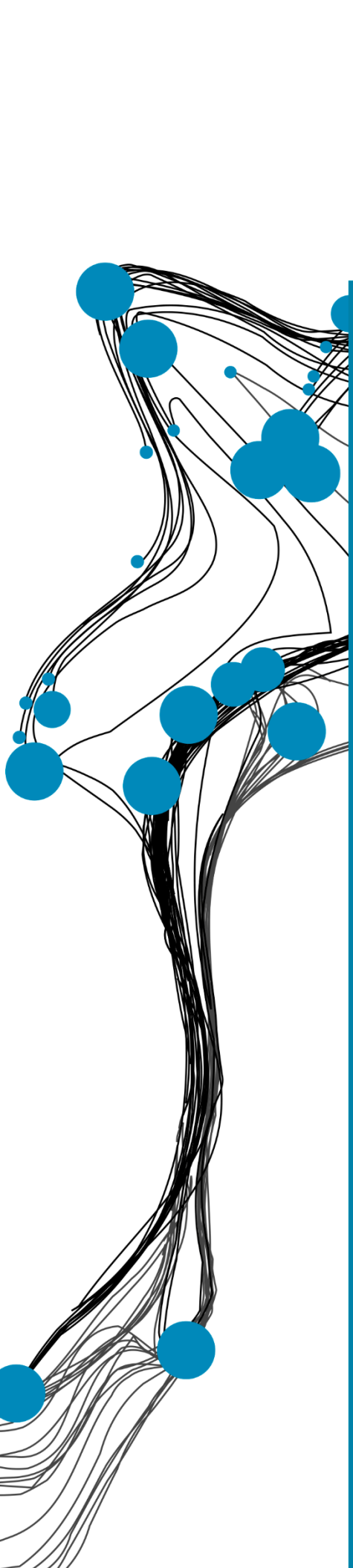

BACHELOR THESIS

# The needs of college students in regard to stress management- an evaluation of the Kenkou Stress Guide App: A qualitative study


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## Abstract

As several studies have shown that students are struggling with an increased pressure to perform, financial insecurity, less time available for leisure and therefore often a drop in their academic performance. This leads to an increase in mental issues and unhealthy compulsory behaviour. Based on these results, it is advised to focus on easily accessible, preventive measures to educate students and help them on their way of self-improvement. Therefore, this qualitative study in two rounds was conducted to evaluate the stress management application Kenkou and redesign a prototype which is taking the needs of the student, regarding design and usability into account. A sample of 20 participants, collected by convenient sampling and via the SONA system, answered questions concerning their stress level, stress management, their experience with mhealth applications and their expectations with regard to these. Afterwards, they explored the Kenkou application for the first time, getting to know the app and took their first stress measurement. Based on their expectations and previous researched literature, a prototype was created which was focussing on the personalization of the application. This implies that the prototype was posing questions about what is causing stress for the user and how the person normally copes with it. In addition, the answers shall help to adapt the exercises in the application (e.g. a sporty user will receive more physical focussed exercises, a user seeks journaling in order to cope or manage will receive new input for this way), the exercises now show how long it will take to fulfil them and the user is able to indicate how many minutes per day he is willing to invest in the application. Lastly, the user is also able to change the sex of the voice within the application. In the second session, the participants have been asked questions concerning the frequency of the usage and the quality of the usage. Afterwards, they explored the paper-based prototype and gave an evaluation for the design and usability. The opportunity for personalization resulted in positive feedback, just small adjustment concerning the navigation should be improved further. The participants have been more likely to recommend the adapted prototype compared to the original app. The results show that general design and its usability are suited for a broad variety of users, and it is more important to offer an option to personalize the application as this makes the user felt heard and understood. Keeping the decreasing mental well-being of students in mind, mhealth applications should be pursued by universities.

# 1 Introduction

Stress is an increasing issue among students. Several studies such as the one from Dopmeijer (2017) shows that nearly seven out of ten students suffer from presentation pressure. This leads to an increase in stress, anxiety, alcohol and drug abuse and burnout related symptoms. In addition, the increased stress leads to a decrease in academic performance and to an academic burnout (Lin & Huang, 2014).

The paper, published by researchers and students from the University of Twente investigated the mental well-being of all students throughout all departments. Their findings show that the perceived stress of students is high as well as their compulsory behaviour which includes drugs, alcohol and internet usage. Based on their results, the researchers stated that there is a high need for preventive methods in regard to student well-being, for example targeting preventive interventions which are teaching students how to cope with stress.

Stress is simply a bodily reaction to different stimuli and burdens. It aids to mobilize the body by an increased blood circulation to the brain and muscles. This serves to increase the attention of the individual. However, when the intensity and frequency of the stress exceeds a normal level and becomes permanent and outpaces the coping resources of the individual it can turn into a chronic burden, chronic stress. Chronic stress can have multidimensional negative impacts in regards to the physical, mental, cognitive and behavioural aspects of an individual. Common negative effects of chronic stress are: increased heart rate, changed behaviour patterns and memory problems. It is affecting the immune system, the sleeping behaviour and the cardiovascular system (American Psychological Asssociation, n.d.)

Stress and chronic stress can affect anyone, regardless of age, socioeconomic status (SES) or profession. The results of research from the Robert-Koch Institute that investigated stress and its influence and factors on the population in the age group of 18 to 64 years show that in all age groups women experience a higher, subjective encumbrance. In addition, individuals with a low SES and low social support system reported a higher subjective encumbrance compared to people with a higher SES and a bigger social support system (Hapke, 2015).

The World Health Organization (WHO) took a step further investigating the relationship between stress and diseases such as dementia or strokes and the relationship between stress and sleeping problems (WHO, 1998). Their results show that a high amount of stress increases the

risk for auto immune diseases, strokes and has a negative impact on the sleep and metal well-being of an individual. Whereas, studies show that stress in students does not just result in distress and a lower well-being but that stress in students often results in compulsory behaviour such as substance and alcohol abuse. The results of Kelders, Oberschmidt & Bohlmeijer (2019) show that 14.7 % of the participants can be identified as heavy drinkers and 33.2 % reported that they drink alcohol several times a week which is high compared to the Dutch population of 20.5 % (Monshouwer, Tuithof, & Van Dorsselaer, 2018). These findings are also supported by the findings of Dopmeijer (2017), who identified that 31.4 % of the males who are drinking can be classified as heavy drinkers and 24.4% of the females. Additionally, Kelders, Oberschmidt & Bohlmeijer (2019) also found that UT-Students used more cannabis, ecstasy and cocaine compared to over Dutch university students and compared to the general population. Lastly, the study also identified that half of their sample shows a problematic internet usage. The reasons for the perceived stress in students is manifold. To fulfil  the academic standard and all the related work load leads to a feeling of time pressure, which many students, especially those with a bad time management experience as stressful (Gall, 1988). In addition, seven out of ten students are stating that the pressure to achieve is tangible for them and 60% stated that the pressure to achieve increased (Dopmeijer, 2017). Lastly, the study of Hall (2010) also shows that full-time students are also getting more involved with part-time jobs as the financial support of the government is decreasing and a part of the student s is dependent on this financial aid.

When faced with stress, there are several techniques and ways of coping an individual can use to better cope with the stressor or to overcome it. This is called stress management.

In the paper from Folkmann & Lazarus (1988), two distinctive ways of coping with threatening life events/trauma or stress have been identified. The first one is based on emotion and its viewed from a Darwinian perspective. This way of coping focusses on the learned behaviours of an animal to overcome the threat by controlling the evoked emotions. This shall help to enable a person to think more clearly and to create the right mindset before working on a problem-based solution (Scott, 2019). Emotion-based coping techniques are for example: meditation, reframing or positive thinking. The second way of coping is cognitive based and includes cognitive processes such as denial, suppression or problem-solving behaviour which shall reduce the source of the stress. Both pathways see coping as a reaction to the evoked emotions and shall result in arousal of the individual of reduction of tension.

In addition, coping can be divided into two different approaches, namely avoidant and vigilant coping. Avoidant coping describes behaviour which aims at escaping the stressor through compulsive behaviours such as drinking, sleeping or smoking. Whereas, vigilant behaviour directs the attention and effort of the individual towards the prevention or control of the threat (Folkmann & Lazarus, 1988).

In addition to that, WHO also published an information sheet concerning stress management. Next to raise awareness about common symptoms the sheet also elaborates on preventions which increase the ability to cope with stress and to reduce the experience of stress. The mentioned strategies include a well-balanced diet, sufficient sleep, regular exercising and also meditation and mindfulness exercises are recommendations (WHO,1998). Keeping the above-elaborated definitions in mind, these strategies would be emotion-based coping strategies.

These can be found via several channels such as books, online guides but also on smartphones and tablets as a mobile health application.

Concerning the needs of students, one important factor can be identified by literature, as studies show that there is a growth in students involved in part-time employment which also results in a decrease in their involvement with their study and available leisure time (Hall, 2010). The study of Nonis & Hudson (2010) support the finding of a decrease of involvement as they found that time spends at work correlated negatively with the GPA of students and therefore, negatively affected their academic results. Additionally, Lin & Huang (2014) have shown that stressful life in college students can results in an academic burnout and in a decrease of academic performance. As the leisure time of students is decreasing, they are in need of a time efficient, preventive measure such as the mentioned applications.

