relief. Several sources report that stressed students are more likely to engage in health damaging behaviors such as eating junk food (Hudd et. al., 2000), smoking (Naquin & Gilbert, 1996), drinking (Morgan, 1997) or the tendency to use neuro-enhancement methods (Pettit & DeBarr, 2011). Nonetheless, unhealthy behaviors are detrimental strategies, because they damage the body and are ineffective to reduce stress on the long-term (Stockwell, 1985). In sum, unhealthy behaviors are coping strategies that work to reduce stress directly, but on the long-term the benefits are outweighed by the damaging consequences.

Even though stress can have negative consequences, stress is not always a state that humans should escape. According to Selye (1974) stress can be either distress or eustress. While distress has negative effects on humans, the experience of eustress helps people to realize their potential. Eustress is a level of stress that feels manageable and challenging to a person. In contrast, distress goes beyond the own capabilities of coping and is therefore perceived as threatening (Gibbons, 2012). So, stress can be useful to enhance students' performance, but stress should be lowered when it is perceived as overpowering.

mHealth

To reduce unhealthy stress, mobile health (mHealth) interventions may be helpful for students. mHealth is the use of mobile technologies like apps to promote health. In times where mobile coverage is increasing steadily worldwide, using phones or wearables can be beneficial, because it enables an easy and quick access to interventions (World Health Organization, 2011). Also, mHealth interventions do not require the presence of a coach that gives live instructions, which makes mHealth interventions suitable to help a lot of people at once. In addition to that, they are cost-efficient (Kumar et al., 2013). For students, one of the main stressors is their perceived lack of time (Robotham & Julian, 2006). mHealth interventions fit well to that need, because they are more time-efficient than personal counseling or group methods. More advantages of mHealth for students are time and place flexibility, anonymity and no waiting times (Fleischmann at al., 2018). All in all, mHealth interventions seem to be a suitable for students.

To make students engage in mHealth interventions, it can be helpful to know the predictors of mHealth intervention use. A study that researched which health apps users download, found two positively related variables. One variable was the explicit development with expert involvement. The second variable was frequent and positive ratings in the app store. Negatively related were the costs of the app (Pereira-Azevedo et al., 2016). Also

studied were factors that influence users' willingness to continue using a mHealth intervention. A review about mHealth apps for people with psychosis found higher rates of continuation if the intervention included social presence like chatting with a coach, or if they enabled users to be involved with the development of the intervention, for instance by feedback surveys. Also, those interventions with the shortest duration had the highest rates of adherence (Killikelly, He, Reeder & Wykes, 2017). Additionally, the perceived quality and trustworthiness of interventions were found to influence continuation (Akter, D'Ambra, & Ray, 2010; Akter, Ray & D'Ambra, 2012). All in all, factors that were found to influence users' willingness to use mHealth interventions were expert involvement, user ratings, social presence, duration, perceived quality, trustworthiness, and involvement in the intervention development.

Stress Management Techniques for mHealth

In order to reduce stress, mHealth interventions make use of different stress management techniques (SMTs). In general, there is no clear consensus over what can be considered as SMTs (Ong, Linden & Young, 2004). SMTs can be divided into two main categories. One category is the problem-solving approach, in which a person uses actions that directly work at reducing the stressor, for instance by training in test-taking, social skills, or effective learning. Another category is the emotion-focus approach that aims to reduce the emotional distress of negative stress (Lazarus & Folkman, 1984). Emotion-focused techniques are for instance relaxation techniques or methods to change the perception of stress. Stress interventions with SMTs showed to be successful for students. Deckro et al. (2002) found significant stress improvements in students that did an intervention based on relaxation response and cognitive behavioral training. Moreover, interventions with solely emotion-focused techniques reduced students' stress compared to control groups (Oman, Shapiro, Thoresen, Plante & Flinders, 2008). Effective was also the intervention of Rosenzweig, Reibel, Greeson, Brainard & Hojat (2003) who conducted a mindfulness intervention with different meditations and yoga exercises. So, stress-interventions with different approaches could successfully reduce students' stress.

In order to make students engage with stress interventions, it is important to find out students' opinion on them. Even though there are various studies about the effectiveness of SMTs, only one study was found that explored the opinion of students qualitatively. In the study of Fleischmann, Harrer, Zarski, Baumeister, Lehr & Ebert (2018) students showed skepticism towards an intervention that integrated SMTs in an app. Less than half of the

participants expected their stress could be reduced by the intervention. Half of the participants expected little or no effect from the intervention. Also, half of the participants asked for more sources to back up explanations, as well as for scientific explanations on how the mechanism of the techniques works. It was concluded that the comprehensibility of mechanisms is especially important for university students, due to the fact that students are trained to be critical. Additionally, some students stated that they are not motivated to participate, because the emotion-focused part of the app seemed purposeless to them. That many students did not believe in the effectiveness of the stress-management app might lead to a low usage rate. It is necessary to see if the negative believes in effectiveness can be found in other mHealth interventions as well. To conclude, many participants did not believe that the mHealth intervention can reduce stress, which might affect the usage-rates negatively.

Efficacy-Beliefs

The beliefs whether a certain action leads to a desired outcome or not are called outcome expectancies (Francis, 2010). Bandura (1997), one of the most famous researchers in efficacy-beliefs, differentiated that outcome expectancies are not dependent on a persons' feeling of ability to exert a behavior. Some actions might not be fruitful to attain a goal even though they are done completely as intended. For example, even when people engage in an intervention, it might not be effective, if the intervention is not helpful. A study proved that positive outcome expectancies heighten behavior, and negative outcome expectancies diminish behavior (Williams, Anderson & Winett, 2005). So when people do not perceive a behavior as effective, they will not engage in it. This might be also relevant for the field of mHealth interventions that often work on a voluntarily basis. If students do not think that an intervention can be effective, there is no reason for them to engage in the intervention. So, outcome expectancies might play a role in students' motivation to use mHealth.

Outcome expectancies might also directly influence the effectiveness of stress-reducing interventions. Even when mHealth interventions are part of a mandatory program, the results might be diminished when students' outcome expectancies are negative. Outcome expectancies were found to influence peoples' quality of engagement; their willingness to practice at home; the length of participation; as well as the total effectiveness of a traditional intervention, therapy or program (Greenberg, Constantino & Bruce, 2006; Hansson & Berglund 1987; Price & Anderson, 2012; Resnick, 1998). The findings speak for the fact that negative outcome expectancies reduce the effectiveness of traditional interventions or programs in many cases.

Despite their advantages, mHealth interventions are prone to the threat of negative outcome expectancies. Stress management apps are mostly intended to be used on an autonomous basis, so students have to choose to use the app every time on their own. Non-usage and drop-outs are issues that mHealth programs have to face. Out of a sample in the Netherlands 36,5% of participants indicated that they installed on their mobiles, and 7.8% out of the total sample indicated that they installed health apps but never used them (Bol, Helberger & Weert, 2018). Participants also reported that they used about one-third of the health apps they installed (Steinhubl, Muse & Topol, 2015). A qualitative study reported that reasons why people stopped using mHealth apps were a lack of time, electronic issues and a lack of motivation and discipline (Peng, Kanthawala, Yuan & Hussain, 2016). Even though not stated explicitly, one possibility for users' lack of motivation could have been negative outcome expectancies. More research is necessary whether outcome expectancies play a role in students' motivation to use stress-management apps. So far, many mHealth interventions are not used frequently, one reason for that might be negative outcome expectancies.

Due to the role negative outcome expectancies could have for the effectiveness of mHealth interventions, it is important to find out what user's expectations are influenced by. Studies about this are scarce so far. One study about guided imagery found that users' familiarity with the method and the credibility of the app influenced outcome expectancies positively, while differences of users' coping styles had no effects on their outcome expectancies (Kwekkeboom, 2001). A different study highlighted that professionality and reliability of the intervention influenced outcome expectancies of participants (Hardy et al., 1995). In a qualitative study, students indicated that a lack of scientific proofs and explanations how methods work were associated with negative outcome expectations (Fleischmann et al., 2018). So far, factors that were found to influence outcome expectancies were the perceived quality and reliability of a program, familiarity with the method, as well as the comprehensibility of mechanisms.

Aim of the Study

This study aimed to contribute to the scientific understanding of how outcome expectancies towards a mHealth intervention arise. We wanted to find out what elements induce outcome expectancies and how these expectations come about. In addition to that, the study examined how positive or negative students' outcome expectancies are towards different aspects of a stress management app and what the reasons are. It was expected to get

insights whether it is possible to heighten students' outcome expectancies for a stress management app and if so, by which means it is possible to heighten the perceived effectiveness. Lastly, this study wanted to explore if increased outcome expectancies can enhance students' motivation to engage with a mHealth intervention.

Method

Design

This qualitative research consisted out of two semi-structured interview sessions. The interview sessions entailed two sets of questions and a think-aloud task in which each participant explored the existing stress-management app Kenkou in the first session and a prototype in the second session. The first session started with a paper-pencil assessment of demographics and the Perceived Stress Scale (PSS) score. In each session one set of semi-structured questions was asked before the think-aloud task and a second set of questions was asked after the think-aloud scenario. Based on the participants' feedback in the first session, the prototype for the second session was developed. To get more familiar with the app the participants could explore the app further at home between the two meetings.

Participants

The study focused on students in the Netherlands and Germany. Between October and November 2019, 19 participants were recruited. The subjects were recruited by convenience sampling. Thirteen participants were recruited from the personal network of the researchers, and six participants were recruited via Sona. Sona is an experiment-management system that enables to recruit participants (Sona Systems, 2015). The participants could choose freely to participate in the study, though for the students recruited by Sona participating in some studies was mandatory in order to attain their degree. Inclusion criteria were English proficiency and the willingness to use a stress-management app. Students were asked to participate only if their phone was compatible, so if they had at least an IPhone 6, or Android phones with at least operating system 6 (Marshmallow). The participants were of German (9), Dutch (8), Swiss (1), and Finnish (1) nationality. Twelve female and seven male students were interviewed. Their age ranged from 19 to 26 years (M = 21,8, SD = 1,8). The participants had PSS scores from 6 to 22 (M = 16.4, SD = 5.1), which indicates a medium stress level. Due to the studies' internal set up, for the second interviews only 10 out of 19 participants were interviewed.

Materials

First interview.

The app.

The existing stress-reduction app that was used is named Kenkou Stress-Guide and was developed by the health-tech start-up Kenkou (Elsässer, 2018). The app aims to increase persons' awareness about their stress level, reduce stress, and increase resilience against stress (Kenkou, 2019, March). To reduce stress, Kenkou states to use biofeedback breathing training, mindfulness & meditation. Within the relaxation exercises, different SMTs are combined. An example is an exercise in which first, different muscle areas should constricted, followed by breathing in different body areas and after that, a repeating a word mentally. Other features of the app are a heart-rate stress measure via phone camera (see Figure 1), a quote of the day, and auditive information about stress and stress-reducing methods. The exercises are structured in a daily course that includes an assortment of five to seven tasks for every day over 28 weeks.

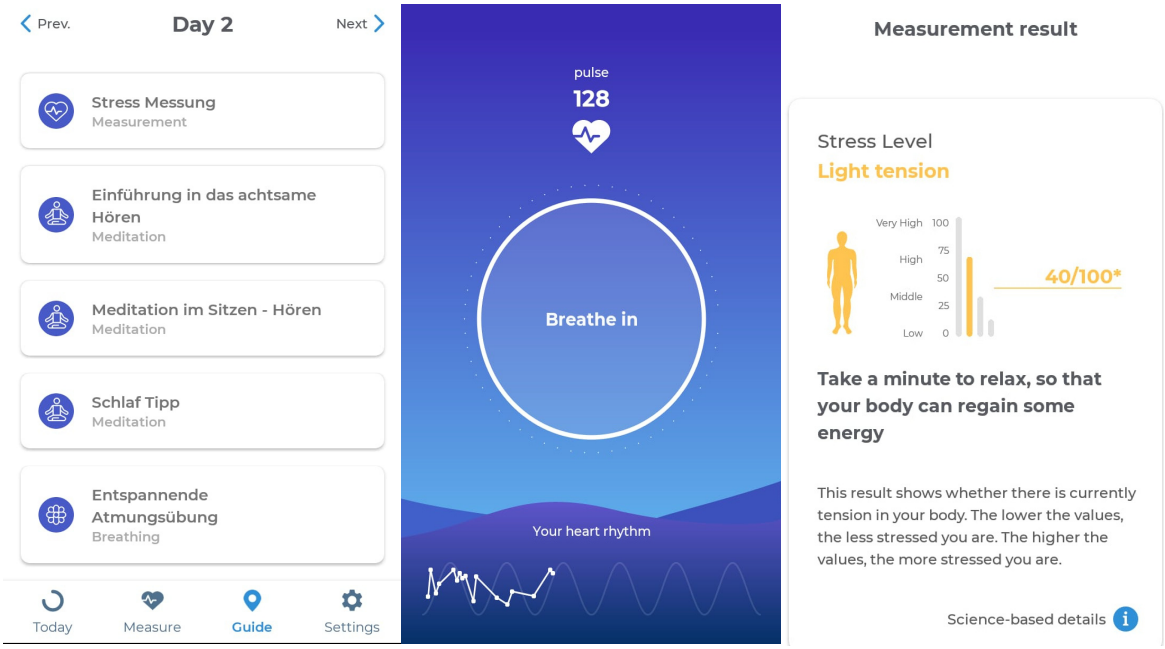

Figure 1. Three different screenshots of the app Kenkou. The screens show an example of daily courses, the heart-rate measurement feature, and part of the measurement results.

Interview scheme.

For the first session an interview scheme with 18 open-ended questions was used. The interview started with seven questions to get background information about students' stressors, their beliefs whether stress should be avoided, students' coping strategies and their perceived effectiveness, as well as students' prior experiences with stress-interventions, meditation, and mindfulness. To assess students' general outcome expectancies towards using a stress management app, the students were asked, "do you think an app can be effective to reduce stress?- Explain why (not)". After the students had gathered first impressions about the app during a think-aloud scenario, six questions assessed subjects' outcome expectancies towards different features of the app. The questions were formulated like this: "Do you think that the feature X is effective to reduce stress? – Explain why (not). The word "feature X" was replaced by the name of the respective feature. Finally, another four questions asked for background information, such as students' expectancies of their future app usage and improvements that could be made in the app. All questions were made up by the researcher. (The interview questions can be found in Appendix A.)

Perceived stress scale.

The 10-item PSS assesses stress with few questions. The PSS measures the level of stress during the past month, as well as the experienced burden associated to it (Cohen, 1994). The scales' items were found to be reliable to measure stress in students (Cronbach's alpha = .89) and valid, by two factors explaining 62% of variance (Roberti, Harrington & Storch, 2006). The results can be interpreted in a way that values from 13 or higher indicate a middle stress level and values from 20 on imply a high stress level (Cohen & Williamson, 1988). Due to the efficiency and applicability to the target group, the PSS was included in the paper-and-pencil pre-measure of the study.

Scenario-based think-aloud.

To gather users' first impressions of the app participants were asked to share their thoughts within a 20 minute scenario-based think-aloud task, while they explored the app. The scenario was that the students should imagine that they are stressed at the moment. Then, they should go to the app-store, download the app Kenkou and explore it as if they really want to reduce their stress.

Second interview.

Prototype.

To find out whether changes in the app can heighten users' outcome expectancies a prototype was created. The decisions how to design the prototype were based on participants' thoughts about the app. Elements that received positive feedback were kept as they were. Elements with positive and negative feedback received solutions that allowed personal choice. Elements with solely negative feedback were either changed completely or omitted. (For a detailed description of changes see Appendix B.) As medium for the prototype, an interactive PowerPoint was chosen, because it offers easy employment of interactive elements. The PowerPoint presentation was displayed on a laptop to participants. To imitate an app, a home screen was shown as a starting point, from which different slides could be opened. Participants could navigate through the prototype by clicking on different elements on each slide that opened other slides. All slides offered the possibility to go back to the home screen by one click. The prototype can be viewed via Google Slides (http://bit.ly/36OltmU open with google slides).

Interview scheme.

The second session started with four questions about usage of the Kenkou app during the past weeks. Then five questions assessed outcome expectancies towards the app, with questions such as "What about the app did you experience as effective? - Why?" and "What can be done so that you see the app as more effective?". After the think-aloud task with the prototype, a final set of questions was asked to get insight whether the prototype enhanced users' outcome expectancies. The questions closely resembled the second set of questions from interview one. Additionally, questions were added to assess outcome expectancies towards newly added features such as the streak, the acute stress-reduction page, and the find-stress-reduction-methods-in-your-area page.

Scenario-based think-aloud.

To get insights into users' first impressions of the prototype, the subjects were asked to share their thoughts within a 15 minute think-aloud scenario, while they explored the prototype. The scenario was to imagine that the prototype was the actual app. The students were asked to explore the prototype like they explored the existing app in interview session one.

Ethical considerations.

The study with registration number 191252 was approved by the ethical committee of the University of Twente. In accordance with the guidelines of the Ethics Committee of the Faculty of Behavioral, Management and Social Sciences (BMS), all participants gave written informed consent prior to their participation (see Appendix C). The participants were assured about the anonymous data usage and the ability to withdraw any time without negative consequences. Participants knew about the purpose of the study and that their information might be used to improve the app.

Procedure

The participants were contacted personally, as well as via SONA. In advance of the interviews, the participants were asked to register on a website for access to the apps' full version. Also, subjects were asked to not download the app before the first meeting. The interviews were held in quiet rooms. The first sessions took from 25 to 50 minutes. The duration of the second interviews ranged from 30 to 45 minutes.

The first interview session started with an introduction to the study. Then, the participants signed informed consents. The students were reminded that they could be fully honest with their opinions and that there are no right or wrong answers. After that, the participants filled out the PSS questionnaire. After that, an audio record was activated and the participants answered questions. Next, the participants were asked to download and explore the app on their devices, while concurrently speaking out their thoughts. The participants were given a short task to practice. When they stopped talking for a while, the participants were reminded to continue thinking aloud with a nudge. For four participants the full-version did not work, so they had limited possibilities to explore the app during the think-aloud and at home. After the think-aloud task, the participants were asked another set of questions. The first session ended with the instructions to use the app at home until the next meeting.

The second interviews took place in a similar location. After the participants were welcomed and informed about the sessions' set-up, the first questions were asked. Then, the participants explored a prototype. Meanwhile, the subjects were asked to speak out their thoughts. In the end, a final set of questions was asked. Conclusively, the students were thanked for participating and dismissed.

Data Analysis

For the content analysis all interviews were transcribed verbatim from audio with the software Microsoft Word. The interviews were held in English and German, however they were translated into English during transcribing. To ensure confidentiality, information that could reveal identity was replaced with functional codes. The coding schemes were developed with the program ATLAS.ti 8.4 by the researcher. Separate ATLAS.ti files with coding schemes were developed (a) for the first session, (b) for the experience with the app after two weeks, and (c) for the prototype.

Two main coding schemes were developed, one for outcome expectancies towards the app and one for outcome expectancies towards the prototype. To gather codes for those coding schemes, the think-aloud protocols and the answers for outcome-expectancy questions were screened for fragments about outcome expectations towards different aspects of the app. Codes were applied inductively to units of meaning; applying several codes for the same fragment was allowed. The codes were refined by adding new codes when phrases did not fit the existing codes and merging single codes together into a broader one, when several codes had one overall theme in common. After the coding was done, the codes were grouped into four overarching categories that were derived inductively. The analysis was based on the coding manual for qualitative researchers by Saldana (2015).

Additionally, separate smaller coding schemes were developed for questions that did not assess outcome expectancies. In most cases the coding schemes were only constructed for the answers of one question so, almost every question had a new coding scheme. The codes were applied to units of meaning for answers of the respective question. Applying several codes to the same fragment was not allowed. The codes were derived inductively. The only exception was students' coping behavior, which was coded deductively with three codes, one code for each coping mechanism and one code for the usage of both mechanisms.

Results

First Interview Session

General information.

Students mentioned different stressors as causes of their stress. By far the most mentioned stressor for participants was their workload. Students said they had to handle a wide range of tasks and that their stress is often exacerbated by time pressure. Another

frequently mentioned stressor was social issues. Students mentioned to be stressed by family conflicts, peer pressure, and the unreliability of others. Other stressors were unexpected situations, a lack of motivation, and high self-expectations.

Half of the students used a mix of distracting and problem-solving coping methods. Ways students distract themselves from stress were enjoyable activities such as watching TV, cooking, taking a bath or a walk, and imagining a better future. Problem-solving coping methods encompassed creating time-plans, focusing on the reduction of the stressor, and avoiding doing other things than reducing the stressor. About half of the participants' had experiences with stress interventions, mindfulness or meditation.

Most of the students were able to deal with their stress, at least to some extent. Eight students stated to attain relaxation when they try to reduce their stress. Seven students said that they were able to relax in some cases, but not always. Three participants said that they were unsuccessful at reducing stress. About one-third of the students were of the opinion that stress should not be avoided and another third said that stress should be avoided. Other participants said that whether stress should be avoided or not depends on the extent of stress.

Outcome expectancies before seeing the app.