Mobile health (mHealth) applications are applications running on mobile devices which are supporting individuals with health-related problems. This includes food trackers, mindfulness applications, meditation, fitness coaches or applications aimed at reducing stress. mHealth applications are a good tool for self-monitoring and self-improvement (Schnall et al., 2016)

As for an increasing amount of people, a life without their smartphones and the possibility to access the internet is not imaginable any more, mhealth applications are good way to engage people in their own improvement process.

In 2018, 96 percent of people of the age of 12 and older had access to the internet and about 86 percent used it daily (CBS, 2019).

Even though, the access to the internet is mostly used for social media, online banking or online shopping there is also an uprising trend in the Netherlands to use the internet to look up information concerning health. Compared to 2012, in 2018 67 percent of the Dutch population in the age group of 12 and up have been looking up information on health. This amount increased by more than 100 percent in these four years. Commonly researched topics have been information about nutrition, exercises or diseases (CBS, 2019). This also offers the assumption that an increasing amount of Dutch people are more reflection on lifestyle and health issues. As these topics are becoming more dominant in society, the need for accessible applications concerning these issues is increasing.

Mhealth applications have been proven to be an efficient and cost-efficient tool in order to reduce college-related stress symptoms in students (Harrer et al., 2018), but it is important that the apps are easy accessible. It was shown that users value if a mHealth application is easily accessible, guides through meditation exercises and offers personalization (Goodwin, Cummins, Behan, & O'Brien, 2016). In addition, they also emphasize the involvement of the end user in the design process such as the study of Schnall et al. (2016) does too by identifying the user-centred approach (UPA) as the most suited approach for designing a mHealth application.

So in order to design or evaluate an application which shall be tailored to the needs of a certain target group it is of high importance to involve this group in the design process.

The user centred design approach (UPA) is seen as one of the most useful approaches in designing. UPA involves the user in all design steps. This study specifically is evaluating the design of an application and redesigning it based on the provided feedback. Redesigning is a process aimed to make a plan to restructure an existing artefact in order to adapt it to fulfil purposes the original was not fulfilling. In this case, the redesign is aimed to restructure the artefact for a specific target group.

**Current study**

The current study is aimed at to evaluate whether the Kenkou Stress Guide application is fulfilling the needs of college students in regard to their needs, belief and thoughts and adjusting a prototype to better suit their needs. It is a qualitative study in two rounds focussed on the mentioned application and its redesign.

# 2 Methods

## 2.1 Participants and Design

This is a qualitative study based on interviews conducted with college students with different backgrounds considering their studies and current lifestyles as this provides a variety of input regarding personal needs. Therefore, semi-structured interviews will be conducted with participants from the target group. The data collection will be split in two sessions, the first revolving around the mentioned values, the first contact with the app and a brief evaluation of its usability. Afterwards, the participants will be asked to use the app for two weeks and meet again for the second session. In that, they will be asked to report about their usage of the application and later on will be presented with a paper-based prototype which includes modifications which are based on the theoretical framework as well as the results from the first session. Lastly, the participants will be asked to evaluate the usability of the prototype. A qualitative approach was chosen in order to gain a better insight into the needs, thoughts and beliefs (in this needs include everything which the end-users consider helpful with regard to a simplified and effective use) of a prospective end-users, namely college students, in regard to a mobile mental health application and to gain more knowledge about possible improvements for the Kenkou Stress Guide application. Face-to-face semi-structured interviews were considered the best approach as it is offering the possibility to engage with the participant (e.g. nudging in ambiguous situations) and gain a more honest and deeper understanding of the person needs. The interviews have been conducted during the period of November 2019 to December 2019.

The study consisted of a set of 20 participants and participants for this research were approached within the social circle of the researcher as this provided a wide range of possible participants and it was assumed that the existing relationship between participant and researcher would be favourable in regard to the sensitive topic. The approached individuals have all been within the target group of college students as this is inclusion criteria. Participants took place voluntary thus there was no reward. Due to the collaboration with another student, this paper will examine interviews from 20 participants. These participants have been collected via the SONA-system of the University of Twente. This system enables students from social sciences to upload their research in order to recruit participants. In return, all first-year students of bachelor

education in psychology are obligated to obtain 10 SONA points to be awarded their bachelor diploma at the end of their study. Students can earn .5 SONA points for approximately 30 minutes of work.

Due to the necessity of using the Kenkou Stress Guide app, individuals have been excluded if their mobiles have not been suited to use the application. A flashlight close to the back camera is necessary for the application to measure the HRV and stress resistance of the user and for future evaluation. Based on experience it became clear that it is easier to use the application if the mobile does not have three different cameras but one or two. In addition, the application is not compatible with all phones (e.g. Samsung Galaxy J) and individuals with phones which did not support the application were also excluded. To be sure that the participants would meet the inclusion criteria, a small survey was created with asked for their demographics and also which smartphone they were using and how many cameras it has. Based on these answers, one participant was excluded because she did not fit the target group and a second participant was excluded halfway his first session as it later became clear that this mobile was not suited fo the application.

## 2.2 Materials

### 2.2.1 Application

Kenkou Stress Guide. Kenkou is a mobile application, developed by a German team in 2014 and in their own words it is aiming to reduce the stress level of the user through using digital applications.

In the beginning, the app is determining three different values namely; the stress level of a person, the recovery ability and the energy status. The stress level of a person is dependent on heart rate variability (HRV) and stress resistance. The term HRV describes the fluctuation of the heartbeat over a certain time. These fluctuations may be small but they are an indicator of how well a person is able to handle stress. A high HRV shows that a person can handle stress well as the body is able to balance the rising heartbeat. In contrast, a small HRV can display stress or even illness (Kenkou GmbH, 2019). The recovery ability and energy status are accessed via the parasympathetic nervous system. A high value for this indicator shows that the body is able to cope well with stress and calm down faster compared to an individual with a low score. The last-

mentioned indicator, the energy status, is assessing whether the body is at rest or using reserves (Kenkou GmbH, 2019).
All the mentioned measurements are done by laying the fingertip of the index finger on the camera of the individuals' smartphone and the flashlight to illuminating the fingertip. With this method, the app is able to detect and analyse the bodily change based on the colour deviation in the blood vessels as blood is pumped through them. Based on the results, the application is offering a variety of exercises in order to gain a better insight into the current level of stress and stress management and to reduce the level of stress. Example of such exercises can be: breathing exercises, guided meditation or relaxation exercise.
The exercises are presented in a daily schedule, displaying multiple exercises as well as two stress measurement moments. This plan, however, is just available if the user paid for the application. Free of charge, is the stress measurement feature, which is assessing the HRV of a person.

### 2.2.2 Usability test

#### *2.2.2.1 First session*

In the first session the participants have been asked to sign up for the premium membership. But asked not to download the app or to take a look at it. In the progress of the interview the usability test took place, as participants have been asked to download the app and explore it as they wanted to reduce their stress while thinking aloud. The thinking aloud process was explained with a simple task (e.g. setting an alarm for a specific time). If not done while exploring, the participants have been asked to take their first stress measurement. The usability test stated that the researcher may only nudge if the participants falls silent for a longer time.

#### *2.2.2.2 Second session*

During the second session, the usability test was based on a paper prototype. Which was created with screenshots from the Kenkou stress guide app. The papers, on which the prototype was printed, have been sorted according to their appearance in the app, the modifications have been

made with the computer program “Paint”. The colour scheme of the adjustments has been adjusted to the general design of the application. They have been stacked and the participants have been asked to explore the prototype like it would be a real application in order to reduce their stress. The researcher just intervened with a nudge if the participant fell silent for a longer time.

### 2.2.3 Interview scheme

In the first session the interview scheme consisted of multiple parts. The questions were focussing on different main themes, namely the background of the participant also including previous experience with any sorts of stress management or specifically mHealth applications. The interview scheme is based on literature focussing on user-centred design in electrical mental health (Årsand & Demiris 2008, van Gemert-Pijnen, Peters & Ossebaard 2013).

Firstly, they filled out the ten-item perceived stress scale which also asked for their demographic information. Continuing with the interview scheme, the participants were asked some general questions concerning their current stress level and how they usually cope with stress. In addition, they were asked about their experience with mindfulness and mobile mental health applications and what their expectations concerning the Kenkou Stress Guide app are. Afterwards, they were asked to perform the usability test. The second half of the interview consisted of questions regarding outcome-expectancy and usability in regard of the used application. At the end, the participants have been given room to pose their own questions.

In the second session, the interview scheme started with questions regarding the usage frequency and a general evaluation of the current state of the application. After the usability test, the participants have been asked questions concerning outcome-expectancy /analyzed in a different study) and usability in regards of the prototype.

### 2.2.4 Prototype

The modifications have been focussing on the process of personalization. At the beginning of the application, the participants encountered a short questionnaire which was focussing on the origin of their stress and their specific coping style. The next modifications could have been found in the exercises, as the single parts received a timestamp which should serve as an indication of

how long a specific exercise will take. Additionally, the daily schedule received a more physical active approach by including a yoga session which was visually supported. This change is dependent on the answers of the participant in the beginning and can be elaborated in any direction. The last changes have been made in the setting section of the application, as a new sub-section was included which was named "personalization" and enabled the user to choose the sex of the voice over in the application and a button which allowed to set how much time the user is willing to spend each day on the application. This should reduce the number of exercises to the precise amount of available time. The precise changes can be seen in Appendix C.
The participants needed to navigate through the prototype as it would be a real application and give their opinion on the modifications. As the measurement feature of the application is an interactive feature, it was left out in the prototype.