In advance of seeing the app, participants were asked whether they believe an app can be effective to reduce stress. Nine students stated to believe an app can be effective, for example, because it is possible to incorporate effective methods in an app. Nine participants explained that an app could be effective to some extent, but it also depends on the users' motivation. Only one participant thought an app cannot be effective to reduce stress, because reducing stress is something a person has to do without an app. Conclusively, most participants either had positive outcome expectancies or believed that an app can be effective to some extent.

Impressions of the app.

After exploring the app, users were asked what consequences regular usage of the app could have. The majority of participants expected positive consequences. Participants stated sixteen times to expect the app would reduce stress, increase self-consciousness, or enhance knowledge about stress reactions. Six times the students were indecisive whether the app can change something. They needed to use the app more to make statements about effects.

The participants were of different opinions how often they would use the app if it was not part of a study. Seven participants argued that that their usage-time depended on the price

of the app, whether they remember having the app, the effectivity of the app and the own stress-level, whereby a lot of stress would increase the usage-time. Six participants stated that they would use the app five times per week or more often. Another six participants stated that they would not use the app at all.

Outcome expectancies towards different aspects of the app.

There are different elements and concepts related to the app that induced outcome expectancies in users. Relative to the apps' effectivity, the 19 students mentioned in total 18 different aspects that were allocated to four overarching categories. As Table 1 shows, altogether 267 fragments were coded, out of which 96 were positive; 50 were neutral; and 121 were negative remarks.

Feature.

The most coded feature of the app was *emotion-focused exercise*. Participants made in total 35 comments about the tasks that also received the highest number of positive statements. Within 23 positive remarks students mostly described the relaxing effects of the exercises. For instance one subject described: "[The] meditation exercise, like with the smiling, I think that would really kind of like cheer you up as well, your stress might put you down. Yea there is really like calming down and I am sure that would help". Nine negative comments were made about specific parts of the exercises that were not considered as relaxing, especially about the part where participants had to contract face-muscles, because it leaded to wrinkles or was exhausting. Also, a few comments were made in which participants said they did not know how the exercise would help to reduce stress or in which participants expressed the need for additional content.

The second most often code was the heart-rate *measurement*. In total, 26 remarks were made about the feature. Within eight positive statements subjects said that the measurement can be effective because it increases awareness about stress. Participants made 14 negative remarks about the measurement, which was the highest number of negative codes for one feature. One participant described that the measurement increased stress: "Below there is a line on which my heart rhythm is shown and there is a line how it should be and mine is like so off of that. I am very worried now." Other reasons for negative outcome expectancies were that the measurement didn't function at all, a low trustworthiness towards the validity and that the measurement was included too often in the app.

Table 1.

*Number of Efficacy Comments per aspect of the App (*Percentages in Parentheses)

Category	Element	Explanation	Total counts	Positive comments	Neutral comments	Negative comments
Feature (aspects of the app that could function independently of the app, or in a different app)						
	Emotion-focused exercises	Statements about relaxation exercises	35	23 (65,7)	3 (8,6)	9 (25,7)
	Measurement	Statements about the heart-rate measurement	26	7 (20)	5 (14,3)	14 (40)
	Quote of the day *	Statements about the quote of the day	21	2 (9,5)	7 (33,3)	12 (57,1)
	Reminder	Statements about the reminder	14	9 (64,3)	3 (21,4)	2 (14,3)
	Daily course	Statements about the daily course	8	6 (75)	1 (12,5)	1 (12,5)
Content (aspects that spread throughout the app, or aspects that are not independent features)						
	Design*	Statements about the look of the app	22	22 (100)	0 (0)	0 (0)
	Information-texts*	Statements about verbalized information, as well as written texts	22	10 (45,5)	3 (13,6)	9 (40,1)
	Audio	Statements about sounds and the speaker	11	3 (27,3)	0 (0)	8 (72,7)
	Problem-solving	Statements about problem-solving methods	7	0 (0)	0 (0)	7 (100)
	Personalization	Statements about personalization that were not related to other aspects	3	0 (0)	0 (0)	3 (100)
Condition (conditions that participants base outcome expectations on)						
	Time-taking	Statements about the time that is needed to use the app; or when to use the app	18	2 (11,1)	5 (27,8)	11 (61,1)
	Long-term results	Statements about the need to see results on a long-term basis	16	1 (6,25)	15 (93,8)	0 (0)

	Trustworthiness	Statements about the trustworthiness of information or features	16	2 (12,5)	1 (6,25)	13 (81,25)
	Phone as medium	Statements about the phone as medium	12	5 (41,6)	2 (16,7)	5 (41,7)
	Motivation for usage	Statements about students' motivation to use the app	9	0 (0)	3 (33,3)	6 (66,6)
	Difficulty	Statements about the difficulty of elements	4	1 (25)	0 (0)	3 (75)
Usability (aspects that relate to the usability of the app)						
	Electronic issues	Statements about electronic aspects	16	0 (0)	2 (12,5)	14 (87,5)
	Guidance	Statements about the guidance in the app and the order of features	7	3 (42,9)	0 (0)	4 (57,1)
Total			267	96 (36)	50 (19)	121 (45,3)

Note. n=264. Elements that were asked for within interview questions are indicated with asterisk (*).

The students talked 21 times about the effectivity of the *quote of the day*. Only two positive statements were made. The positive remarks included that the quote is assumed to help against depressive moods. Seven times the participants said something neutral, such as that the quote is not an important factor but made them smile. The quote of the day is the feature with the highest percentage of negative codes. Twelve negative fragments entailed that the quote did not reduce stress or even enhances stress, because the quote was difficult to comprehend.

Analysis yielded 14 codes for the effectivity of the *reminder* of the app. Nine, so the majority of statements was positive. The reminder was considered as useful, because it helps to think of the app. Within the other five comments students were indecisive whether reminders are useful or stressful.

Eight statements were made about the effectiveness of the *daily course of* the app. Six, so almost all codes were positive. Participants considered the possibility to have a structured daily routine as effective. Negatively mentioned was the high workload as additional burden.

Content.

Talking about the content of the app, in total 22 fragments were coded that refer to the *design*. The apps' look is the only aspect of the app that received positive feedback only. Students explained that they experienced the blue and purple colors as relaxing. In addition to that, the minimalistic design leads to an easy use of the app, which in turn supports stress-reduction.

Also, 22 times the participants talked about the *information-texts* in the app. Ten, so about half of the comments were positive, because the information was considered as valuable. Nine, so almost the other half of codes was negative. Reasons were that the information-texts were difficult to comprehend, the information was irrelevant, and that the audio format seemed unhandy to participants.

In total 12 remarks were coded for the *audio* output of the app. Three of the statements were positive, in which students mentioned the relaxing effect of the voice. All other nine codes included negative opinions over the speed of the voice, the invariability of the speaker, or the fact that the texts cannot be read.

The effectivity of *problem-solving methods* was mentioned seven times by participants. The element was only mentioned in a negative context, because problem-solving was considered as completely absent in the app. The students expressed the need for organization and time-management aids.

The last feature is the level of *personalization* in the app. All three remarks were negative. The students explained that the app appeared impersonal and that it could not be changed to users' individual characteristics and preferences.

Condition.

Time taking is the condition that was coded 18 times and most often. Even though two times the participants stated that the app is not time-consuming, the majority of the statements were negative. Within 11 negative statements subjects stated that it is not possible to use the app during stressful situations; that it is unclear when to use the app; and that the app takes too much time.

Another condition that was discussed frequently is the *long-term result*. Out of 16, 15 statements were neutral, in which students mentioned that in order to say something about the effectivity, the students need to experience long-term results, which was not possible within the short time they had with the app. Participants uttered the need for the effects to be long-

lasting. Like this participant explained “If I would be stressed, then would I do the exercise? Probably not, so will this last like long enough to when I get into a stressful situation that I won’t be stressed then?”. Due to the short time with the app, the majority of participants could not evaluate the results on a long-term basis.

Also 16 codes were about to the *trustworthiness* of the app. Within two positive comments the participants said that the scientific background is effective. Negative fragments were coded 13 times. In the statements some subjects uttered the need for approval from other users. Moreover, participants uttered doubt towards different elements of the app, mostly to the heart-rate measurement, for instance by saying “the pulse depends on more things than stress”.

Students talked 12 times about the effectivity of a *phone as medium* for stress-reduction methods. Almost a half of statements were positive, because the students always had their phone with them. About the other half of students considered the phone as an ineffective medium, because an app cannot solve problems and phones are associated with stress.

Participants spoke nine times about the *motivation* to use the app. Within three neutral statements participants said that the effectiveness of the app depends on users’ level of engagement with the practice. In six negative coded fragments, students mentioned the lack of motivating elements. One participant described: “I did not feel that it was so rewarding for me, so I know this from other apps that they always give you a feeling that you are doing a great job at everything”.

Four times was the *difficulty* of the app coded. Within one positive fragment, a student valued that the app made it easy to meditate for beginners. Three negative codes included statements that the app that the app is targeted at beginners too much or that the app is too difficult. The participants seemed indifferent whether the app is too easy, too difficult or appropriate.

Usability.

The most coded usability-element was *electronic issues*. Students spoke about electronic issues in total 16 times. Almost all coded were negative, in which participants described electronic errors. Features that were mentioned as not functional were mostly the heart-rate measurement, that the free version didn’t work, and that language settings could not be changed.

G*uidance and order* was coded seven times. Three positive statements indicated that the order in the app was clear. While four negative remarks were made about the confusing order, the lack of an introduction to the app, and the predominance of the measurement function.

Changes in the prototype.

Several changes of the app were shown in the prototype. In general, users were enabled to make more choices. The different SMTs were offered as separate exercises with different lengths. Walking meditations, video-meditations and chants and mantras were added. Additionally, participants could change audio and difficulty settings. Based on the latter, exercises changed for instance in their level of guidance. Moreover, the diversity of content was increased by an additional page for acute stress aid, psychotherapeutic methods, and a page to find personal help in the users' area. Also, problem-solving methods were incorporated, for instance a to-do list with a reminder function. Additionally, different stress-measurements were integrated, such as a self-rate scale and a questionnaire. To back up informative texts, scientific studies were attached by hyperlinks. As reinforcing element, a streak was added that counts all days on which at least one exercise was done in a row. The number would set back to zero in case no exercise was done one day. To increase the usability of the app, a tour through the app was added that explained for instance how to navigate through the app.

Second Interview Session

Experience after two weeks.

Usage of the app.

After two weeks the participants were asked how often they used the app or features of it. Only one participant stated that he or she used the app daily. Four, so almost half of the participants used the app three to five times within two weeks. The students reasoned that on the other days they were not motivated to take the time; they lost interest in the app; or did not experience the exercises as helpful**.** The other half of subjects used the app one time or less. The participants focused on different features of the app. Two participants indicated having used all features of the app. Three participants just clicked through the app to get an

overview. Three participants used only the heart-rate measurement. Apart from that, all participants except one stated that they have been moderately to fully concentrated while using the app.

Outcome expectancies towards the app after two weeks.

Participants' outcome expectancies towards the app were divided. About one-third of students were undecided whether the app is effective or not. They said that for them personally the app was not effective, but they imagine the app to be effective for users that are not familiar with meditation. In contrast to that, almost one-third of students thought that the app can be effective to reduce stress. The other third of students thought that the app is not effective, because the app did solve their problems and an app cannot be used in stressful situations.

The participants suggested changes that could increase the effectivity of the app. Four times the participants mentioned that more exercises and methods enhance excitement to use the app. Subjects told that time-management and organization aids are needed. Three participants were of the opinion that the reminder function should work more reliably and that a varying quote could be integrated. Two students said that the exercise-tracking has to be improved and that the app lacks of rewards for regular usage. It was also stated that the measurement accuracy has to be improved somehow. Another aspect was mentioned was the too lengthy breathing time. To increase effectivity of the app, participants wanted several electronic errors to be reduced, a provision of different exercises, shorter breathing times, and motivating elements.

Participants were asked whether they wanted to continue using the app after the study. Seven out of 10 participants stated that they do not want to use the app anymore. Reasons were that the app didn't help; students expected to forget the app; students already had own methods to reduce stress; and distrust was experienced due to unexpected measurement outcomes.

Outcome expectancies towards the prototype.

Different elements and concepts related to the app induced outcome expectancies in users. Relative to the apps' effectivity, 10 participants mentioned in total 20 different aspects that were divided into one of the four categories: feature, content, condition and usability. As Table 2 shows, there were altogether 167 single codes, out of which 111 were positive, 21 were neutral, and 35 were negative coded fragments.

Table 2.

*Number of Efficacy Comments per Aspect of the Prototype (*Percentages in Parentheses)

Category	Element	Explanation	Total counts	Positive comments	Neutral comments	Negative comments
Feature	Stress-reduction methods in your area *	Statements about the page stress-reduction methods in your area	19	11 (57,9)	4 (21,1)	4 (21,1)
	Streak *	Statements about the streak	18	15 (83,3)	3 (16,7)	0 (0)
	Quick stress-reduction *	Statements about the page quick stress reduction	14	7 (50)	2 (14,3)	5 (35,7)
	Reminder	Statements about the reminder	7	7 (100)	0 (0)	0 (0)
	Emotion-focused exercises	Statements about the emotion-focused exercises	6	3 (50)	0 (0)	3 (50)
	Psychotherapeutically courses	Statements about Psychotherapeutically courses	6	2 (33,3)	4 (66,7)	0 (0)
	Themed courses	Statements about the themed courses	4	4 (100)	0 (0)	0 (0)
	Measurements	Statements about the measurements	3	0 (0)	0 (0)	3 (100)
Content	Problem-solving methods	Statements about problem-solving methods	21	17 (81)	2 (9,4)	2 (9,4)
	Information texts *	Statements about the information-texts	16	11 (68,8)	1 (6,3)	4 (25)
	Design *	Statements about the look of the app	13	9 (69,2)	3 (23,1)	1 (7,7)
	Diversity	Statements about the diversity of content	11	11 (100)	0 (0)	0 (0)
	Videos	Statements about videos	6	0 (0)	1 (16,7)	5 (83,3)
	Personalization	Statements about the possibility to adapt the app to personal needs	5	5 (100)	0 (0)	0 (0)
	Audio	Statements about the audio	2	1 (50)	1 (50)	0 (0)
Condition	Phone as a medium	Statements about the phone as a medium for SMTs	4	2 (50)	0 (0)	2 (50)

	Time-taking	Statements about the time needed to use the app	4	1 (25)	0 (0)	3 (75)
	Trustworthiness	Statements about the trustworthiness of the information, or the trustworthiness measurement	3	2 (66,7)	0 (0)	1 (33,3)
	Difficulty	Statements about the difficulty of practice	2	2 (100)	0 (0)	0 (0)
Usability	Layout	Statements about the arrangement of elements	3	1 (33,3)	0 (0)	2 (66,7)
Total			167	111 (66,5)	21 (12,6)	35 (21)

Note. n=167. Elements that were mentioned specifically in the interview questions are indicated with asterisk (*).

Feature.

The most coded feature was the page *find stress-reduction methods in your area*. It was mentioned 19 times in total. Eleven positive comments involved that it makes the app effective to connect users to the real world. A student described that the features helps the app to be effective even when the app itself is not effective: “Most people just do not take the first step to actually seeking help. It starts with downloading an app and then deleting it after two days, because it doesn’t work. But this one you can look at like okay, this app totally failed, but at least now I can maybe find Dr. Peterson.” Also, the possibility to meet people with similar problems was seen as a positive aspect. Four neutral comments reflected the uncertainty whether students would actually want personal help, because it requires even more time. Other subjects were not sure how the feature would be realized and whether it would have more value than a Google search. Within four negative codes, students stated to prefer using Google, because not all options might be shown in the app.

The second most coded feature was the *streak*. It was mentioned 18 times. With 83% it is the feature with the highest percentage of positive comments. Students valued the reinforcing element, because it was experienced like a mini-game which increased motivation. Others told about positive experiences with streaks in other apps. Three neutral comments suggested that the motivating effect could be increased if the streak had special effects. One participant proposed, “maybe in the end when you fulfilled it some flowers should come out, so that you see you attained 300 days and then something happens. Like a surprising effect”. No negative remarks were stated relative to the streak.

The participants commented 14 times on the effectivity of the *quick stress-reduction page*. Half of the statements were positive. Arguments were that the short instructions can help to bring thoughts back to the present moment and the page helps to direct them into a positive direction. Five negative statements comprised that there is no time to use the app during stressful situations; that the provided content is not enough to help with acute stress; and that animations, rather than a text, would be more comprehensible during a stressful situation.

Another feature that was coded only positively is the *reminder*. In total, students spoke seven times about the function. One student described "The reminder part would have been really, really useful, because my biggest problem was to open the app and use it". The participants argued that a reminder would enhance effectivity, because without it they forgot the app.

The next element is *emotion-focused exercises,* that were coded six times. Students made three positive and three negative comments on the techniques. Positively mentioned was that there are various emotion-focused exercises, so the students could skip the ones they do not like. Negatively, students mentioned that the exercises were too long and that they did not believe that exerting exercises reduces stress.

Another feature that was coded six times was the *psychotherapeutically course.* The students made two positive comments in which they regarded therapeutically methods as effective, because they expected to learn to control their emotions and to stay calm during stressful situations. Four neutral fragments contained uncertainty how the course would be realized in the app.

Participants talked four times about the effectivity of the *themed courses*. Only positive statements were made. Students appreciated that various topics that can cause stress were covered. The students valued that they can select themes of their choice, which makes the app targeted more to individual needs.

The effectivity of *measurement* was coded three times. All fragments were interpreted as negative. The participants said that stress measurements are redundant because a measurement does not reduce stress. One student suggested that if would be effective if the app could automatically measure stress during the day without opening the app and then notify the user when they are too stressed.

Content.

Problem-solving methods were coded 27 times and were the most coded element related the content of the prototype. With 81% positive comments, problem-solving methods had the highest percentage of positive remarks. Students thought problem-solving methods were effective because they tackle stress by its' roots. One participant described "it's really aiming at sustainably tools, to also prevent stress in the future. So it's not just only focused at reducing the stress now, but it's also aimed at reducing overall stress". Several students considered the to-do list in form of a calendar as effective and would like to use the feature. One student said: "I think it can be quiet of a daily companion app, in addition to just reducing stress, helping people to do their daily life". Two negative statements included that there aren't enough problem-solving exercises and that social skills cannot be thaught efficiently through an app.

All in all, 16 codes were about the *information-texts* in the prototype. Eleven codes were positive. Positive was the reliability of the information, also through the scientific back up. Fragments explicitly mentioned as helpful were explanations of the heart-rate measurement, information how to cope with stress, the statement that stress is normal, and the advice "to think about whether the problem would still be there in two years". Also the instructions on how to use the app were valued. Four negative comments included that background information is not necessary to reduce stress, that scientific studies are not suitable for unacademic users, and that there is a lack of visuals.

For the *design* 13 statements were coded. Nine positive remarks contained that the icons, as well as the clear design increased usability. The colours and the background theme were calming. Within three neutral sayings subjects stated that the design is neither stress-inducing nor stress-reducing. As negatively, it was experienced that it took more steps to get to the heart-rate measurement.

In total 11 comments were made the *diversity* of content. All comments are positive. Participants appreciated that the range of content enabled them to choose activities based on their preferences. One explained: "I can do what I want to do and actually tackle the problems that are bothering me". Also seen as positive was seen that the prototype covers different stressors and can therefore be helpful also when students' stressors change.

Videos in the prototype were coded six times. Five phrases were negative, in which students said the app would be more effective if it contained videos or animations. One student suggested "maybe includ[e] videos to just explain how the methods could work and see somebody else actually doing it". The participants preferred visual highlights in the app, because it makes information intake easier.

Five times the possibility for *personalization* was coded. All sayings were positive. The students valued that the prototype entailed different settings and that the prototype could be used in different ways. Students considered the diverse possibilities as effective, because they allow to use the app based on individual needs.

Talking about the *audio* of the app, one student stated that the possibility to choose the speaker reduced stress, while another student assumed that it might be unrelaxing when the fastest speaker talks.

Condition.

The *phone as medium* for stress-reduction aid was coded four times. Half of the remarks were positive, and the other half were negative. Positive aspects were that it saves time to use an app and that a phone is always accessible. Negative statements were that students thought it is more effective if they change their life directly.

Four comments were coded about *time-taking*. Positively a student stated that the exercises are short and can be incorporated into daily life easily. Three negative comments included that the exercises are too long and that in a stressful moment it is not possible to use the app.

Three fragments were coded about *trustworthiness*. Two utterances were positive, because students said that the information seems reliable and trustworthy sources are included. Within one negative comment, a subject said that for him or her, a recommendation to use the app from a familiar person is necessary to use the app.

Two occasions statements about the *difficulty* were coded. In both positive statements students appreciated the possibility to choose different levels. One participant said: “There will be more easy exercises and more guidance it says. So, that sounds good. Also would support me to adhere to the app and actually use it. “

Usability.

Three statements were coded about the *layout* of the app. For one student the layout was easily comprehensible while for two students the layout was perceived as complicated, because there were too many elements to click on and specific features were complicated to find.

Impressions of the prototype.

After exploring the prototype, users were asked what consequences they think regular usage of the app has, if it was changed based on the prototype. About half of the participants stated that they expect to be more relaxed and that they would use the app more often. Two times the participants said that the app would increase the ability to cope with stress and enhance awareness about stress.