## 2.3 Procedure

### 2.3.1 First session

Before the actual interview took place, the researcher sent the participants a link, provided by the developers of the application which enabled them to sign up for a free month of the premium version of the application. The participants have been asked to sign up via the link but not to make any contact with the application in advance, so they would have an unbiased first impression of the app.
The interviews took place in an enclosed and private room either on the campus of the University of Twente without any disturbances or distractions. On average the first interview session took from 42 - 52 minutes. This time frame also includes the time needed for the informed consent and the perceived stress scale. In the beginning the participants have been asked to sign an informed consent which stated that they agree on all requirements (e.g. audio recordings) and given the room to pose all questions and express any concerns. Afterwards, the participants have been asked to fill out the ten-item version of the Perceived Stress Scale (PSS).
The PSS is a widely used psychological measurement instrument to evaluate the perception of stress for an individual. The questions are aiming to indicate whether the participant faced uncontrollable, unpredictable or unbearable situations in the last months. A higher PSS is associated with a higher vulnerability to the above-mentioned situations and negative affects on

the individual itself such as depressive symptoms (Cohen & Mermelstein, 1994).
The participants have been asked all the questions mentioned in the interview scheme, whereby they have been given the room to elaborate and explain their point of view.
As the interview was designed in collaboration, therefore, the participants have also been asked questions focussing on self-efficacy and outcome efficacy however they will not be included in the analysis of this paper. After all questions were asked all participants were asked to open the application and navigate it under the supervision of the interviewer. In addition, they were asked to take their first measure. This procedure also included the thinking aloud method as this is the best approach to discover weaknesses and strengths of a product and receiving direct feedback from the user (Jasper 2007). Lastly, the participants were asked to use the application for the next two weeks. At the end, the participants have been given room to pose their own questions.

### 2.3.2 Second session

The interviews of the second session included which took place about two weeks after the initial interview investigated the experience the participants had with the application. Researcher and participant have met in an enclosed room on the campus of the University of Twente which ensured that the interview took place without any disturbances. The second session took between 17 – 28 minutes.
Firstly, the participants have been asked questions focussing on the frequency of use, usability, and the evaluation of the application. As a part of the interview, the participants also were shown a paper-based prototype of a modified application based on research and the answers of the initial interview.
The prototype was presented to the participants as they would have seen on screen, thus they merely have been able to see on screen, excluding a screen which allowed scrolling, then the participant was presented with multiple pages vertically arranged to simulate the scrolling. The researcher was controlling the prototype, as the participants needed to press on the presented buttons and then the researcher would switch to the next screen. This was done to ensure that the participants would not get lost in the prototype. After navigating through the prototype, the participants have been asked questions concerning outcome-expectancy and usability. They have been given room to express their feelings and concerns about the application itself but also about

the prototype and how further improvements could be implemented. Also, these interviews have been recorded and transcribed for further analysis.

### 2.4 Analysis

The transcriptions have been exchanged after the data collection have been finished.
A thematic analysis was conducted as this is a flexible and accessible approach to gain a deeper understanding of qualitative data (Braun & Clarke, 2006). The interviews were audio-recorded and transcribed with the help of AmberScript, which is an online service which is automatically transcribing audio files. The output of these transcripts have been read and re-read to finalize them.
Afterwards, the coding has been carried out with the software Atlas.ti 8. Whereby, only the extracts relevant for this research have been investigated, meaning the parts concerning outcome-efficacy has been neglected. The first interviews have been coded freely, identifying the main themes and combining them into the main codes. After adding a new code, a clear description was left in the code manager in order to assign the themes clearly throughout the whole analysis. This process was continued until the fourth interview of both researchers, so in total eight transcripts. The gained codes served as a template codebook which was checked by two independent volunteers before processing. Both have been asked to code two transcripts with the provided codebook. Afterwards, it checked if the codings of the volunteers and the researcher matched and to which degree. Especially, small statements from participants, positive as well as negative, which were hard to allocate to a specific group have been coded under the code: “App itself”. After a later meeting with the responsible supervisor, this code was revised and quotations have been allocated to other codes or have been dropped as irrelevant units. Irregularities and ambitious codes were identified and straightened out before applying the codebook on the remaining interviews. The coding has been continued till saturation was achieved.
After revising all codes, themes and categories, the final codebook contained three main themes with 15 categories. Only meaningful units have been coded, this means only the part which gave an answer to the question or contained valuable information has been coded. The units did not have a given length.
The post-measure interviews have been coded with the developed codebook, excepting the codes

developed for the first half of the interviews, concerning the needs and expectations of the participants.

## 3 Results

Table 1
*Themes coded in the first session*

| Themes | Categories | No. times coded |
|---|---|---|
| Background | Feeling of stress | 26 |
| | Cause of stress | 21 |
| | How stressful | 22 |
| | Avoid stress | 16 |
| | Usage of phone | 21 |
| Coping and expectations | Coping style | 27 |
| | Activities against stress | 31 |
| | Prior experience interventions | 3 |
| | Mindfulness | 9 |
| | Mobile health apps | 2 |
| | Expectations | 56 |
| Usage of the application | Design | 66 |
| | Usability | 59 |
| | Measurement | 27 |
| | Recommending | 15 |

Table 2

*Expanded codes from design and usability with included feedback*

| Code | Positive feedback | Negative feedback |
|---|---|---|
| Colour scheme | 3 | |
| Button arrangement/ Layout | 15 | 7 |
| Sex of speaker | 2 | |
| Speed of voice | 1 | 1 |
| Tone of voice | | 3 |
| Technical faults | 4 | 3 |

### 3.1 Background

Nineteen undergraduate students and one graduate student (11 F, 9 M, Mage = 21,95 SD = 1.82, range = 19 - 26 years) participated in this study. Eight of them have the German nationality, nine the Dutch, one has dual citizenship of the above mentioned and two had any other nationality. They had an average Mpss score of 16.65 which is slightly above average.(Cohen & Mermelstein, 1994).When they have been asked what causes stress for them, most participants have reported that time pressure and a big workload are stress for them. These themes can be intervened but also have been reported apart. Further, points of stress which have been mentioned are social conflict and self-indulged stress through a perfectionists personality.
For the participants, stress is manifesting manifold, from a simple feeling of discomfort to sleeping problems and a drop in appetite to the feeling of not being able to cope with the situation any more. Some also reported that their emotional state is suffering, and they are getting irritated faster. Some participants also reported physical discomfort such as "*Most of the time when I'm stressed I feel it in my stomach. I feel less hungry and my stomach feels bloated/irritated*" (P20). When the participants have been asked how stressful their life currently is, a majority reported that they are currently at a more relaxed phase of their life or just ended a

very stressful period "*Well I just finished my last exam today. This morning it was super stressful.*" (P17). Other found themselves in a very stressful period due to deadlines or important decisions which they need to make.

When they have been asked if they think that stress should be avoided the answers have been divided. Some participants stated that stress can be a motivational force which pushes yourself to more efficient state *"No, a small amount of stress can help push you forward and make you more productive"* (P10) and it also shows that you care about the outcome *"Not necessarily. Stress is also useful like it helps you decide on whether you should run or stay engaged"* (P15). On the other hand, participants stated that the simple occurrence of stress shows that the situation is too much for the individual and this should be avoided *"Yes in my perception stress is always bad in the sense that you're unable to cope or you're mentally not coping well with the issues at hand. So, ideally, you're never stressed. You can be a little bit worried or things can be busy but you don't have to be stressed in my perception"* (P13). Both sides however agreed that stress should not extend a certain level which is mostly reached with physical discomfort and mental limitations *"But sometimes I feel like it gets really unhealthy for me if I am constantly stressed and sometimes I wish I could just take a break."* (P2).

When they have been asked how often a day they are using their phone, the majority reported a high usage of their mobiles, ranging from *"Well I use it constantly. Like I have it in my hand, I check it all the time. Its really too much"* (P2) to at least once an hour. They stated that they mostly use it for communication purposes, work/organizing and entertainment: *"..mostly if I have an email or WhatsApp that I need to respond to.."* (P17), *"Mostly, in between activities for calendar for not being bored"* (P13).

## 3.2 First interview session

### 3.2.1 Coping and expectations

When they have been asked how they normally cope with stress in their life, they gave manifold answer. Some participants felt overwhelmed by the stress they are facing and fall in a state of procrastination in which they do not do anything *"I lay on the couch like I don't know where to start. I didn't know how to start working"* (P14) or they try to distract themselves with their phones *"If it's just too much then I normally spend a lot of time on my phone or the internet, just wasting time"* (P4) or social interactions with friends or housemates *"...talk with friends"* (P3).

Others seek physical exercise, for example: *"And in addition to that sports has always helped to blow some steam off, so Badminton in my case"* (P13) or *"I try to distract myself with something I enjoy doing. I like to do a sport or a workout helps yeah just push through it"* (P16) in order to reduce their stress or go for a walk to clear their head. Furthermore, it was also mentioned that they, depending on the stress factor, are seeking social support from their friends to reduce their stress *"I think I will talk to my friends about it because they experience some sort of same level"* (P14).

When asked about any prior experience with interventions against stress they often reported either no experience at all, in this case also concerning the mindfulness and mobile health applications, or they reported that they participated in small courses like a time management course *"I followed of course of time management here at the University during my study"* (P12), in a yoga/pilates class or mindfulness/meditation course *"Like I do yoga and I do meditate but not specifically to target stress. It's just a hobby and more a spiritual thing for me"* (P2), often provided by the University of Twente or their local gym. A prior used application which have been mentioned is Headspace which is a mindfulness app with guided meditation. One participant faced burnout and therefore had prior experience with therapy and interventions against stress.

At last, when asked what they would expect from a stress guide application, the answers of the participants often correlated with their mentioned cause of stress and their usual way of coping. An individual who is struggling with time management and a lot of workload mentioned that she is expecting a tool which would support her in planning her life and giving tips on how to improve her time management *"How to organize things in a way that it is not a lot of work"* (P3). A participant who has a diploma in physiotherapy was expecting physical exercises *"I would also expect maybe something active in the app that do this. Also some examples for stress relieving exercises or something like that that it's not only about tips like you know you have to breathe in and breathe out or something like that but like actively do something about the stress that you experience at that point"* (P12) and someone who seeks comfort in the support of their social system thought a personal guide might be part of the application.

In general, it can be said that the participants stated mostly that they expect that the application will help and teach them how to handle and reduce their stress. This should have been achieved with implementations such as a: step by step plan, tips and knowledge *"If there are tricks to*

*lower your stress level or how to recognize you are stressed that would be interesting"* (P13), certain tools such as a calendar and reminders *"I think like a to-do list or a calendar where I can enter my deadlines and stuff and get my notifications to get reminded, that a deadline is coming closer"* (P6).

### 3.2.2 Usage of the application

In the beginning of the application, participants have been confused by the necessity of providing personal information such as their weight and age "*I'm filling in my birthday. Gender. My other quite personal details"* (P13).While navigating through the application the participants recognized the colour scheme which is kept in several shades of light blue *"Well it's blue. I enjoy the colour blue"* (P16). They described this design choice as calming and also as simple *"I like the simplicity and the clear focus of the app"* (P11) and clean *"..plain and clean layout"* (P13). Afterwards, they saw the prominent stress measurement tool and then mostly directly started with this. At the start, the participants often had problems with the measurement as the instructions have been displayed just if the fingertip was placed correctly, by a slight mistake the measurement was disrupted. Therefore, some measurements needed several tries *"The measurement did not work, I don't know why. I don't think it works, because usually there should be red light from the flashlight"* (P3), *"..which is not working immediately"* (P13), especially if the mobile phone of the participants had multiple cameras which made the measure more difficult. Another point of concern was that some participants reported that their lung capacity was not big enough to breathe in the displayed rhythm and that this possibly led to a bodily reaction similar to stress (increased heart rate) *"So I don't have enough lung capacity left over breathing. I think so. It's like I'm trying to get the timing right which is probably stress."* (P15). Another participant also reported that laying her fingertip on the flashlight was hurting her and resulted in a tingling feeling. Afterwards, she did not felt safe enough to continue using any exercise or measurement which required her to lay her finger on the flashlight *"They said I did it wrong. I do it again, sorry. That hurts my finger with the light in it I don't know is that healthy if the light is shining through your bones, because it hurts my finger. I don't want to do this. I don't think it's healthy. I don't know, I got like stings in my finger all of a sudden, where that flash light was. I don't know, I don't want to do this, sorry."* (P2). While looking at their results, they reported confusion by the results either by contradicting results *"My pulse is really high it's 134,*

*I wonder if that's correct. Ah now it goes down. Well my pulse is really changing super fast it goes from 34 to 100 in a few seconds. Like I am really not sure if that measure is correct"* (P12) or by a lack of explanation on how the data was collected and how they have been analysed *"So it means your body does not have enough reserves left in a struggle like your legs. But actually I think this is a bit confusing I don't get it"* (P18). When nudged towards the little icon, containing the information to these, the participants read through the information. Afterwards, the reported that the information, on the one hand, have been helpful to understand the measurement, on the other hand, it was also stated that this amount of information was unnecessary and sometimes and it made the results for the participants even more confusing "*of the measurement I start to doubt how accurate a reading with the flash of my phone will be.* (P20) "*So it means your body does not have enough reserves left in a struggle like your legs. But actually I think this is a bit confusing I don't get.*(P18). After, the measurement the participants most often went to the guide section of the application which contained the exercises. Also, there the reactions have been divided. On the one hand, participants liked that there are several exercises which resemble a step by step plan, others felt overwhelmed by the number of tasks they need to full fill in one day "*Since this is like a step by step plan on how to get less stressful. Interesting.I have gotten all kinds of tasks here. So a lot of mindfulness steps and different exercises.*" (P16). Additionally, it was stated the week plans below, was hard to read as it was grey on white but that it also was demotivating as it became clear how long the process of the stress guide can take "*It's a lot of it it scares me. There are so many weeks out it's going to take 25 weeks."* (P15). Not every participant listened to the introduction audiotape on the first day, the participants who did also had divided opinions about it. Some said that the provided information was helpful and offered them new insights into the nature and consequences of stress "*Okay that was quite informative. I knew most of the beginning but I never thought about not being able to fight or flight resulting in staying in fight or flight mode*" (P11) and that the voice was nice to listen to as it was calming and soft "*Okay, so it's a nice voice, It's a man, that's cool, and he has a nice voice*" (P4). Contrastingly, other participants stated that the provided information is unnecessary in a situation where someone is suffering from stress-related symptoms and is looking for a solution "*Oh that's a bit boring. It's just so not on point like what does he talk about all the time. I don't have time to listen to that.*" (P2). They described it as too much at once, not relevant " *I feel like that information is nice, but kind of irrelevant for me if I am really stressed and I just want something*

*to reduce my stress, I don't want to hear about adrenaline and stuff.*" (P10) and also stated that the voice is too slow "*Too slow for me.*" (P15). In general, it can be said that the opinions regarding the voices in the applications have been manifold. Some participants reported that the voice sounds calming and soothing, others thought that the speed of speaking was too slow and irritated them and one participant also reported that the voice sounds too robotic and makes her feel uncomfortable "*I think it would be so much better to have like a real voice as I also said I would not trust this. A woman would be also nice*" (P18). It was also stated that it would be appreciated if it would be possible to choose between the sex of the speakers and to switch the spoken language to your mother tongue, in this case, German "*I think this is really this is like stressing me more than and relaxed me because it reminds me of a lecture or something. I will go to a practical exercise maybe that's nicer. I constantly have to study in English and I think it would also be good true to hear someone in your mother tongue like me in German.*" (P18). While further exploring the guide, a few participants recognized that there is no indication on how long an exercise will take. This was a point of concern for some participants as it was stated by this participant: "*Maybe I can't see at all how long the tasks take so that it feels like I don't know or should do them all in one go over how long it will take or because it sounds to me like this is something I'd like to do in the morning if just when I wake up just calm down relaxed. What if it takes too long?*" (P12). As the participants have been doing some exercises there have been several remarks, such as the design of the specific exercise is very plain and that pictures would make it more interesting to look on the phone and concentrate on the purpose. Furthermore, another participant stated that she feels uncomfortable listening to an audio-guided meditation and would prefer if it would be visually supported by an instruction video or having relaxing music in the background "*Yeah and maybe also seeing someone also sitting there meditating because it still feels a bit embarrassing if you have to start it*." (P18). On the other hand though, a participant also acknowledged the simple design, as it is not distracting the user from the intentional purpose of the application and increases focussing "*I had one issue with the screens weren't showing but the design is quite relaxing it's all in shades of blue and white. And yeah it's overall quite clear so nothing to get stressed about finding something specific or really shouting for attention is good. So yeah if as you mentioned if there are no videos that's always good so you don't have to look at the screen all the time.*" (P13). The majority of the participants chose not to do an exercise during the interview, the ones who chose to do have seen that the

exercises received a tick after they have been completed. But sometimes the application did not properly recognize a finished exercise which led to no tick and resulted in a frustrated participant who did the exercise several times to achieve the tick: " *If the exercise is not ticked in the end I will be angry… That does not end … End the breathing times are too long. My activity is missing again. Results, I already got them a minute ago, why does that repeat? So there is still no tick.*" (P1). Others have marked the already mentioned points concerning the design of the background and the voice. Some participants stopped the meditation or breathing exercises as they found the voice too slow. When it came to the general layout of the guide, participants have been wondering why they needed to do the stress measurement again even though they already have done so in the home menu. In addition, the stress measurement is mentioned twice in the guide and this fact resulted in more confusion and frustration as it was not clear to them why they needed to do this task multiple times a day "*What I don't get. You can just measure at any point of the day but you also have to measure in your day. So you have a stress management on day one. At the first place then you're doing those exercises and then you have a second measurement and in the whole menu you also have the measurement. And I don't know like. Well what about the measurement. What is this. Why do you have to do it all the time.*" (P12). After the participants have been finished exploring the guide, most of them stopped and said they are finished, some also looked at the settings and stated that the reminders are a great tool of the application "*The reminders. Because that's how you keep in contact with the situation; the stress*" (P12).