Users were asked how often they think they would use the app if it was changed based on the prototype. Four participants said that they cannot give an answer, because it would depend on how the app works. Three participants said that they would use the app every day, while one of them just wanted to use the to-do list. Three participants would use the app when being stressed. Imagining being in need for SMTs, four participants stated that they would use the app daily and four participants stated that they would not use the app, because they already found own effective ways how to deal with stress.

The participants were asked what could still be improved about the prototype. Half of the participants said that that there is nothing to be improved. Three participants suggested that more visualization, such as videos and animations should be added. One participant liked more options to choose from. For one participant it was important that the app is used and recommended to him by peers. So, mainly the addition of visuals could improve the prototype.

Discussion

This study aimed to explore why students have positive or negative outcome expectancies towards a mHealth intervention. Outcome expectancies were found to be related to all kinds of elements of the intervention. Students mentioned a diversity of aspects that influenced their outcome expectancies, from which four overarching categories could be derived: feature, content, condition and usability. The categories cover all kinds of aspects that go beyond directly visible features like the reminder, or content related aspects of the app such as the diversity of exercises. Participants also connected outcome-expectancies to conditions that the app implies, such as the time-investment that is necessary for the practice. Additionally, usability aspects played a role, for instance because of an introduction-assistant that explains how to use the app. This is in contrast to other studies that only found one or to two factors that influenced outcome expectancies (Kwekkeboom, 2001; Hardy et al., 1995). This discrepancy can be explained by the fact that those studies tested only up to three predicting variables as, while this study was open to all aspects as possible predictors. To

conclude, outcome expectancies are not influenced by a few main factors, but by a diversity of aspects of the app.

In addition to that, the study wanted to research why students have positive or negative outcome expectancies towards aspects of a stress management app. Students perceived the emotion-focused exercises as efficient, because the relaxing effects of the exercises could be experienced directly. Other studies also show that relaxation exercises reduce stress immediately. They investigated that stress-reducing effects are caused, because the exercises regulate emotions, reduce rumination and induce nonattachment of happiness from external events (Coffey & Hartman, 2008). Also, the simplistic design with calming colours was perceived as stress-reducing. Several other studies support these findings by reporting about the calming effects of the colours blue and pink (Jacobs & Suess, 1975; Schauss, 1979; Stone, 2003). The calming effects are induced by light wavelengths that reach through neurochemical channels the pineal glands, which produce the sleeping hormone melatonin (Schauss, 1979). Additionally, students considered the reminder and reinforcing elements as efficient, because these features make them engage with the app. Also, students did not believe that emotion-focused exercises alone solve their problems. To consider the app as effective they wanted problem-solving methods to be included. In addition to that, students thought that for effectiveness, animations and videos and should be included into the intervention, because by animations and videos the accessibility of information is enhanced. Moreover, students did not find it effective that the voice of the speaker was set, they rather want to determine the speed themselves or read the information to skip unimportant passages. Additionally, the credibility of the apps' features influenced outcome expectancies. Students were skeptical, because the heart-rate stress measurement outcomes did not match their own feelings. Another factor that influenced outcome expectancies is the functionality of the app. Electronic errors led to frustration in students. Moreover, students said that more personalization would enhance effectivity, because the app is impersonal and not adaptable to personal needs. The students perceived a high task load as ineffective, due to the fact that the students experienced time-pressure. Additionally, the students expressed the need to know at which times the app is used best. All in all, for each aspect individual reasons were mentioned that caused outcome expectancies, though students based their outcome expectancies on their own feelings or imaginations of the app.

The predictors of outcome expectancies that other studies found are to some extent comparable to the findings of this study. Previous studies mainly concluded that the perceived reliability and credibility of the methods in an intervention influenced outcome

expectancies (Kwekkeboom, 2001; Hardy et al., 1995; Fleischmann et al., 2018). In our study the respective aspects, coded as trustworthiness, were mentioned often by subjects. Nonetheless, in this study only two participants mentioned doubts towards the emotion-focused exercises. More participants were skeptical about the stress-measurement via phone camera. The study of Kwekkeboom (2001) also found that familiarity of the method influenced outcome expectancies. The fact that about half of the participants in this study already had experience with relaxation exercises, and some of them already used the techniques to reduce stress, may explain the more positive attitude towards relaxation exercises. For the participants of our study the use of meditation and mindfulness might be more common and accepted as technique to reduce stress. Additionally it may be that the mechanisms how exercises work were already explained sufficiently in the app Kenkou. So, like in other studies the perceived reliability influenced students' outcome expectancies, nonetheless, rather the stress-measurement than the relaxation exercises were matters of concern.

Additional expected outcomes of this study were insights whether it is possible to heighten students' outcome expectancies for a stress management app and if so, by which means. One main factor that enhanced outcome expectancies visibly was that the modified version entailed a lot more options of which students could choose from. Other forms of meditation were added, such as walking and video meditations. Additionally, the prototype offered more possibilities to personalize the app, such as audio and difficulty settings but also the choice of how to use the app in general, either by selecting specific exercises directly, by taking a themed course or by letting the app give a selection of tasks for that day. Moreover, students considered the descriptions about the content of exercise and their duration as effective, because they enabled them to choose the exercises they like. These results indicate that students' outcome expectancies are heightened, when they are enabled to decide how to use the app. These outcomes are in line with the principles of the self-determination theory, one of the leading theories about humans' motivation (Weinstein, Campbell & Vansteenkiste, 2017). The self-determination theory entails that humans have a need for autonomy, which means that people want to organize things in a way that they are in line with their feeling of self (Deci & Ryan, 2000). By having more choices, students could have felt more autonomous to use the app integral to their characteristics, which might have enhanced the perceived effectivity.

This study also wanted to see whether increased outcome expectancies can enhance students' motivation to engage with a mHealth intervention. Some students stated that they

do not want to use the app, though they experienced more aspects as effective. The students reasoned that they already found own effective ways to cope with stress. At the beginning of the study only three out of 19 participants said that they were not able to achieve a reduction of stress with their coping strategies, which indicates that the majority of subjects in this study experienced eustress. Additionally, only one participant mentioned to engage in unhealthy behaviors to cope with stress, which was smoking. This is in contrast to other studies that reported that students are severely stressed and often try to cope with it by unhealthy behaviors (Hudd et. al., 2000; Morgan, 1997; Naquin & Gilbert, 1996; Owalt & Riddock, 2007; Pettit & DeBarr, 2011). Those divergences may be explained by the fact that our sample experienced less stress than students on average, which can be seen by lower PSS scores, even compared to other students from the same university. Nonetheless, some participants indicated that they can imagine using some features of the app daily. Explicitly mentioned were the themed courses and the calendar with the integrated to-do list. The students showed interested in features with which they can increase their organization-skills, time management, or solve specific problems in their lives. All in all, enhanced outcome expectancies did not seem to motivate the majority of students to use the intervention in general, though some participants showed interest in the problem-solving aspects.

Limitations and strengths

Some weaknesses of the study occurred because of the method of coding. It cannot necessarily be concluded that aspects with a high number of codes were more important for participants than aspects with fewer codes. It may be that participants mentioned important aspects more often, but this conclusion is not granted. Some aspects might just have been more present in subjects' mind, for instance because they saw them at last. Apart from that, some aspects of the app were directly addressed within the questions from this study. It is logical that students mentioned those aspects more often. Therefore, those aspects were marked in the outcome tables. Due to the fact that various factors influenced how often participants mentioned aspects, the numbers of resulting codes should only be used to recognize tendencies.

An additional threat to the studies' reliability is the subjective process of coding. The coding was only executed by one researcher. Therefore, no interrater-reliability could be calculated. Though, the saturation of the codes was good, which means that the last interviews fitted the previously created codes and there was no information not already covered by codes, it is possible that with a second coder the codes would have to be revised

to some extent. Conclusively, because there was only one coder, the consistency of the implementation of the coding scheme is uncertain.

Another limitation is the decision which fragments to code out of the think-aloud protocols. The choice was blurry in some cases. Parts in which participants said that they liked something or not weren't coded, because liking does not imply that the students consider the aspect as stress-reducing. However, in case a participant said for example "there is a nice sound like the sea or something" the fragment was not coded, even though it is possible that the participant experienced the sounds as stress reducing. However, the participants tended to repeat their opinions regarding most aspects while answering the interview questions, so in case fragments were not coded out of the think-aloud report, they were most likely coded again at a later point. Though some relevant fragments might not have been coded out of the think-aloud protocols, it seems as if the large majority of relevant opinions was coded at a later point.

What may have confounded the validity of the study is that no psychometrically validated measures were used to research outcome expectancies. The questions to measure outcome expectancies were invented by the researchers and not tested in any ways. It is possible that participants also stated opinions about aspects that were not related to outcome expectancies. Nonetheless, it was observed that participants differentiated between general opinions and opinions over the effectivity of the app. For example, one participant said about a feature "well, it's nice to read, but I don't really know if that reduces stress." Though the questions were self-invented, subjects' answers indicate that overall the focus on the effectivity to reduce stress was understood.

The strengths of this study lay in the high qualitative approach. The students could state their opinions completely free during the think-aloud tasks. This enabled to gather impressions that were independent of the influence of questions. Additionally, semi-structured questions asked for participants' opinion, specifically about their outcome expectancies, to get deeper insight into this area. Moreover, students did not have contact with the app in advance of the study, so the participants shared their first impressions about the app. Also, studies in the field of mHealth interventions usually assess users' opinions after engagement with the intervention. The recent study in contrast captured students' thoughts immediately while using the app and also while trying out different exercises. This approach enabled direct insights into students' thoughts about the app. Moreover, the focus of the study on users' outcome expectancies towards an mHealth intervention is completely new and gives first important insights into this field. All in all, the studies' set up enabled to

gather broad and direct impressions of users' outcome expectancies towards an mHealth intervention.

Implications

This study showed that outcome expectancies are not dependent on one or two single factors, but that outcome expectancies can be influenced by all aspects of an intervention. So far, studies about the predictors of outcome expectancies for interventions focused only on a few aspects. However, the findings of this study suggest that research could explore determinants of outcome expectancies more qualitatively, because it seems that outcome expectancies are influenced by a diversity of aspects. Additionally, the fact that outcome expectancies are linked to a range of aspects could mean that outcome expectancies are a relevant factor for peoples' motivation to use a mHealth intervention and should not be left out in research and intervention development.

In the study, users' outcome expectancies could be heightened by a change of several aspects of the intervention. For mHealth construction this means that attaining an intervention that is perceived as efficient goes beyond integrating an effective method. Negative outcome expectancies could also be caused by aspects that might not be associated with the goal of stress-reduction at first sight. For instance a complicated design could cause frustration, or the absence of reinforcing elements could cause a lack of excitement to use the app, which reduces the perceived effectivity for users. Additionally, the study indicates that for students it is important to be able to adapt an app according to the own preferences. On the other hand, mHealth designers have to evaluate whether it makes sense to integrate all aspects that users desire into an app. Some aspects like video-meditations might seem attractive for students, but could lead further away from the relaxing state of mindfulness. mHealth interventions need to find a balance between sufficient outcome expectancies and purposefulness.