### 3.2.3 Evaluation of the usability and design

When asked about their opinion concerning the design and usability participants reported that they enjoyed the simple and plain design as nothing is distracting them from the actual purpose. It felt easy for them navigating through the application as its contains a limited amount of buttons which are also described clearly "*I like that you don't have an oversized menu so beneath you only have the four buttons. Yea today, measure, guides and settings and for the rest. Also the home menu... Is just clear. Just yeah. I don't know. There are no questions that I have and it's not too much.*" (P12). In addition, participants also pointed out that is positive that the menu is not too crowded, which increases the usability. On the other hand, one participant also pointed out that it was not clear to him what each button would to and it felt like an try and error trial for him

"*Yes, kind of. But not clear enough, because it was kind of try, and I was just trying around and I did not know beforehand what the specific things are, so I didn't really know about the functions, before clicking on the specific button."* (P10). However, one participant stated that it appears contradicting to him why the measurement received such a prominent place compared to the guide, as this is the tool which the user shall engage with "*I do not get why the guide and the measurement are not turned around, as the guide is the thing which shall help you.*" (P16). As already mentioned before, the calm colour scheme was pointed out as positive. When asked what they liked about the application, the participants summarized it and pointed out the already mentioned points such as, the plain and simple design, the easy navigation, the interesting way of measuring and the relaxing exercises. Then they have been able to indicate what they did not liked about the application and also there they repeated the already mentioned themes such as the mentioned negative aspects of the voices, that they feel that the measurement is unreliable and it physically hurts them. In addition, it was also mentioned that the occurred problems with the login procedure have been seen as a strong negative point "*Yea I didn't like that it didn't work so far. Um yea, so maybe that could be improved, that they find a better way to measure stress, maybe more with a questionnaire instead of just like the pulse, because that didn't work.*" (P8). Afterwards, participants stated what they have been missing within the application and this was often something they have been expecting in the beginning such as a calendar tool within the application, a bigger focus on physical exercises or to-do lists. Furthermore, one participant mentioned that he missed a general introduction to the application itself and felt thrown into the whole process "*As I said, I would have liked it if there was an introduction or if there was a welcome and just some information about what the app is meant for."* (P4). Additionally, another participant was missing actual tips and help after his measurement showed that he was stressed, he felt left alone in this situation. Other participants pointed out that they have been missing a form of personalization for example including the personal lifestyle of the user more into the exercises "*The option of personalization was missing for me. The felt too general and there are only a few options to make the app more efficient for my use.*"(P20).

Lastly, the participants answered whether they would recommend the application to others and the answers have been manifold. Some would recommend it to their friends if they know they are currently stressed but under the condition that this person enjoys mediation and breathing exercises "*If they would be into meditating. I think it's a nice tool that they actually measure*

*yourself. So then I would say is okay or at least that they should try it. If that works for them.*“ (P18), others did not felt inclined to make a statement at this point and others did not wanted to recommend the application as they did not felt like it is a useful tool “*Not necessarily, it has not helped me until now and seeing it for the first time has not blown my mind.* “(P20) or because the high price was not suited for their fellow students “*That the app costs a lot. I would not pay that much.*” (P7), “*Um no, because it costs money, and I could not see really what it offers.*” (P8).

## 3.3 Second interview session

### 3.3.1 Recap

In the beginning, the participants have been asked how frequently they used the application in the time between the first and second session. None of the ten participants used it on a regular basis, the majority stated that they tried it several times and some stated that they did not use it at all. When asked for the reasons, they stated that there has been no added value to their life by the application and that their life did not leave any room to use the application. One participant who used the application for about a day reported that he was not able to continue as the application stopped after the first day. Afterwards, he was shown how to continue to the next day.
Participants who have been using the application stated that they used in relaxed moments as for example: while laying on the couch or before going to bed. The exercises which have been used are the breathing exercises and meditations.

Table 3
*Expanded codes from design and usability with feedback used in the second session*

| Code | Positive feedback | Negative feedback |
|---|---|---|
| Colour scheme | 1 | |
| Button arrangement/ Layout | 6 | 4 |
| Sex of speaker | 4 | |
| Time estimation | 7 | 3 |
| Video in exercise | 3 | |

### 3.3.2 Prototype

When faced with the start interface of the prototype, the participants recognized that it contained the logo of an insurance company. The German participants recognized this and stated that it increased their trust in the application/prototype "*Insurance company supports this app it might be more serious or so*" (P10). To the participants with a different nationality it has been explained from which company this logo is.

In the beginning, the majority did not comment on the presented questionnaire which was part of the personalization process. However, when directly asked if they can imagine why this could have been included, eight out of ten figured that it must have been something to do with the above described reason. One participant directly figured that the question were aiming at personalizing the app and another participant have been not able to think about a reason why this questionnaire has been placed at the beginning of the application.

As the general layout did not change, navigation through the application went smoothly for everyone. When the participants reached the exercises, nine out of ten people have been positive towards the included time stamps next to the exercises "*Yeah it is a good beginning. Then it gets personal a bit of an issue. If you want to start slow and not invest too much in the beginning then you keep getting your goals every day. That's good*". (P9). One person stated that it is good to know how long the exercise will take but that it can also be contra-productive, as this shows the user how much time is needed and a longer time frame may lead to a decrease of motivation and therefore to a decrease in usage "*And maybe it's also sometimes it can be bad and you see the minutes beforehand because then you will not even start the program."* (P2). The implemented visual support in form of a video instead of audio-guided exercises resulted in mixed feelings from the participants. On the one hand, they appreciated a more lively approach "*Okay I was like what that would be nice.*" (P3) on the other hand it was pointed out that the visual support can also be distracting from the actual aim of the footage and that small animations may be better "*I think it's good. Maybe it's even more calm as you you know you use a stick figure too*" (P6). Also in regard to usability as it is easier to rewind those (e.g. yoga poses). After, they have taken a look at the different form of the exercises the researcher nudged them towards the settings of the application. The participants evaluated the implemented tool of the time adjustment as positive "*And then I think that's close nice. So you can adjust how many minutes you want to spend on the*

*app. So then I would probably go for three or something that goes if you would do all the exercise that it's probably up to 20 minutes and I would not like to spend that many minutes every day.*" (P5), as well as the possibility to choose the sex of the voice in the application "*That's also nice because some people just do not like one way so they could switch the male on"* (P5). However, some participants also stated that this adjustment is not a necessity for them. Even though, the feedback was positive, some participants recommended that this specific adjustment should rather be placed at the beginning of the application to enable the user to directly influence his experience *"I didn't like that personalization was some sort of hidden somewhere."* (P6).

### 3.3.3 Evaluation

A majority of the participants gave positive feedback about the adjustments. They reported that it feels good that the application seems to be more interested in the personality and the background of the user by asking the questions at the beginning. Furthermore, they appreciated the more personal approach which would have let them to interact better with the app. After the adjustments more participants reported that they will be likely to use the application now or recommend it to the people in their environment "*I think I would tell my friends about it. If they tell me that they are stressed and I then can. Tell them about a new app that is not only focused on meditation but also. Yeah this. Can be personalized.*" (P5). However, the price of the application is still a point of concern for all participants as 70 Euros for a whole year, if the membership is bought in the cheapest package, is too much for an application in their opinion. In addition, participants reported that they may use the app for several weeks or a month but then would not likely use it further as they got a general grasp of the provided exercises and then either do them for themselves or drop them. This also holds for a general evaluation of the usage of an application for stress management. Every participant saw advantages of using an app because an app is easy accessible, however, when asked if they would continue using the app after the study the majority stated that they are not interested in using it any more mainly for the above-mentioned cost factor but also because they reported that the application is not adding anything new to their life what they have been missing in books, online exercises, courses or therapy sessions.

The most striking comment made by a participant revolved around the personalization and that

he appreciated it as the application before was held so general that he did not felt inclined "*You know more to feel like oh hey this is made for me and this isn't just a step by step thing you can give it to literally anyone on the street and they'll get relaxed."* (P8).

## 4 Discussion

The results have shown that the students in the collected sample mostly are stressed due to a lot of workloads in combination with a lack of time management. They use avoidant as well as vigilant coping strategies, however, striking unhealthy compulsive behaviours (excessive drinking or drug usage) have not been reported. The participants did not have any experiences with a comparable application and mostly reported expectations which correlated with their own struggles. When faced with the application, the majority stated that they liked the simple and clean layout in combination with the calming colour scheme. Previous research has shown that colours with a short wavelength (e.g. blue) are having a soothing effect on individuals (Jacobs & Hustmyer, 1974). In addition, the research of Cyr & Larios (2010) showed that blue is the colour which elicits trust in a website, in Germans. As the sample of this research is cultural comparable to the sample of the above-mentioned research, it can be assumed that the blue colour scheme elicits trust within the participants and a different colour scheme, especially from a different wavelength would be evaluated as negative. Furthermore, the layout and button arrangement was designed easy enough so the participants had no trouble navigating through the application. However, a minority of participants experienced small issues navigating through the application, therefore, the user interface needs a better introduction or guidance. This observation appears to be in line with research from Maes (1995). Her paper illustrated that, due to the increasing amount of usage of computer-based tasks the interaction with the computers needs to change. Instead of a direct manipulation from the user who initiates all tasks, indirect management is preferred. Indirect management refers to the process in which the user and a computer agent interact with each other, communicate and perform tasks together. The computer agent is a self-learning AI with the purpose of smoothing the interaction of the user with the computer interface. It appears that navigation through the Kenkou application is still relying on direct manipulation and would benefit from a switch to a more indirect management approach. When it came to the guide part of the application, participants opinions have been divided often. Some

appreciated the manifold opportunities, whereas offers felt overwhelmed by the number of tasks. Just as the prototype offered the option to reduce the number of exercises by indicating the maximum amount of minutes per day, Hiltz & Turoff (1985) state that a computer system/communication system needs to offer a diversity of options for users to organize the information flow. This holds especially if the user is new to the system. Therefore, some form of regulation should be implemented within the application. The same divided opinions can be observed regarding the evaluation of the voice used in the application. It has been described as calming and nice, on the other hand also as too slow and robotic. The effects of the speaker's sex on individuals has been investigated before. The research of Newcombe & Arnkoff (1979) which was based on the findings of Lakoff (1975, as cited in Newcombe & Arnkoff, 1979) showed that a female voice, in general, was described as warmer and more polite compared to the male voices in the study. However, people still have their own preferences and even though several participants evaluated the option to switch the sex of the speaker as positive, the option should not be disabled by solely deciding on a female voice.

Nevertheless, the participants would not necessarily recommend the application. Their points of concerns have been that the price of the application is very high and that they have been missing the added value of the application, compared to e.g. mediation videos on the internet which can be accessed for free.

When it came to the interaction with the prototype the feedback provided by the participants has been positive concerning the implemented questionnaire, the time estimation in the exercises, the implemented video and the personalization option. In addition, they also stated that the increased the likelihood that they would continue using the application.

In conclusion, it can be said that the design and usability have been implemented in a way which enables a broad variety of users to interact with it. The application, therefore, met the needs of the target group with regard to design and usability. This can be seen in the positive feedback of the participants and the striking quote mentioned in the paragraph above. Therefore, it was not necessary to adapt these factors to the specific target group as the factor of personalization was of higher importance. The results show that the design should be adapted in a way the users feels heard and cared for. This means that mhealth applications, in general, should keep a simple and clean layout which is easily accessible through an understandable button arrangement, with a clear focus on the specific aim of the application such as losing weight, tracking your training

progress or improve your stress management. In accordance with the findings of Goodwin, Cummins, Behan, & O'Brien, 2016 the option of personalization is needed for the end-user to use the application to its full extent.

### 4.1 Strengths

One of the strengths of the study is the study design itself as the first session collected data on the users and feedback on the current state of the application. This was taken into account while creating the prototype and then requesting feedback on the prototype and the modifications. This is creating a loop in which the needs of the users are prioritized and supported by literature and research. In addition, the face-to-face interviews enabled the researcher to gain a deeper understanding of the needs and thoughts of the participants. Non-verbal cues and simple sounds such as a sigh also carry meaning and are not accessible in a survey.
Last but not least, the sample used in this study offered a broad variety of participants which provided a broad input for improvements regarding the user interface and how to improve the usability and the application in regard to design. The sample consisted of students from diverse study backgrounds and therefore they focussed on different aspects of the application such as the exercises, the design or the usability. This also offered a variety of recommendations helping to improve the application for the target group.

### 4.2 Limitations

One of the biggest limitations to this study and the assessment of improvement is the limitation regarding the hardware. Throughout the process of the thesis, it became obvious that multi-cameras are posing a threat to the mechanism of the measurement as the application requires the main camera to take the measurement with the flashlight close to it in order to illuminate the fingertip of the user. Multi-camera smartphones are using 2 or more cameras arranged in a vertical line (compare Honor P20 light) or in a triangle (compare Apple iPhone 11), therefore, there is no guarantee that the measurement will be correct. This feature was also identified by the participants as one of the most interesting. The paper written by Campos is evaluating the possibilities offered by HRV and is concluding that the measurement accuracy and reliability is posing questions and therefore, the results should be evaluated carefully. The proposed HRV score should be seen as a tool to create more awareness about the stress level of

an individual and can promote behavioural change in a few users. It is advised to not get scared if the HRV score is very high or low (Campos MD, 2019).
Furthermore, many participants have reported that measurements often yielded contradictory results, both with the results within a single measurement and between two measurements at a relatively short interval. In most cases, this led to misunderstandings and mistrust of the app.
In addition, it should also be taken into account if the recruitment of the participants itself has been flawed. A convenience sample can include the disadvantages of people participating for the sake of the researcher and less for the sake that the research is actually appealing to them. Furthermore, the participants recruited by the second researcher have been approached via the SONA system of the University of Twente. So participating in this study rewarded them with 2.0 points. Therefore, it should be accented that there is a possibility that the participants took place in the study solely to obtain the credits.
Lastly, it can be said that the used sample have been relatively small and is not representative as also the background, such as their PSS-score, of the participants was neglected in the inclusion and exclusion criteria. This should be taken into account while evaluating the results and thinking about further research.

### 4.3 Reflexivity

Reflecting on my own opinion with regard to the necessity of a mobile mental health application in order to reduce stress and to learn how to manage your personal and especially on the usability of the examined application it needs to be stated that the general atmosphere which has been aimed for was a neutral and non-judgemental environment. However, as the participants have been approached within the established social circle, there have been face-to-face encounters in which participants had the opportunity to experience that not everything went smooth. Therefore, it should be taken into account that the participants may have been negatively biased in regard to the functionality and usability of the app.
Furthermore, the signing up process was dysfunctional with multiple accounts and that could have also influenced the opinion of the participants.

### 4.4 Recommendations

The results showed that college students are open for a mobile mental health application as long as their needs are taken into account. It became clear that personalization in regard to their personal time management is appreciated. Simple modifications such as an indication of how much time an exercise is consuming was reported as a positive adjustment. This modification in combination with the possibility to indicate the amount of time willingly invested in the application increased the likelihood of using the application. In addition, participants gave positive feedback over the personalized modifications in regard to the exercises. Based on these results, further research should investigate whether these results can be replicated and if certain modifications are needed for the target group of college students. Furthermore, as the study of Kelders, Oberschmidt & Bohlmeijer (2019) shows there are differences in how women and men experience depression and as this research neglected the demographic background of the participants, it should be considered to implement these factors into further research to investigate if the implemented modifications will have a positive influence on the stress management and resilience.

At last, it could be considered to implement the results of this study into a further developed prototype, according to the IRF model, to investigate if the results will be stable throughout further research. However, the following prototypes should resemble a real application more (e.g. haptic feedback).

## 5 Conclusion

It can be concluded that, the Kenkou Stress Guide application in its current is not attractive for college students as it is not fulfilling their needs, it does not add a value and is currently too expensive for students.

However, due to the necessity of the implementation of a preventive measure in the field of higher education this sort of application should receive more attention from universities in general and specifically from the University of Twente. Further research and adjustments could lead to an application which is accessible for students, allowing them to improve their resilience and stress mindset.

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# Appendix

## A1 Interview schemes

### First session

To be filled out with pencil:

## PERCEIVED STRESS SCALE

**The questions in this scale ask you about your feelings and thoughts** during the last month. **In each case, you will be asked to indicate by circling *how often* you felt or thought a certain way.**

Nationality _____ Profession _____

Age _____ Gender (*Circle*): **M F** Other _____

| | **0 = Never** | **1 = Almost Never** | **2 = Sometimes** | **3 = Fairly Often** | **4 = Very Often** |
|---|---|---|---|---|---|
| 1. In the last month, how often have you been upset because of something that happened unexpectedly? | 0 | 1 | 2 | 3 | 4 |
| 2. In the last month, how often have you felt that you were unable to control the important things in your life? | 0 | 1 | 2 | 3 | 4 |
| 3. In the last month, how often have you felt nervous and "stressed"? | 0 | 1 | 2 | 3 | 4 |
| 4. In the last month, how often have you felt confident about your ability to handle your personal problems? | 0 | 1 | 2 | 3 | 4 |
| 5. In the last month, how often have you felt that things were going your way? | 0 | 1 | 2 | 3 | 4 |
| 6. In the last month, how often have you found that you could not cope with all the things that you had to do? | 0 | 1 | 2 | 3 | 4 |
| 7. In the last month, how often have you been able to control irritations in your life? | 0 | 1 | 2 | 3 | 4 |
| 8. In the last month, how often have you felt that you were on top of things? | 0 | 1 | 2 | 3 | 4 |
| 9. In the last month, how often have you been angered because of things that were outside of your control? | 0 | 1 | 2 | 3 | 4 |
| 10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them? | 0 | 1 | 2 | 3 | 4 |

Interview questions (audio recorded):

- How do you feel that you are stressed?
- How stressful is your life at the moment?
- What causes the stress?

Stress management:

- Do you think that stress should be avoided?
- What are you doing when you are stressed?
- Are there activities you tried out to reduce stress?
- Do you feel like they were helpful?

- What is your prior experience with interventions against stress?
- Do you have experience with meditation or mindfulness?

- Did you already had contact with eMental health?
- How often do you use your phone?
- What do you expect from a stress guide app?
- What would you like to learn from a stress guide app?
- Which functions do you expect ?
- Do you think an app can be effective to reduce stress? Why?

Thinking aloud scenario

Instructions:

Go to the app-store, search for the app, download it and imagine you would explore it, because you want to reduce stress.

While doing the task, speak out whatever comes to your mind. The participants should practice thinking-aloud while opening a random app of their choice (e.g. alarm clock) The researcher intervene only with a nudge when a participant stop talking. After you got familiar with the app, please take the first measure in the app, which will be your starting point for this research.

Outcome expectancies :

- 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?
- 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?

Usability

- What did you liked?
- What did you not liked?
- What has been missing?
- Was the procedure understandable?
- Would you recommend the app?
- Did you had any expectations regarding the app?
- Have your expectations been met?

**Second session**

Interview questions

Experience with 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

- 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 with prototype

"Explore the prototype like it was the actual app. While you do that, please speak out whatever comes to your mind."