Moreover, the study showed that students do not have a large need for direct stress-reduction techniques but rather want support in the area of problem-solving. Therefore, an app targeted on students could lower the focus on emotion-focused techniques and instead integrate methods that tackle students' stressors at their roots, for instance by offering support in time-management; organizing; and solving of possible problems in student-life. Nonetheless, it should be noted that the prototype only signified how features could look in an actual app. It might be that after realizing the features in an app, problem-solving methods might be less attractive than the study indicated. Additionally, the sample in this study was stressed less than usual students, and the majority of subjects was able to cope with their

stress by own means. Other students might have a higher need for emotion-focused techniques to reduce the overwhelming feeling of stress. The study showed that students considered problem-solving methods as more efficient than for emotion-focused techniques, but this might have been due to the specialties of the sample and study.

Future studies could investigate similar stress-interventions within other populations than students. It is plausible that different target groups have other needs to consider an intervention as effective. Apart from that, for instance adults might have a higher motivation to use a stress-reduction app compared to students, because they are not that familiar with alternative platforms like YouTube to get access to emotion-focused exercises. Also suitable target groups might be students or other persons that experience distress, because they have a higher need to learn coping strategies.

Conclusion

This study provides insights in students' outcome expectancies towards specific aspects of a stress-reduction app. The study shows that outcome expectancies are not influenced by a few aspects, but that all aspects of a mHealth intervention can impact users' outcome expectancies. The reasons of students to consider aspects of a mHealth intervention as effective or not are manifold. Some aspects that turned out to be associated with positive outcome expectancies were for instance a reminder, the offer of settings and a range of techniques, the presence of problem-solving methods, motivating elements like reinforcers and a display of progress, as well as the possibility to make autonomous decisions how to use the app.

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Appendix A

Interview Scheme

Interview Session 1.

Stress.

What causes your stress?

Do you think that stress should be avoided?

Coping.

What are you doing when you are stressed?

Are there activities you tried out to reduce stress?

Do you feel like they were helpful?

Prior experience.

What is your prior experience with interventions against stress?

Do you have experience with meditation or mindfulness?

Efficacy beliefs.

Do you think an app can be effective to reduce stress? Why?

Think-aloud scenario.

The participants were instructed with the words:

We made some changes in the app that are presented in this prototype based on the feedback we got during the first interviews. We want to get to know what you think about it. Therefore, please explore the prototype as if it was the actual app. While you do that, please speak out whatever comes to your mind, like you did in the first meeting. Please read the instructions on the screen carefully. They will tell how to use the prototype and what to do next.

After the participants got an idea of how to think aloud, the instructions were:

Now, the actual task is to go to the app-store, search for the app Kenkou, download it and imagine you were alone and would explore it, because you want to reduce stress. While doing that speak out whatever thoughts come to your mind.

Outcome expectancies towards aspects of the app.

- What do you think can be effective about this app? Why? (Explain with use of the app which features influence the beliefs)
- What do you think is not effective about this app? Why? (Explain with use of the app which features influence the beliefs)
- Do you think the design of the app is effective to reduce stress? Why?
-Do you think the method of the app is effective to reduce stress? Why?
-Do you think the quote of the day in the app is effective to reduce stress? Why?
-Do you think the educative background information given in the app is effective to reduce stress? Why?

Impressions of the app.

-What do you think will change if you use the app regularly? Why?
-How often would you use the app yourself if it was not part of the study? Why?
-If you felt like you needed to do something to manage stress better, how often would you use this app? Why?
-What can be done to increase your motivation to use the app?

Interview Session 2.

Usage of the app.

During the last two weeks, how often did you use the app? Why?
In which situations did you use the app?
How concentrated were you while you used the app?
What did you do with the app (e.g. which features did you use)?

Outcome expectancies to the app after two weeks.

Do you think the app is effective to reduce stress? Why or why not?
What about the app did you experience as effective? Why?

What about the app did you experience as ineffective? Why?
What can be changed so that you see the app as more effective?
Will you continue using the app? Why or why not?

Think-aloud scenario.

The participants were instructed with the words:

We made some changes in the app that are presented in this prototype based on the feedback we got during the first interviews. We want to get to know what you think about it. Therefore, please explore the prototype as if it was the actual app. While you do that, please speak out whatever comes to your mind, like you did in the first meeting. Please read the instructions on the screen carefully. They will tell how to use the prototype and what to do next.

Outcome expectancies to the prototype.

- What do you think can be effective about the app, if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)
- What do you think is not effective about the app, if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)
- Do you think the design of the prototype is effective to reduce stress? Why or why not?
- Do you think the method of the prototype is effective to reduce stress? Why or why not?
- Do you think the educative background information given in the prototype is effective to reduce stress? Why or why not?
- Do you think the streak in the app is effective to reduce stress? Why or why not?
- Do you think the acute stress reduction page is effective to reduce stress? Why or why not?
- Do you think the page to find stress reduction methods in your area is effective to reduce stress? Why or why not?
- What do you think will change if you use the app regularly, if it was changed based on the prototype? Why?
- How often would you use the app, if it was changed based on the prototype, if it was not part of the study? Why?
- If you felt like you needed to do something to manage stress better, how often would you use this app if it was changed based on the prototype? Why?

- What can be changed so that you see the app as more effective?

Appendix B

Outcome Expectancies On specific Features and Improvements for the Prototype

The transcripts of participants' interviews were screened towards aspects that users associate with positive or negative efficacy beliefs. Users' feedback and possible solutions to enhance perceived efficacy in the prototype are presented in the following. For a better overview categories were created that combine several codes.

Emotion-focused exercises and measurement.

Students had a range of opinions on the effectivity of *emotion-focused exercises,* as Table 3 shows. The perception of concrete exercises differed. Nine participants said they consider the SMTs as relaxing. In contrast to that, nine participants stated to not feel relaxed after the progressive muscle relaxation, the biofeedback measurement, or the deep breathing. Because those participants only disliked one aspect of the exercises, the prototype did not mix of different techniques, but offered separation, so that users could pick the method they like. A remark was inserted that each person has different needs and preferences and that users should try out which relaxation exercises fit to them. Moreover, short descriptions summarized the content and duration of exercises, which enabled them to choose the exercises they liked.

Table 3.

Participants' Feedback on Emotion-Focused Exercises and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
9	SMTs are relaxing	
9	One of the SMTs is not relaxing	Separation of techniques
		Summarizing titles
		Note about individual preferences
3	Participants want varying exercises, walking meditations, psychotherapeutic methods, and visuals	Added walking meditations, chants & mantras, psychotherapeutic methods, and video-meditations
3	Participants understand the mechanism	Optional texts explain mechanism

2	Participants did not understand how the relaxation exercises reduce their stress	

Note. n=19.

Apart from that, three participants stated the need for more variation in meditation content. Students suggested walking meditations that can be done while going to work, or video meditations to facilitate the focus on the exercises. Also psychotherapeutic methods were expected by a student. For more variation walking meditations, video meditations and chants and mantras were added to the prototype, as well as a page with psychotherapeutically cognitive and behavioral courses for stress reduction (see Figure 2).

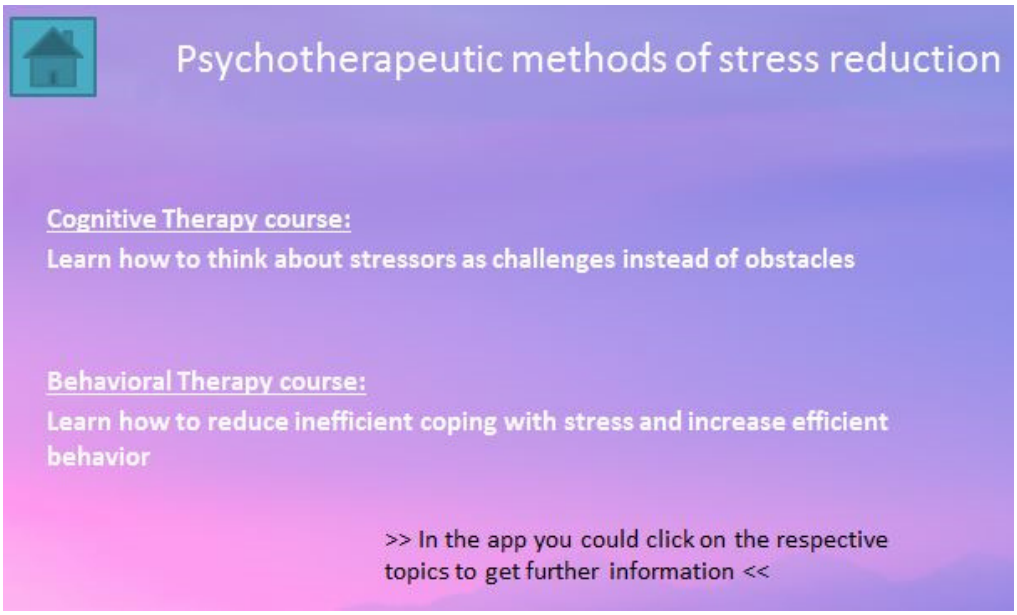

Figure 2. Screen of the prototype psychotherapeutic courses.

Another reason for perceived ineffectiveness was that students couldn't comprehend the mechanism how emotion-focused exercises reduce stress. To reduce the uncertainty for some users, the prototype entailed information that highlights how the specific relaxation exercises reduce stress and how relaxation exercises increase users' efficiency in handling stressful situations.

Information texts and audio.

Regarding the perceived effectiveness of the *information-texts*, several comments were made by the participants (Table 4). Eleven students made positive remarks that the

provided information was valuable to them. The participants valued information about the benefits of the exercises, explanations how exercises reduce stress, as well as information about stress, such as causes, consequences, and coping methods. Due to the positive feedback for the background-information in the app, the texts remain in the prototype.

Table 4.

Participants' Feedback on Information-Texts and Audio; and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
11	Valuable information	
4	Lengthy texts	On point texts
4	Irrelevant texts	Summarizing titles
4	Complex texts	Easy language
2	Written texts preferred	Written texts included
2	Voice too slow	Various speakers
2	Good speed of voice	
1	Lack of diversity in speakers	

Note. n=19.

Apart from positive comments, also negative fragments about the information were found. Four students said the texts are not effective in stress reduction, because they are too long. In addition to that, four participants experienced the texts as not important and four participants thought they were too complex. Therefore, the prototype texts contain only relevant information. The texts were written in everyday language and entailed no technical terms. The titles of information texts summarized the content so that students could choose the information they are interested in.