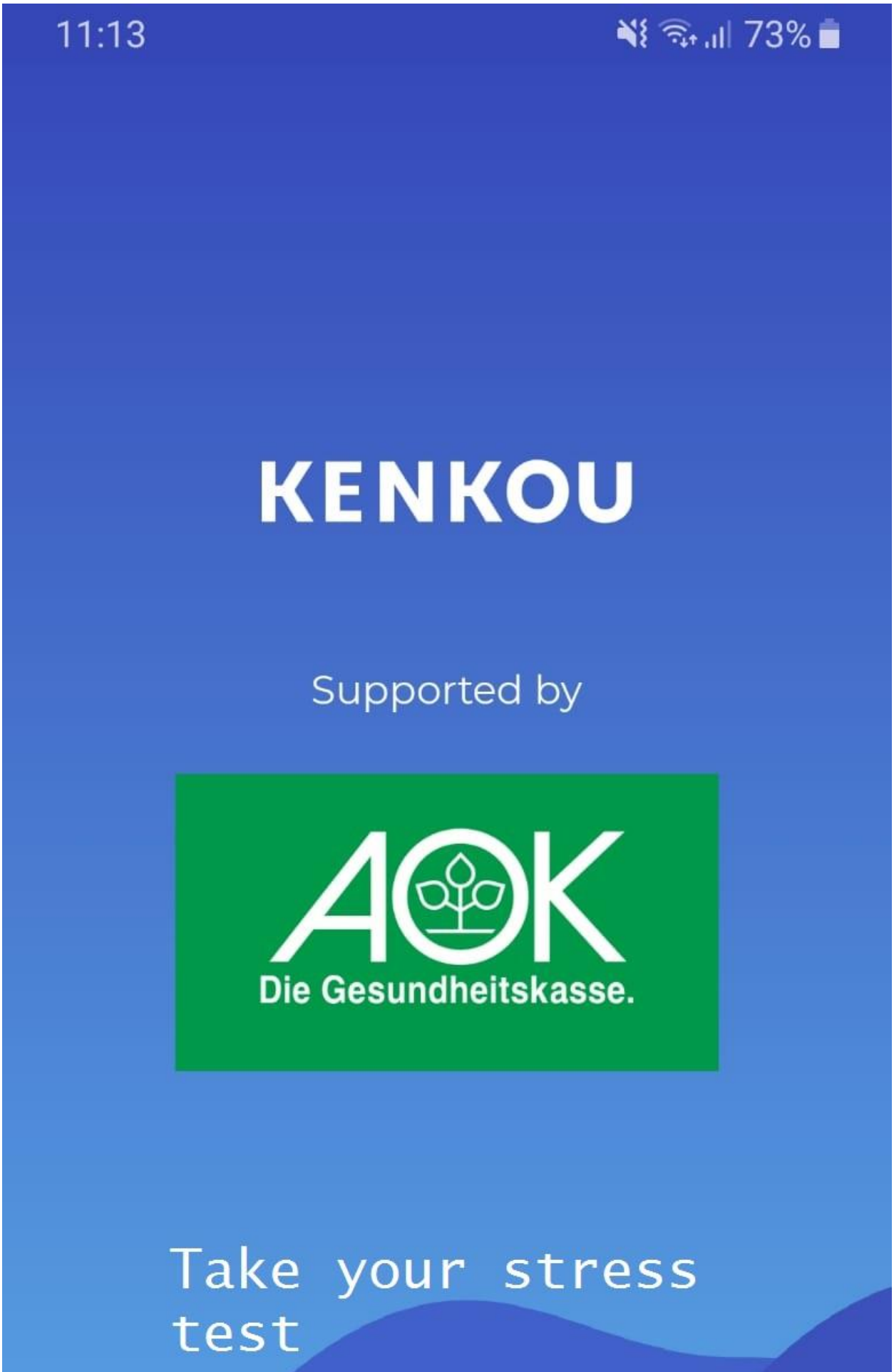
Post-measure

-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?
- Do you think the method of the prototype is effective to reduce stress? Why?
- Do you think the educative background information given in the prototype is effective to reduce stress? Why?
- Do you think the streak in the app is effective to reduce stress? Why?
- 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 done to increase your motivation to use the app if it was changed based on the prototype?

Usability

· What did you liked if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)?
· What did you not liked if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)?
· What has been missing if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)?
· Was the procedure understandable if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)?
· Would you recommend the app if it was changed based on the prototype? Why? (Explain with use of the prototype which features influence the beliefs)?

## A2 Prototype


11:13
73%
KENKOU
Supported by
AOK
Die Gesundheitskasse.
Take your stress test

What do you prefer to do when you are feeling stressed?

- Something relaxing (reading, taking a walk or write something)
- Something active
- Talking with someone
- Nothing

# Measure your Stress Level and Recovery Ability

Start measurement

Find out how to make a perfect

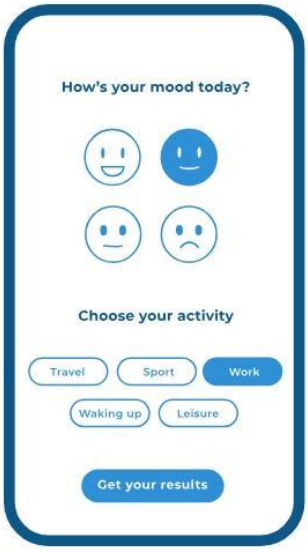
Sit comfortably and
**do not move**

Put your finger on the
**camera and flash**

Don't apply
**too much pressure**

## Select your activity & mood

After your measurement, you can select your activity & mood to get detailed results



# What causes the stress for you?

- Time pressure
- A lot of work
- Social related

Make sure your finger covers camera and flash

If it's not working, try another finger

Try to apply less pressure on camera and flash

Try not to move and sit

## You wonder how we can collect all this data using just your fingerprint?

The flash light makes your veins visible for the camera., so we are able to analyze your pulse waves. By finding the peaks of each pulse wave, we can determine your Heart Rate Variability (HRV). Your HRV is needed to calculate your stress

# Measurement result

## Stress Level

**Light tension**

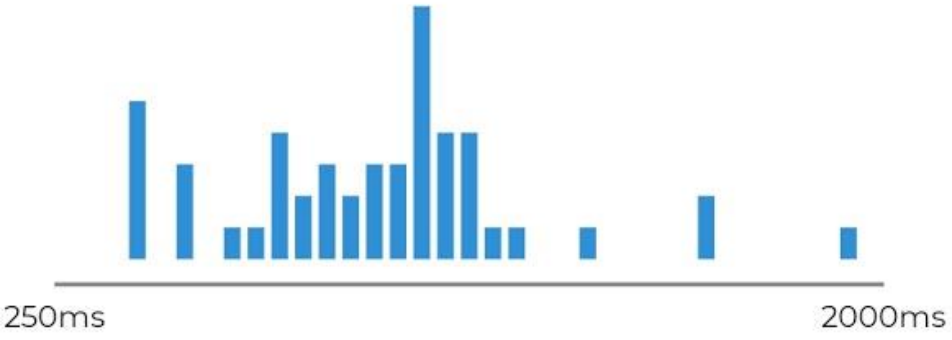

## Take a minute to relax, so that your body can regain some energy

This result shows whether there is currently tension in your body. The lower the values, the less stressed you are. The higher the values, the more stressed you are.

**The Stress Level shows whether there is currently tension in your body.**

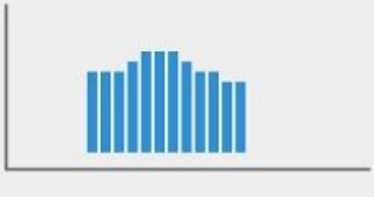
It is measured using an HRV* Diagram.

**Your HRV-Diagram***

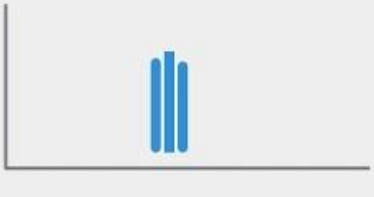



**Example**

Amount of different heartbeats



Many different beats =



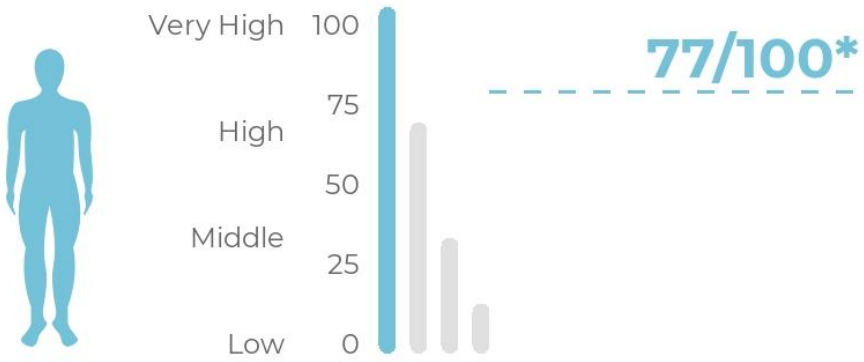
Less different beats =

tension in your body. The lower the values, the less stressed you are. The higher the values, the more stressed you are.

Science-based details

## Recovery Ability

**Very High**



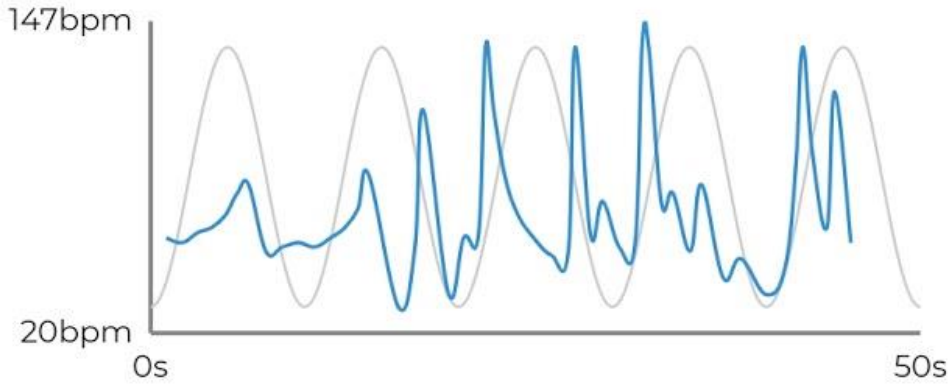

**Very good, your body has enough reserves and can settle down easily**

Your body needs power reserves in order to relax and recover. This index is related to your available reserves. The higher the value, the easier it is for you to calm down if

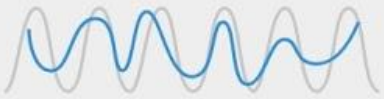
**The Recovery Ability indicates the ability to calm down, and switch from a stressed to a relaxed state.**

It is measured using an RSA* diagram.

## Your RSA Diagram




## Example



Very good recovery ability

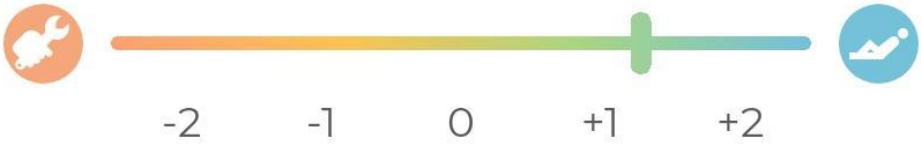
Recovery Ability is not very good

to relax and recover. This index is related to your available reserves. The higher the value, the easier it is for you to calm down if you are in a state of stress.

Science-based details

## Energy Status: High

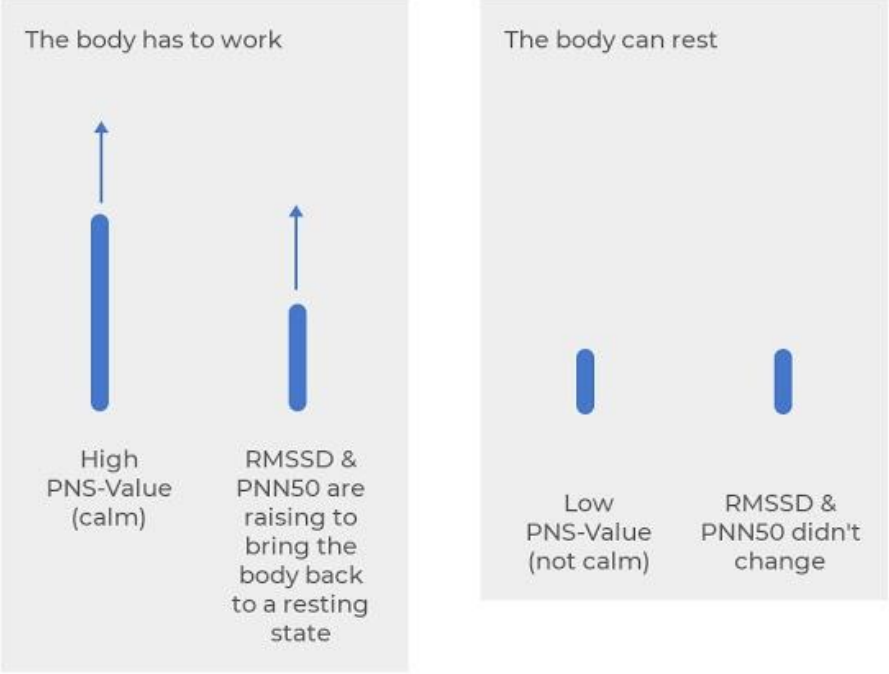
**Your body is currently gaining energy**




The Recovery Ability indicates the ability to calm down, and switch from a stressed to a relaxed state.

Science-based details

**The Energy Status indicates whether your body is currently in a phase of gaining new energy or using your available energy reserves.**




Fast changes in the heart rate are measured using the RMSSD* and PNN50** values. When both values are rising, the body is currently resting.

When both values are low, the body

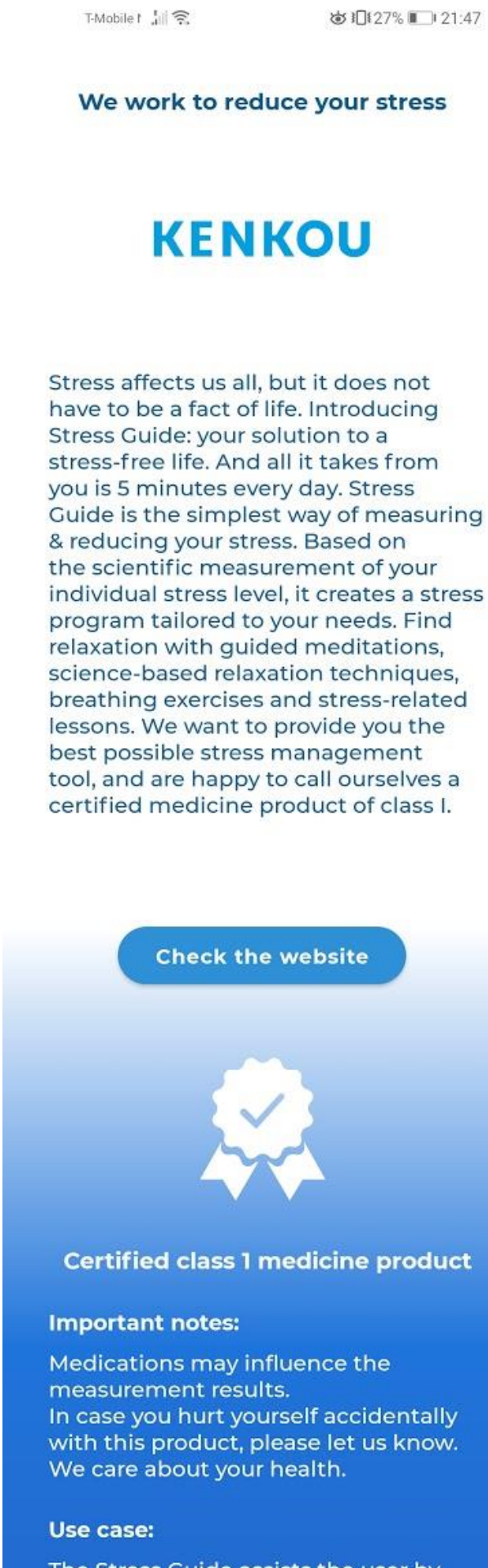
## Pulse: Medium




The pulse is a rhythmical throbbing of the blood propelled trough the veins.

## Mood: Bad

The mood helps us to relate your values with your current state of mind


T-Mobile
27%
21:47
We work to reduce your stress
KENKOU
Stress affects us all, but it does not have to be a fact of life. Introducing Stress Guide: your solution to a stress-free life. And all it takes from you is 5 minutes every day. Stress Guide is the simplest way of measuring & reducing your stress. Based on the scientific measurement of your individual stress level, it creates a stress program tailored to your needs. Find relaxation with guided meditations, science-based relaxation techniques, breathing exercises and stress-related lessons. We want to provide you the best possible stress management tool, and are happy to call ourselves a certified medicine product of class I.
Check the website
Certified class 1 medicine product
Important notes:
Medications may influence the measurement results.
In case you hurt yourself accidentally with this product, please let us know.
We care about your health.
Use case:

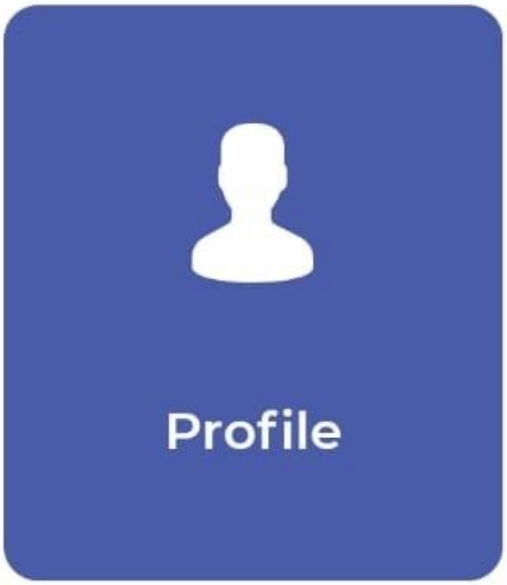
# Personalization

How much time do you have each day over?

1 min 

Do you prefer a male or female voice?

- ○ Male
- ○ Female





Stress Guide Premium

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# Week 27 - No stress mix

## Number 8

### Day 1

Next

- Relaxing Breathing Exercise
  Breathing
  2:00 min
- Stress measurement
  Measurement
- Lesson - Awareness and Goal Setting
  Meditation
  5:00 min
- Meditation - Breathing technique to stay present
  Meditation
  7:00 min

# Yoga

# Contact us

Our customer support will reply
to you via email shortly.