Participants made remarks about the apps' *audio* as well. Two participants said they prefer to read information, so that they can skip irrelevant passages and can determine the reading speed by themselves. The opinions over the speed of the voice were divided. Two participants explicitly mentioned that they liked the slow voice, for two others the voice was too slow. Also, one participant wanted to hear different speakers. One participant felt that the wave sounds during the exercises were relaxing. To incorporate the feedback in the prototype, the information texts were made available in written form as well as audio.

Moreover, participants could choose different speakers, with male and female voices that talk in different speeds (see Figure 3).

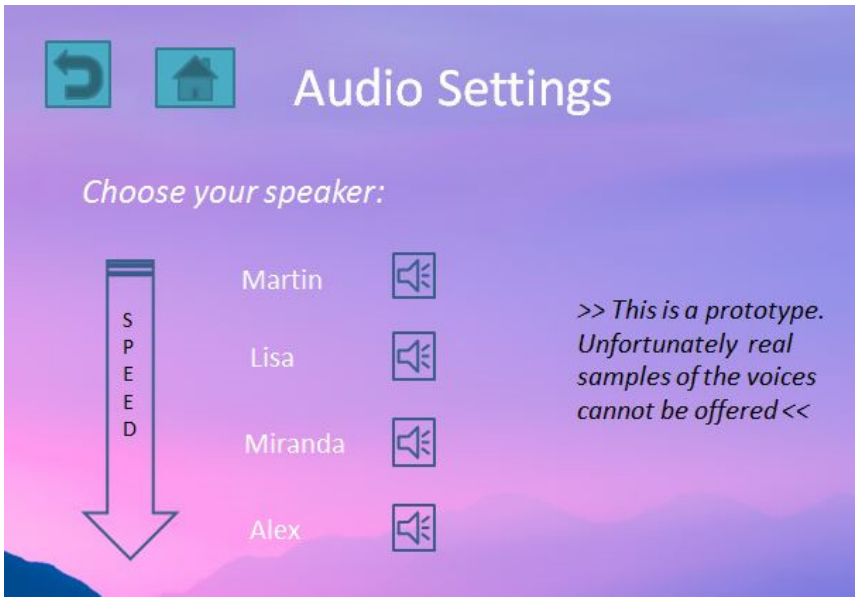

Figure 3. The screen shows the audio settings of the prototype. Within the configurations users can determine whether they want to hear male or female voices that start from low speed and get faster to the bottom. The blue buttons in the left upper corner allow moving through the prototype.

Design.

As can be seen in Table 5, participants' feedback on the effectivity on the apps' *design* was solely positive. One participant said for example "I think it's pretty nice designed and not too many different colors and stuff. It's really clean and simple designed ". In total, 12 students stated that they consider the clear and minimalistic design as relaxing. Eleven students reported that the purple and blue colors had a calming effect. Moreover, three participants said the relaxation effects are increased by the background theme, the silhouette of mountains. The positive feedback indicates that students already had positive outcome expectations towards the design; therefore the design in the prototype remained similar.

Table 5.

Participants' Feedback on Design and Improvement in the Prototype

Number of the participants	Participants' feedback	Improvement in prototype

12	Relaxing layout	
11	Relaxing colors	
3	Relaxing background	

Note. n=19 .

Quote of the day.

Most feedback for the *quote of the day* was negative (Table 6). Nine students conceived the element as unnecessary or even stressful. One participant explained "It stresses me because I had to read it twice and still not understood it". However, three participants found positive words for the quote. One student suggested "maybe for the quote of the day that it is like a message in the home screen, so you can see that and I don't know what quotes it will be but (…) just smile or think about it". Two students had negative associations towards the spirituality of the quote. They said they do not believe in esoteric things and just wanted to reduce their stress. Due to the fact that the prototype does not show real quotes, nothing was changed in this aspect. To react to the negative feedback, the quote of the day got less attention in the prototype. The quote was incorporated as an optional notification combined with the reminding function.

Table 6.

Participants' Feedback on the Quote of the Day and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
9	Quote is irrelevant or stressful	Quote is optional
3	Quote is nice	
2	Too esoteric	Not applicable

Note. n=19.

Time-taking.

Participants were of the opinion that several aspects related to *time-taking* could be improved to enhance effectivity (see Table 7). One aspect related to time that was mentioned is that participants wanted to know how long an exercise or informative speech will take. For instance this student explained "I do not like that I have no possibility to see how much time

everything will take, therefore I cannot plan ahead". To decrease this problem in the prototype time-stamps were added to the exercsies.

Table 7.

Students' Feedback on Time-Taking and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
2	Participants want to know durations	Time stamps were added
2	Participants think the app is not time consuming	
2	Participants do not have time for relaxation exercises when they are stressed	Quick solutions against acute stress were added
2	Participants do not know when to do the exercises	Information page about optimal usage of the app was added
1	Participants cannot use the app while stressed	

Note. n=19.

Even though two participants said that the app is not too much time-consuming, two other participants felt like they do not have time for the exercises when they are stressed. One participant explained "I mean it it's relaxing but it takes a lot of time. I don't think I will have that when I am stressed". Another student described that it seemed paradox to use an app when being stressed, because this would decrease the time to work on stressors, which in turn would increase stress. To tackle that problem, the prototype entailed a page with quick solutions for acute stress (see Figure 4).

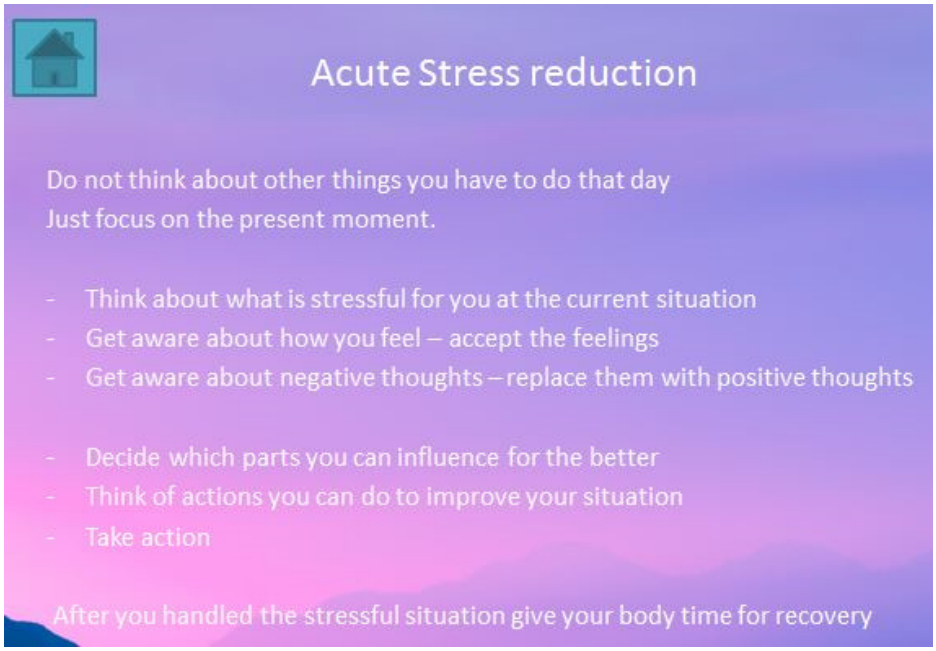

Figure 4.

Regarding time-taking, two users were unsure whether they should use the app when being stressed or not. As this participant said "I am not sure when the meditation is going to happen or so, I would just pick a random time, I guess. Is it more when I am stressed? Maybe". Another user added that it is not always possible to use the app during stressful situations, for example while working. To reduce those doubts, an information page was added to the prototype. The page informed that the app can best be used when students have a bit of time and that the effects will be long-lasting if practiced regularly, so they would feel less stressed throughout the whole day.

Long-term results.

An important factor for students was to see *long-term results* in order to believe in the effectivity of the app (Table 8). Five students said that for them it is necessary to see improvement within their physical data. One participant described "I would be curious if I would see a change in my pulse for example of a couple of weeks and if I would reduce my stress, if my pulse would also stabilize or calm down". To increase the visibility of results a graphic was added to the prototype that shows different measurement outcomes in a curve-diagram.

Table 8.

Students' Feedback on Results and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
5	Visible improvement necessary	A diagram shows progress of measurement results
2	Independence-skills	An annotation writes that users can learn to relax independently from the app

Note. n=19.

Two participants stated to consider the app as effective in case they will be able to relax independently of the app on the long-term. One participant said for example: "I hope I will get better at it and one day eventually I'd be even able to meditate and relax without the help of the app, maybe just to relax and calm myself down with my own thoughts". Due to the fact that the prototype does not entail real exercises that users can try, this feedback could not fully be realized. Nontheless, participants could read the sentence "this will help you to relex independently of guidance" within the app, which indicated that the app leads to independent stress-reduction skills.

Electronic issues.

Five times the participants mentioned minor *electronic errors* that irritated them (Table 9). Those were that exercises were not ticked correctly; screens were not showing; and complications with the registration processes. Those problems are not applicable to the prototype; therefore no changes were made in this regard.

Table 9.

Participants' Feedback on Electronic Issues and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
5	Minor electronic errors	Not applicable
4	Heartrate-measurement does not work	Reduced focus on measurement
		Note in case the feature does not work, users should try different exercises
		Additional stress measures added
1	Impossibility to jump to desired themes	Every theme can be chosen directly

Note. n=19.

Talking about functions that did not work, four times the heart-measurement was mentioned. Due to the fact that the heart-rate measurement did not work, the participants considered the app ineffective. To avoid that participants directly think of reduced effectivity when the measurement does not work, the measurement received less importance in the prototype, by offering it just as one out of many relaxation exercises that users can choose from. Apart from that, a note was displayed that informs users that the measurement does not work on every phone and in case their device is not compatible it is recommended they should continue with other relaxation exercises. Additionally, measures in form of a questionnaire and a self-rate scale were added, that allow to measure stress by other means than the heart-rate.

One participant stated that it is exhausting to click through every day in the courses to get to the next topic. In case a user wanted to explore the topic of week five, the participant had to click through 35 days. Therefore in the prototype, users could immediately click on the theme they wanted (see Figure 5).

Figure 5. The screen of the prototype lists all themed courses that users could choose of. The two buttons in the upper left corner can be used to navigate through the app.

Trustworthiness.

Considering *trustworthiness*, several times mentioned was distrust against different aspects of the app (Table 10). One feature that was explicitly often mentioned was the stress measurement based on heart-rate. One participant remarked for example “I don’t know how valid the measurement of the pulse is, I don’t know if that’s really representing my level of stress”. One subject indicated that the information provided in the app is not effective. Nonetheless, three participants stated that they think the scientific background the app has, is effective already. To increase trustworthiness of the measurement, scientific explanations were added that explain how the phone camera is able to track heart rates and how the heart rate variability is related to stress. Scientific studies were attached to hyperlinks. Also the information pages were backed up with studies.

Table 10.

Participants’ Feedback on Trustworthiness and Improvement in the Prototype

Number of participants	Participants’ feedback	Improvement in prototype
6	Measurement is not trustworthy	Science based explanations with hyperlinks to studies were added
1	Information is not trustworthy	
3	Scientific background is good	
2	Experiences of others are missing	Reference to app-store ratings

Note. n=19.

In addition to that, some participants wanted experienced-based information of other users. One participant explained what could enhance effectivity is “maybe an introduction text in the beginning which tells me that the app is actually useful and that many people used it and it did help them”. Due to the fact that plain texts about other users opinoions in the app seem unreliable, a link was added to ratings in the app store.

Reminders and daily courses.

Students’ opinion on the effectivity of the *reminder* is accurately represented with the following quote: “If you have a reminder to meditate maybe you do it then. But that’s also somehow ironically, because the alarm might stress you, because you think oh my god now I have to meditate” (Table 11). Seven students think the reminder is useful, however three noted that a gentle form of reminding should be used. The app displayed only a notification

on top of users' home screen, so it fulfills users' wants already. For the reason that the reminder in the app was already like participants want it to be, the feature remained unchanged in the prototype.

Table 11.

Students' Feedback on the Reminder & Daily Courses and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
7	Reminder seemed useful	
3	Reminder should not be alarming	
4	Participants liked the daily routine	Daily courses with varying exercises and recommendation for daily practice were kept in the prototype
2	Daily courses are too loaded	Reduction of tasks

Note. n=19.

Apart from that, four students said that they thought it is especially effective that the app can become part of a daily routine. For example, one participant stated "it's like a daily routine. I think it can give some structure, like the daily relaxation. And I mean relieve some tension every day". Nontheless, two participants stated that the daily courses take too long and that they felt pressured to do all scheduled tasks. Due to the fact that students liked the possibility to get a daily routine, the daily courses with varying tasks were kept in the prototype. Other than that it was recommended to do some exercises twice a day. To reduce the workload only three tasks per day were included (see Figure 6).

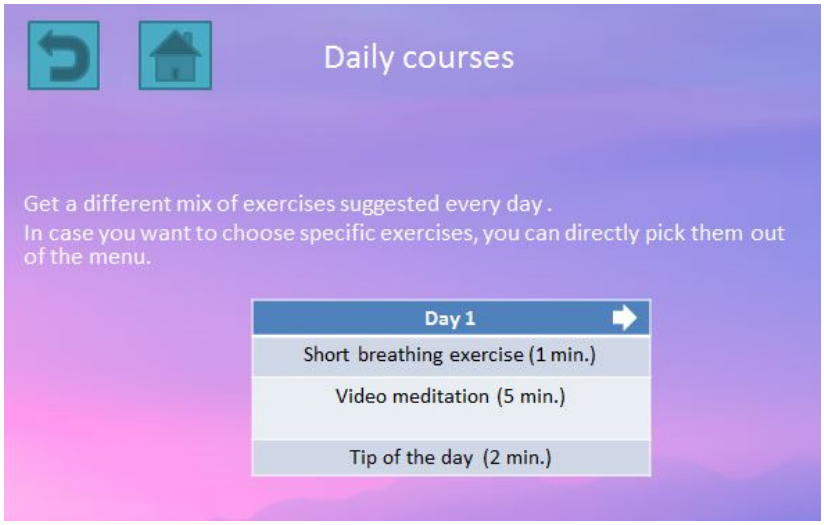

Figure 6. The screen of the prototype shows an example day of the *daily course*. Below the title a short instruction is placed. The table shows the scheduled exercises with time-stamps in brackets. The white arrow lets users skip to the next day. Two blue buttons in the left upper corner allow moving through the prototype.

Phone as a medium.

The opinions of students were divided about whether a phone can be useful to reduce stress or not (Table 12). Five students mentioned to find it handy to use the phone, because it is always accessible for them. However, four students mentioned that they already spent a lot of time with their phones and rather want time off of technology. To also help persons that prefer to use a non-electronic method, the prototype entailed a page that offered users to find stress-reduction methods in their area, such as yoga or meditation courses, stress-management coaches or psychotherapists.

Table 12.

Participants' Feedback on the Phone As Medium and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
5	Students find it handy to use the phone for stress reduction	Find-stress-reduction-in-your-area page
4	Students don't think phones can be effective for stress reduction	

Note. n=19.

Motivation for usage.

Three participants remarked that they believed the success of the app depends on the *users' motivation to use* it (Table 13). It was said for example "I think the effect depend strongly on the willingness of the user to engage, so I think for highly motivated users it can be really effective". This speaks for the fact that the app needs to be motivating for students to use it.

Table 13.

Students' Feedback on Motivation For Usage and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
3	Participants see effectivity dependent on level of engagement	Streak was included as reinforcement
3	Students want to be rewarded for using the app	
2	Students want to be motivated to use the app	

Note. n=19.

In addition to that,three participants indicated that they missed rewarding elements in the app, such as features that track their activity. Two participants spoke about the need to be motivated by fun elements in order to consider the app as effective.One participant explained the principle of streaks as a rewarding feature: "If you are using the app everyday then it counts. But if you don't use the app for one day then the streak is gone. So, that's very basic but I actually like it, because then I feel like I want to have a higher streak and I want to get going yea so that's maybe something". To enhance students' motivation, a streak was included in form of a tealight symbol, as an adaption to the popular snapchat fire-streak (see Figure 7).

Figure 7. As reinforcing element a tea light streak was included. The number shows the number of times a participant completed an exercise in a row.

Guidance and personalization.

The lack of *guidance* and order reduced the apps' effectivity for some participants (Table 14). For three participants the order was clear, but other three participants were confused in which order they should do the tasks. Two participants also missed an introduction assistant. A student said: "I would have liked an introduction, because at first I was kind of lost in the app. There is just a starting display in the app with measurements that I did not even know if I have to do it or how. And how to enter these measures and so on. So, maybe it would be nice to have a hello and welcome and this is how we work". To improve the order, the possibilities to click on per page were reduced. Moreover, users could select a tour through the app that explains different features of the app and how to use them.

Table 14.

Participants' Feedback on Guidance and Personalization; and Improvement in Prototype

Number of participants	Participants' feedback	Improvement in prototype
3	Order is clear	Possibilities to click on per page were reduced
3	Order is unclear	
2	Starting problems	Optional tour through the app
2	Lack of introduction	
2	Lack of personalization	Personalization is offered on general aspects

← *Note.* n=19.

In addition to that, two participants wanted more personalization in the app. One participant described: "Maybe the addition of a little set of questions each day that changes with every person on how they answer the questions. This could help make the app more personal and better in finding out what guidance the user really needs". Participants missed to fill in characteristics such as their hobbies and wished the app would adapt according to that. The subjects want a high level of personalization that could not be realized in the prototype. However, the prototype allowed adaption to individual needs within different elements such as the difficulty, audio, and reminder-settings; as well as by the provision of different ways to use the app, such as doing daily courses, themed courses, or selecting specific exercises.

Problem-solving methods.

Students mentioned that they would like *problem-solving methods* additionally to the emotion-focused practices (Table 15). Four participants said that in order to reduce their stress, they needed support in time-management, to organize their days, and to remember and stick to deadlines. One participant said "maybe it doesn't cover ways (…) like a to-do list or something I mentioned before. Ways I can use the app to manage my time better and reduce my stress because of that". Two participants specifically mentioned that a calendar or to-do lists are effective elements to reduce stress.

Table 15.

Participants' Feedback on Problem-Solving Methods and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
4	Need for organization and time-management skills	Problem-solving methods were added
2	Participants think a calendar reduces stress	

Note. n=19.

To incorporate the feedback in the prototype, problem-solving methods were added in form of tips for organization and problem-solving; social-skills training; as well as a calendar combined with a to-do list in which students can fill deadlines with notifications (see Figure 8).

Figure 8. The screen shows a feature of the prototype in which a calendar is mixed with a to-do list. The calendar is filled in exemplary. The left column shows the tasks that have to be done. The right arrows enable to change the date. The second column consists of deadlines. The third column shows whether a reminder is wanted for the activity. The last column shows ticks for completed exercises.

Difficulty.

Students' had different needs towards the *difficulty* of the app. For two students the breathing times were too long, which gave them an unsatisfactory feeling of failure (Table 16). In contrast, one participant felt like knowing already everything the speaker said. Another student had no experience with meditation before and appreciated the approach for beginners.

Table 16.

Participants' Feedback on Difficulty and Improvement in the Prototype

Number of participants	Participants' feedback	Improvement in prototype
2	Breathing times are too long	3 different levels of exercises were be provided
1	Explanations are known already	
1	Appropriate level of guidance	

←*Note*. n=19.

Due to the mixed feedback, the prototype allows users to choose between three difficulty levels. An text was displayed that said that the app offers different exercises based on the selection of difficulty. The exercises varied in being more or less challenging and being more or less guided (see Figure 9).

Figure 9. The screen shows possible difficulty settings of the prototype. Below the headings are descriptions of each respective level. The boxes indicate that users tick the difficulty of choice.

Appendix C

Informed consent

Consent Form for Kenkou-App
YOU WILL BE GIVEN A COPY OF THIS INFORMED CONSENT FORM

Taking part in the study

I have read and understood the study information dated [xx/xx/xxxx], or it has been read to me. I have been able to ask questions about the study and my questions have been answered to my satisfaction.

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason.

I understand that taking part in the study involves an audio-record of an interview with open-ended questions, as well as a think-aloud protocol that will be audio-recorded and transcribed as text.

Use of the information in the study

I understand that the information I provide might be used by the developers of the Kenkou-App.

I understand that personal information collected about me that can identify me, such as [e.g. my name or where I live], will not be shared.

All gathered information will be completely anonymized by the researchers.

I agree that my information can be anonymized quoted in research outputs.

Future use and reuse of the information by others

I give permission for the excerpts of transcripts that I provide to be archived by the researchers so it can be used for future research and learning. All information will be anonymised by replacing confidential information with codes

All audio-recordings will be completely deleted after the research ended.

The developers of the Kenkou-App will receive the research papers as outcome of the study and might use the outcomes to improve their product.

Signatures

_____ _____

Name of participant [printed]

Signature Date

I have witnessed the accurate reading of the consent form with the potential participant and the individual has had the opportunity to ask questions. I confirm that the individual has given consent freely.

_____ _____ _____

Name of witness [printed] Signature Date

I have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

_____ _____ _____

Researcher name [printed] Signature Date

Study contact details for further information: [*Name, email address*]

Kira Koppik, k.koppik@student.utwente.nl

Angelina Böcker, a.bocker@student.utwente.nl

Contact Information for Questions about Your Rights as a Research Participant

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl