The association between the use of the app #SelfCare

and young women's mood over time

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Abstract

Introduction: Mental health problems are increasingly present nowadays, especially in the context of the Covid-19 pandemic. However, therapy options are limited and not accessible for everyone. Within the process of digitalization, new opportunities to prevent and treat mental health problems arose, among them mobile self-help interventions. Further, is mental health no longer defined as the mere absence of a mental disorder but includes positive wellbeing and positive emotions as substantial elements. #SelfCare is a positive psychological self-compassion app that aims to improve psychological well-being by means of relaxation, distraction, reappraisal and goal-setting. The aim is to investigate the effect of playing #SelfCare on positive and negative mood.

Methods: In a 7-day experience sampling study, female respondents (N = 132) between 18 and 31 years with mild to moderate DASS-scores were asked to rate eight feelings on a 7-point-likert scale five times a day. Their use of #SelfCare was tracked via the EARS tool. Linear Mixed Modelling was used to analyze its effect on levels of happiness, relaxation, energy, satisfaction, worry, irritation/anger, guilt/embarrassment and sadness.

Results: Generally, positive emotions were more present among the sample than negative emotions. Most emotions were not associated with playing #SelfCare, but two were found to be slightly, but significantly improved, namely happiness with a mean difference of 0.15 (*SE* = .06; *p* = .019) and relaxation with a mean difference of 0.19 (*SE* = .08; *p* = .011).

Discussion: Playing #SelfCare had no significant effect on most emotions but a small improving effect on happiness and relaxation among users. Since mood was not negatively impacted during the intervention, #SelfCare might have a preventive effect. Experience Sampling is a useful tool to explore fluctuations of emotions over time and is recommended for future research. Future longitudinal studies should investigate potential long-term effects and the dose-response association of app usage and mood improvement. Studies should include sample with higher scores on the DASS to test the effect of #SelfCare to improve negative mood.

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A majority of individuals who are burdened by mental health problems do not receive appropriate treatment. Mobile devices have been found to be a useful tool to overcome barriers such as lacking accessibility of treatment options, especially under the circumstances of the Covid-19 pandemic. Human mental health is strongly determined by mood: Negative emotions can lead to a mental illness in the long-term whereas positive ones strengthen resilience and buffer against mental illness. Research suggests beneficial effects of mindfulness and self-compassion on mood. The positive psychological app #SelfCare contains mini-games that are intended to improve resilience and psychological well-being of young people to prevent the development of a mental illness. The aim of this study is to test to what extent playing #SelfCare can increase positive mood and decrease negative mood.

Mood and Emotions

Mood and emotions are closely intertwined concepts that can even influence each other (Robbins & Judge, 2009). Whereas emotions are more intense and rather fleeting, mood is more general and long-lasting and consists of several emotions ranging from positive to negative (Grinde, 2012; Robbins & Judge, 2009). Although there are multiple theories on human emotions several researchers have agreed on happiness, surprise, fear, sadness, anger and disgust as essentially universal ones that all other emotions are subordinated to (Robbins & Judge, 2009). All emotions serve a function: From an evolutionary perspective, emotions such as disgust and fear are essential for survival (Grinde, 2012; Robbins & Judge, 2009), whereas jealousy ensures reproduction of own genes (Robbins & Judge, 2009). The function of positive emotions is somewhat more apparent: a favourable feeling (Robbins & Judge, 2009). According to the broaden-and-build theory by Barbara Frederickson, positive emotions generally broaden our attention, enhance problem-solving skills, and even help build up resources, which in turn lead to future positive emotions (Frederickson, 2001). This helps to improve resilience (Frederickson, 2001) which increases wellbeing and health (Jeste et al., 2015) and can buffer against psychological symptomology and the recurrence of a mental disorder (Chakhssi et al., 2018; Tanay et al., 2012). In the present research, not only the function of emotions is relevant to consider but especially their origin.

Mood is strongly dependent on external cues: Stressful daily events negatively affect mood while social activities are associated with an increase of positive mood (Robbins & Judge, 2009). Physical exercise was found to enhance positive mood and is even used for

therapeutical reasons to deal with depression (Robbins & Judge, 2009). Also, positive mood was found to increase towards the weekend and is highest at the mid of the day whereas negative mood is highest on Mondays but shows only little change over time of the day (Robbins & Judge, 2009). Lastly, less or poor sleep produces negative mood because decision-making and emotion-control are impaired (Robbins & Judge, 2009). External factors have a strong impact on mood but also person-dependent characteristics are substantial.

Events can be processed very differently depending on one's personality traits: People high in extraversion tend to show a stronger increase in positive mood after positive events than people who are introverted (Robbins & Judge, 2009). Low emotional stability, also called neuroticism, is associated with a stronger increase of negative mood after a negative event (Robbins & Judge, 2009). Further, so-called *affect intensity* determines how intensely positive and negative emotions are experienced by a person, suggesting that one person can be mildly amused while another person laughs uncontrollably about the same situation or content (Robbins & Judge, 2009). Besides personality, biological factors can produce tendencies for certain moods: The limbic system in the brain is responsible for interpreting events and thus, the emergence of related emotions (Robbins & Judge, 2009). A more active limbic system causes a more negative interpretation of events and a predominance of negative emotions over positive ones (Robbins & Judge, 2009). Since women tend to have a more active limbic system than men, they are on average more susceptible to depression (National Institute of Mental Health, 2019; Robbins & Judge, 2009; WHO, 2021).

A sustained negative change in mood can indicate a depression (WHO, 2001), which is one of the most common mental disorders worldwide and a significant contributor to the overall global burden of disease (WHO, 2021). It is typically accompanied by hopelessness, guilt, irritability, worthlessness, and fatigue (American Psychiatric Association, 2013; WHO, 2001; Zender & Olshansky, 2009). The American Psychiatric Association reports that around one in six people will experience depression at some point in their life (APA, 2020) and lifetime prevalence were found to vary between 9 and 30% (Rohde et al., 2012). According to the World Health Organization, more than 264 million people worldwide currently suffer from depression (WHO, 2021) and the total number generally tends to increase (WHO, 2017). In order to understand this development, causes of depression need to be investigated.

A large amount of research has been conducted to identify the risk factors that facilitate the development of psychological disorders. Internal factors such as self-criticism and self-blame (Zhang et al., 2017), as well as a maladaptive emotion management like rumination, suppression and avoidance were found to be associated with depressive

symptoms (Aldao et al., 2010; Diedrich et al., 2014; Howland et al., 2016). Worrying and rumination are especially strongly related to depressive mood and are counterproductive in dealing with depression since they do not lead to active problem solving (Nolen-Hoeksema et al., 2008) but maintain negative mood states and distress and lead to the loss of social support (Nolen-Hoeksema & Morrow, 1993; Nolen-Hoeksema et al., 2008). Rumination is correlated with self-criticism, pessimism and hopelessness (Nolen-Hoeksema et al., 2008). Hopelessness displays a great obstacle to problem-solving since no positive outcome is expected from the beginning on, and, consequently, the lack of positive experiences initiates a vicious circle of further negative mood and rumination (Wichers, 2013). Nevertheless, not only internal, but also external factors can facilitate the development of mental health problems.

Situational conditions such as social change, stressful work, discrimination, exclusion and an unhealthy lifestyle can increase vulnerability to mental health problems (WHO, 2018). Especially under the current Covid-19 regulations, mental health issues increased among the population: being in quarantine was associated with depressive symptoms (Brooks et al., 2020) and lockdown was related to high stress symptoms (Mucci et al., 2020). In this regard, people of young age were found to be more burdened than others. The current Covid-19 regulations impacted the whole world but especially young people aged 18-30 years felt severely uncertain and were most at risk for psychological distress, depression and anxiety due to Anti-Covid measures (Glowacz & Schmits, 2020). Missing social contacts due to social distancing regulations could not be compensated by digital communication (Glowacz & Schmits, 2020) and uncertainty about the future and educational perspectives increased during the pandemic (Glowacz & Schmits, 2020). Even besides the Covid pandemic, young age was found to be a substantial risk factor for mental health problems.

Emerging Adulthood, referring to the age between 18 and 25 years, was found to be a critical period in experiencing mental distress or disorders (Arnett, 2007; Galambos et al., 2006; Howland et al. 2016). Some interpretations suggest that mental health problems arising during emerging adulthood can be associated with a less structured daily life and the frustration related to the entry to labor market (Arnett, 2007). Although a mental disorder can occur at any time across life, the first onset is often already in adolescence or young adulthood (Christie et al., 1988; Twenge et al., 2019; Wittchen et al., 1998). Depression prevalence among US-American adults is highest between 18 and 25 years (National Institute of Mental Health, 2019). Three quarters of lifetime cases first emerged by the age of 24 (Kessler, 2005). Depression can lead to strong impairments at work, in school or in the family (Brody et al., 2018; Twenge et al., 2019; WHO, 2021) and can even lead to suicide in the worst case

(WHO, 2021). This emphasizes the need for prevention measures especially for young adults. There are several options for improving mental health: some focus on decreasing symptoms of mental disorders and others intend to improve positive mental wellbeing.

Prevention and Treatment of Mental Health Problems

The most well-known way of dealing with mental health is cognitive behavioural therapy (CBT). The basic principle behind CBT is that emotions and behaviours are mostly influenced by cognitions (Kennerley et al., 2017). Dysfunctional, automatic or negative thoughts about events or oneself can facilitate or maintain mental problems (Brewin, 2006; Kennerley et al., 2017). Cognitive therapy teaches the client to challenge negative thoughts instead of accepting the thought as the truth, and by this tackle maladaptive emotion management like avoidance (Nolen-Hoeksema et al., 2008). However, the view on mental health as the mere absence of a mental disorder has shifted.

The adapted definition of being mentally healthy also includes the presence of physical, social and mental wellbeing (WHO, 2018; Westerhof & Keyes, 2010). The two continua model proposes wellbeing and mental health as two related, but distinct dimensions which can allow a human to flourish when combined (Keyes, 2007; Seligman & Csikszentmihalyi, 2000; Westerhof & Keyes, 2010). Positive Psychology, also called the *study of human flourishing*, deals with positive qualities, strengths, hope, wellbeing and happiness (Bannink, 2012; Seligman & Csikszentmihalyi, 2000) as well as life satisfaction and self-realization (Westerhof & Keyes, 2010). Given the favorable effects of positive mood, the aim is to promote positive mental wellbeing, to improve quality of life (Seligman & Csikszentmihalyi, 2000) and to build up resilience, resources and problem-solving skills (Frederickson, 2001). Typical exercises deal with (self-) compassion, relaxation, mindfulness and kindness (Bannink, 2012). Positive psychological approaches are becoming increasingly popular (Gable & Haidt, 2016) however, dissemination might be challenging since there are some fundamental barriers to providing options for improvement of mental health for all.

The majority of people (estimated 60-85%; National Institute of Mental Health 2019; WHO, 2021) with depression do not receive appropriate treatment (Kazdin, 2018). The difference between people with mental disorders and those who receive treatment is called treatment gap (Kazdin, 2018). A shortage of therapists causes long waiting times of up to 6-12 months (Lovell & Richards, 2000). An appointment duration of 45-60 minutes and office hours between 9 a.m. and 5 p.m. minimize possibilities for the majority of people to receive therapy (Lovell & Richards, 2000). Furthermore, a considerable number of people perceive

barriers like stigma (Mak et al., 2018), shame, linguistic barriers and inconvenience (Harris & Birnbaum, 2014) and thus, often do not seek help. People with mild complaints are often not even referred to a therapist by their GP because of a lack of problem severity, although they would benefit from therapeutic guidance (Lovell & Richards, 2000). Yet, especially in times of the Covid-pandemic, when face-to-face therapy is not possible, the need to make more flexible options to seek help available for everyone is even more present. Digital tools present a useful possibility to overcome these issues, providing options for both treatment and the prevention of the development and aggravation of symptoms, accessible for everyone.

Within the process of digitalization, mobile devices have increasingly been used for prevention and treatment (e.g., mobile therapy) and research purposes (e.g., tracking activities) in psychology (Morris & Aguilera, 2012). Countless applications for mobile devices, so-called *E-mental health,* are already available to enhance mental health or to aid in stress management, smoking cessation or sleep (Morris, & Aguilera, 2012). They display a convenient and accessible mental health tool (Harris & Birnbaum, 2014; Lal & Adair, 2014), overcoming barriers such as number and costs of therapists needed (Waller & Gilbody, 2009), stigma and physical distance (Harris & Birnbaum, 2014), reducing the treatment gap (Kazdin, 2018; Linardon, 2020). A growing body of research provides evidence for beneficial effects of digital mental health tools: Mobile self-help interventions related to CBT have been found to decrease the severity of symptoms of depression and stress (Mak et al., 2018). Specifically, mindfulness and self-compassion training show positive effects on well-being (Ciarrochi et al., 2011; Huppert & Johnson, 2010; Mak et al., 2018). Mindfulness interventions were also found to decrease anxiety (Orosa-Duarte et al., 2021), depression (Tanay et al., 2012) and increase self-compassion (Al-Refae et al., 2021; Orosa-Duarte et al., 2021). Self-help wellbeing interventions significantly decrease negative affect and depression and increase positive affect (Coote & MacLeod, 2012). Gamification and personalization reinforced the effectiveness of such interventions (Mak et al., 2018). Particularly younger generations, who grew up using mobile devices, might benefit from this possibility since the majority has access to a mobile phone (Donovan et al., 2016). A digital prevention tool that includes mechanisms that both improve positive mood and decrease negative mood might help to increase wellbeing and in the long-term prevent depressive symptoms from fully emerging.

#SelfCare

By making use of the digital development in this modern world, principles of cognitive therapy and positive psychology are embedded in the mobile self-help app

#SelfCare. Four evidence-based emotion regulation strategies, namely relaxation, distraction, reappraisal and goal-setting are incorporated in multiple mini-games of the app to enhance positive mood and to prevent the increase of negative mood. The mechanism relaxation is employed to reduce dysfunctional responses to stress and to regain control over one's thoughts. Research showed that relaxation improves mood and reduces feelings of stress (Jain et al., 2007). Distraction and goal-setting aid in breaking through the vicious cycle of rumination and hopelessness in #SelfCare. Both mechanisms were found to significantly decrease depressive mood (Coote & MacLeod, 2012; Nolen-Hoeksema & Morrow, 1993) and goal-setting also increases wellbeing (Coote & MacLeod, 2012). A productive and goal-oriented coping style buffers against depressive symptoms (Breton et al., 2015). The emotional regulation strategy reappraisal reduces hopelessness and the impact of negative experiences. It was found to help solving emotional problems and is an important factor for positive emotions (Liu et al., 2020). To buffer against the influence of self-criticism, the app is generally oriented towards calmness and self-compassion. The latter was found to protect against depressive symptoms (Diedrich et al., 2014; Körner et al., 2015; Zhang et al., 2017) by decreasing the impact of self-criticism (Zhang et al., 2017). Self-esteem was also found to be an important factor for positive mental health (Zhang et al., 2017). Table 1 displays all mechanisms and their respective psychological target.

Table 1

The Psychological Mechanisms of Change onto Game Mechanics in #SelfCare

Evidence-based mechanism of change	Game mechanic #SelfCare	Psychological target
Relaxation	Breathing exercise	Dysfunctional physical response to stress
Distraction	Massage circle, crystal memory game, cleaning up laundry game	Rumination, negative memory bias
Reappraisal	journal, word-completion puzzle	Hopelessness, negative memory biases
Goal-setting	journal, candle prompt	Hopelessness, rumination

Experience Sampling and Hypotheses

Previous studies on mindfulness and self-compassion interventions reported consistently positive effects. However, findings emerged from cross-sectional- or pre- and post-test design studies, which cannot reflect immediate changes in mood right after using the intervention tool. Also, these methods provide no information on the causality or the direction of an effect but only a correlation (Conner & Lehman, 2012). Furthermore, they are prone to retrieval difficulties (Barrett & Barrett, 2001) and memory bias due to the great time gap between the measurement and the actual experience (Conner & Lehman, 2012; Verhagen et al., 2017) Some of the barriers are attempted to be overcome by applying the Experience Sampling Method (ESM) in the present study, which entails that multiple daily measurements over several days were prompted (Conner & Lehman, 2012). This method is well suited for this study since it allows to study momentary thoughts, feelings and behaviours in the daily life of the participants and its development over time (Barrett & Barrett, 2001; Conner & Lehman, 2012; Csikszentmihalyi & Larson, 2014; Trull & Ebner-Priemer, 2009). Assessments of mood take place almost in real time (Trull & Ebner-Priemer, 2009; Verhagen et al., 2017, p. 86) and thus, produce more valid data and a more accurate representation of the experience (Trull & Ebner-Priemer, 2009; Van Berkel et al., 2018). Instead of measuring mood once before and after a week of playing #SelfCare, the immediate changes of positive and negative mood after playing #SelfCare were assessed. This allows to apprehend how mood changes over the course of the intervention in relation to the use of #SelfCare in this study.

The aim of this study is to test whether #SelfCare might be a potential tool for improving mood and preventing psychological problems among young adults during a lockdown. The research question is as follows: *To what extent are positive and negative emotions influenced by playing #SelfCare in young women over time?* But, instead of measuring positive and negative affect as whole constructs, specific emotions were assessed in order to gather more detailed information on which emotions are affected in particular by playing #SelfCare. It will be examined to what extent the emotions happiness, relaxed, energized, satisfied, worried, irritated/angry, guilty/embarrassed and sad develop contingent on the participants' engagement with #SelfCare. It was decided to include both high-arousal emotions: happy, energized, worried and irritated/angry, as well as low-arousal emotions: relaxed, satisfied, guilty/embarrassed and sad (Jones et al., 2018). It will also be explored how these effects develop over the course of the intervention. Based on previous research, the hypothesis is that playing #SelfCare will help decrease negative mood and that it will produce

more positive mood. Hence, it is expected that scores on the negative emotions are lower and scores on the positive emotions are higher when the participants played #SelfCare before the mood measurement compared to when they did not.

Methods

Participants

For ESM-studies, it is common to have a smaller sample size than for other types of studies due to multiple measurements (Conner & Lehman, 2012). Yet, this study is part of a larger research project which collected different types of data and hence, aimed at a larger sample. The sample size was set at 125 participants based on a Monte Carlo simulation study including a power of 0.8, alpha of 0.05, and a medium effect size of $r = 0.3$ (Versluis et al., 2016) conducted in MPlus (Muthén & Muthén, 2002). Participants were recruited through the Radboud University study participation system (SONA) and social media based on four inclusion criteria: 1) only participants who are female, identify with the female gender or as gender variant/non-conforming were approached to participate in this study based on the feminine aesthetics of #SelfCare and based on scientific evidence that depression is more common among females (National Institute of Mental Health, 2019; WHO, 2021); 2) participants had to be aged between 18-30 years due to their susceptibility to mental disorders (Glowacz & Schmits, 2020; National Institute of Mental Health, 2019); 3) due to technical reasons, the participants needed to be Android users; 4) only participants with "mild" to "moderate" scores on the Depression Anxiety and Stress Scale (DASS) were included to represent a slightly burdened sample. The DASS-scores of the sample are displayed in table 2.

In total, 139 participants started to participate in the study, of whom seven participants were excluded from the dataset. One participant was excluded because it turned out that he was a male and therefore did not fulfil the inclusion criteria. Another participant dropped out after the pre-test for an unknown reason and one participant dropped out as she did not have an Android device. Two participants had technical problems installing EARS and one did not complete the EMA-assessments for an unknown reason. Lastly, the timepoints of app-use of one participant were not processed correctly due to technical difficulties and were missing. As a consequence, the measurements could not be assigned to the according EMA-timeframe for analyses and the participant was not included in the analyses. The mean number of EMA-assessments completed was 22, ranging from 2 to 48. Some participants completed the measurements for longer than 7 days which caused a wider range than 35 measurement points.

The final sample consisted of 132 participants aged between 18 and 31 years with a mean age of 21 years. All of them were either female, identified with the female gender or a non-conforming or gender-invariant. The majority of participants were students (90.2%). More than half (59.8%) were born in the Netherlands and 73.5% currently live there. Table 2 displays all demographic characteristics.

Table 2

Participant Demographics (n=132)

Category	Subcategory	Frequency (*n*)	%	*Mean*	*Standard deviation*
Gender	Female	130	98.5		
	Gender variant/non-conforming	2	1.5		
Age				21.14	3.26
Country of birth	Netherlands	79	59.8		
	Germany	24	18.2		
	Other, European	20	15.2		
	Other, non-European	9	6.8		
Country of residence	Netherlands	97	73.5		
	Germany	20	15.2		
	Other, European	14	10.6		
	Other, non-European	1	.8		
Occupation	Student	119	90.2		
	Working in the private sector	4	3.0		
	Government employee	1	0.8		
	Self employed	1	0.8		
	Unemployed	5	3.8		
	Other	2	1.5		
DASS-scores	Depression			6.23	3.88
	Anxiety			4.61	3.70
	Stress			8.96	4.07

Procedure and Design

The study design and procedure were approved by the Ethics committee of the Faculty of Social Sciences of the Radboud University (ECSW-2019-162). Participants were screened for eligibility via online screening. If they fulfilled the inclusion criteria, an invitation e-mail including an information letter (Appendix A) was sent. If participants still wanted to participate after being fully informed, they received a link to an online informed consent form (Appendix B) and to the pre-test questionnaire. In the present study, only the information on the demographics and the DASS were used from the pre-test questionnaire (Appendix C1). Afterwards the participants received instructions to install #SelfCare and the EARS application on their android phone for the collection of the data. After that, the 7-day intervention phase collecting the ESM data regarding mood started. In this week, the participants were asked to answer nine questions about their mood five times throughout the day (Appendix C2). In addition, they were reminded to play #SelfCare twice a day. After the 7-day intervention phase, participants were asked to fill out the post-test questionnaire. These data were not used in the current study. Afterwards the participants received instructions to deinstall the EARS tool and #SelfCare. Finally, three months later, participants received a follow-up questionnaire, which was also not included in the current study. The full study design can be found in Figure 1.

Figure 1

Schematic Overview of the Study Design
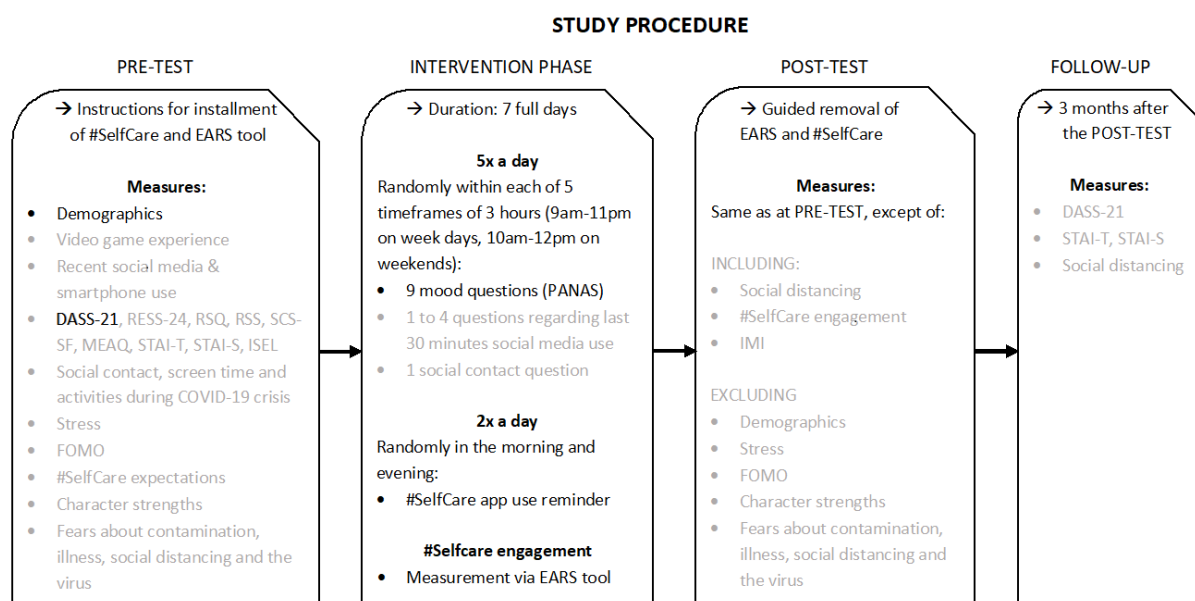
Note. Measures in grey font color were not used in this study but were collected as part of a larger research project.

Materials and Measurements

A correlational study design with two variables was employed in this study. The first variable is "Use_selfcare" with two levels (1, 0), whereof "1" is coded if the participant played #SelfCare in the time since the past mood assessment until the present assessment, respectively. The second variable is "Mood", which contains eight scales named by the respective emotions ("happy", "relaxed", "energized", "satisfied", "worried", "irritated/angry", "guilty/ embarrassed" and "sad") with seven levels each (1 = Not at all, 7 = Extremely).

#SelfCare

The smartphone app #SelfCare (TRU LUV Media Inc., 2020) is a mobile self-help intervention which contains of 14 mini-games that are associated with the mechanisms of change. Figure 2 shows some screenshots of the game. The body in the bed represents that the player is taking a break now. The aim of playing #SelfCare is to rest and to take care of oneself. By clicking on the items that are placed in the room, the respective mini-game is started. For example, the flower on the left table starts a breathing exercise involving the mechanism relaxation. The stack of books on the left starts a word completion game and the pink notebook on the windowsill prompts a journal, both encouraging reappraisal. Also, daily chores like sorting clothes are integrated in terms of a puzzle-game for distraction. There is no score or goal. The rising sun on top of the screen represents the level of energy of the player. It increases with each mini-game played. The room can be personalized with skin color, bed sheets, carpet and footwear.

Figure 2

Screenshots of the Main Screen of #SelfCare, the Word Completion Game and the Breathing

Exercise
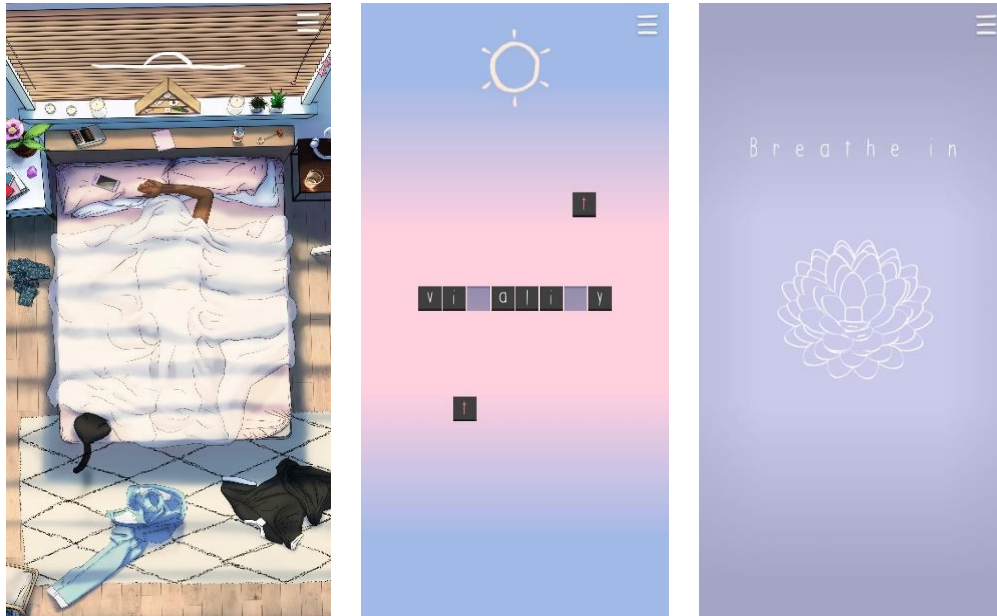
EARS tool

Passive Sensing of Use of #SelfCare. The Effortless Assessment of Risk States (EARS) tool by Lind and colleagues (2018) is a passive sensing app for mobile phones which captures participant's behaviour without extra burden for them (Lind et al., 2018). In the present study, it will collect data on whether the participants used #SelfCare. It will provide information on the time of opening and closing of #SelfCare for each participant in each time frame between the mood measurements.

ESM Mood Measure. Information on the participant's mood was collected via interval contingent sampling (Van Berkel et al., 2018), which entails that the measurement was carried out five times a day in predetermined time slots throughout the 7-day intervention phase. Figure 3 displays the time slots in which the mood questionnaire was randomly triggered and presented to the participants. Questions were randomized to prevent reactivity: the repeated assessment of negative emotions might induce negative mood states (Verhagen et al., 2017). The mood questionnaire (Appendix C2) assessed nine emotions that are assumed to be improved via the above-mentioned mechanisms of change. Eight of them are analyzed in the present study. The four positive emotions happy, relaxed, energized and satisfied are expected to be improved as part of wellbeing and positive mood (Jain et al., 2007; Liu et al., 2020; Zhang et al., 2017). The four negative emotions worried, irritated/angry,

guilty/embarrassed and sad are all related to depression or depressive symptoms (WHO, 2001; Zender & Olshansky, 2009) and are therefore expected to be improved by playing #SelfCare based on previous findings (Breton et al., 2015; Coote & MacLeod, 2012; Diedrich et al., 2014; Körner et al., 2015; Nolen-Hoeksema & Morrow, 1993; Zhang et al., 2017). The participants were asked to rate how strong they felt each emotion at that point of time on a 7-point Likert scale ranging from "not at all" to "extremely".

Nudging #SelfCare. Furthermore, the participants received reminders to play #SelfCare two times a day between 9 a.m. and 12 p.m. and between 7 p.m. and 10 p.m. The reminder reads as follows: "Let's be kind to ourselves. We've been thinking about opening our #SelfCare app. We wonder how it would feel to be in bed again".

Figure 3

The *Time Slots of the ESM Mood Questionnaire*
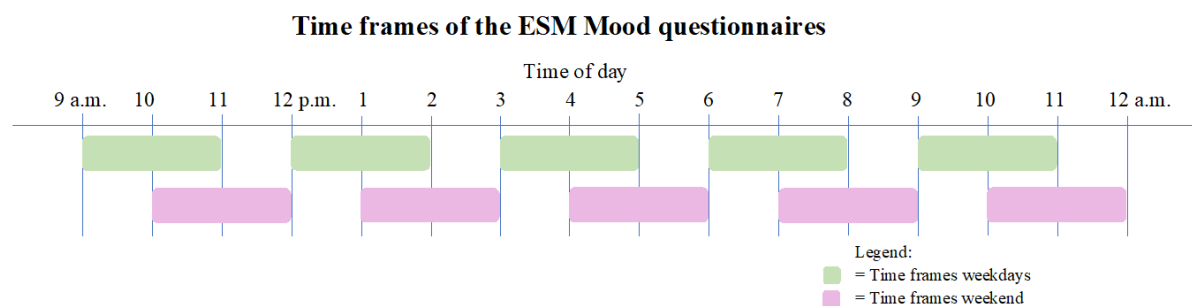
Data analysis strategy

The data was analyzed with the IBM Statistical Program for Social Sciences (SPSS, version 24) after the data were structured into a coherent dataset. Some variables were recoded and frequencies were applied to analyze the demographics of the sample and the user behaviour of #Selfcare per participant. A new, dichotomous variable called "Use_selfcare" was computed: For each mood measurement, it indicates whether #SelfCare was played since the end of the last mood assessment frame. If yes, it was coded "1", and "0" if it was not. Consequently, each row contained the scores on the mood measurement, the indication whether the app was used and if yes, also the time stamps of opening and closing #SelfCare.

Due to difficulties gathering data on opening and closing #SelfCare, over 700 out of the around 3.900 measurements took place outside of the predetermined timeslots, which is why they were deleted. Then, rows containing app-use data but no EMA-measurement were deleted. The remaining 2885 measurements were used for data analysis.

To analyze the nested structure of the longitudinal data, a series of Linear Mixed Models (LMMs) with first-order autoregressive (AR1) covariance matrix with homogeneous variances were built. The timepoint of the assessment was set as repeated measure and the participant numbers were indicated as subjects. First, the data was explored to gather a better idea of app use tendencies and general mood developments. Two separate LMMs were conducted with both the day of intervention and the time of day as a fixed factors with "Use_selfcare" as the DV. The Estimated Marginal Means are displayed in a graph to indicate the proportion of participants who used #Selfcare per day or time of day, respectively. The same analyses were conducted with the time of day as a fixed variable and the eight emotions individually. The Estimated Marginal Means of these analyses were displayed in a graph to show the trajectories of the emotions throughout the day. A single figure displays all trajectories in relation to each other, and eight further figures display each graph individually to gain a more zoomed-in view on the fluctuations of each emotion. Also, the score on the first and the last day of the intervention are compared for each emotion in a table. Furthermore, descriptives were run the total number of times #SelfCare was used per participant in order to display it in a figure.

In total, eight LMMs were built analyzing the association of the use of the app with each of the eight assessed emotions. The dichotomous variable "Use_selfcare" was set as a factor as fixed effect. The scores on each of the eight emotions were set as a dependent variable (DV) each. To answer the research question on the association between the use of #SelfCare and mood, parameter estimates and marginal mean variables were estimated for each time point and each participant.

Results

Use of #SelfCare

The proportion of participants who played #Selfcare per day of the intervention ranged from 8.41% to 21.7% of the sample with a peak on the 1st day (Figure 4). The lowest scores were reached on the last days of the intervention phase. The mean proportion of participants who played #SelfCare per day over the intervention phase was 13.4%. Noon was the most preferred time to play #Selfcare by the participants with a percentage of 13.9% (Figure 5). Least preferred was the evening with 10.9%.
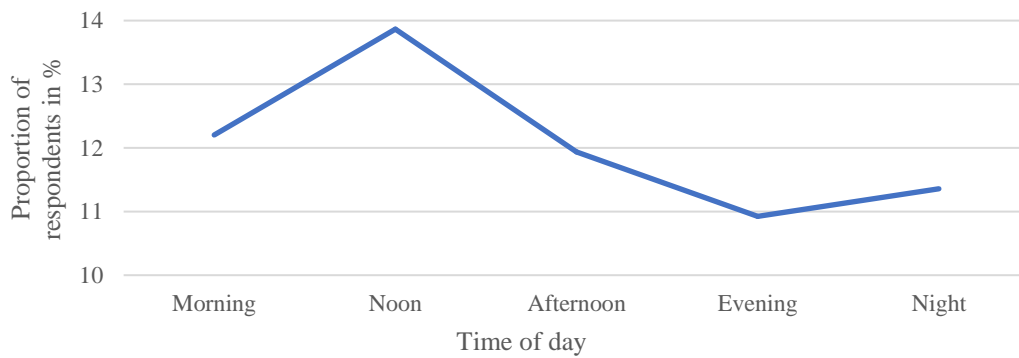
Figure 4

Proportion of Participants who Played #SelfCare per Timepoint/Day of Intervention in %
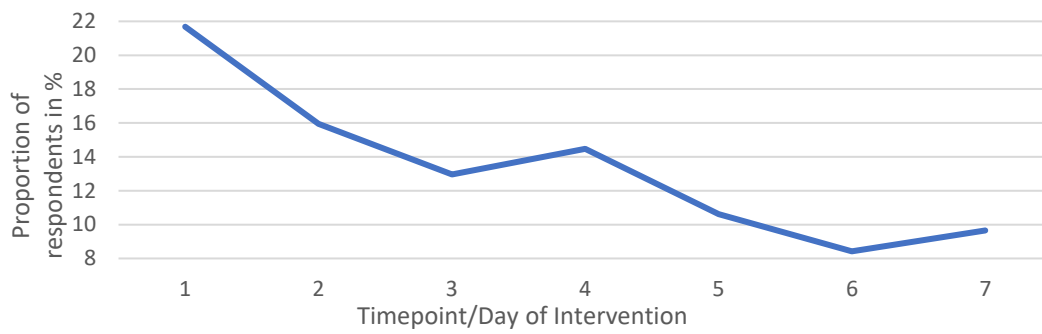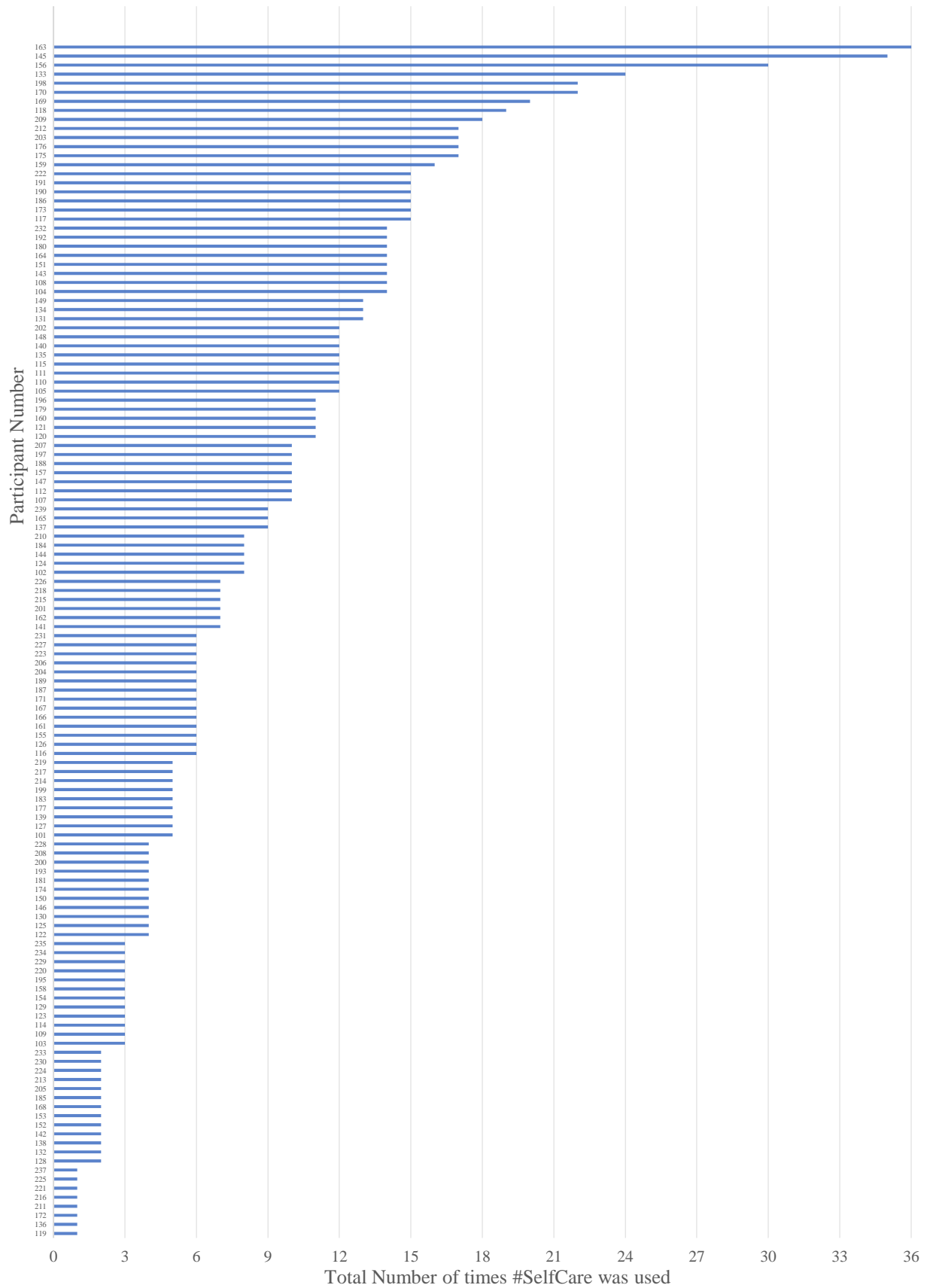

Figure 5

Proportion of Participants who Played #SelfCare per Time of Day in %

As expected, the total number of times a participant has used #SelfCare widely varies among the sample. The total number of times #SelfCare was used per participant ranges from 1 to 36 (Figure 6). On average, #Selfcare was played 8.5 times during the intervention phase.

Figure 6

*Total Number of Times #SelfCare was Used per Participant During the Intervention Phase
Sorted in Descending Order*

Mood

Generally, happiness (M = 4.13) is experienced the most by the participants over the course of the day, compared to the other emotions (Figure 7). Happiness scores were lowest in the morning and highest at noon on average. Relaxation (M = 3.89) is lowest at noon and highest at bedtime. Energy levels (M = 3.53) display a decrease approaching the evening and barely reach a low level at night. In contrast, satisfaction (M = 3.79) increases throughout the day. In total, the positive emotions were reported to be much more present than unpleasant emotions. The trajectory of the emotion worry (M = 2.54) can be found in the middle area of the range. It was higher in the morning than in the evening and night. The feelings irritated/angry (M = 1.56), guilty/embarrassed (M = 1.59) and sad (M = 1.87) were least present and did not exceed level "not at all" on average. They have in common that they were experienced the most in the evening on average. A more detailed and zoomed-in view on the trajectories of the individual emotions can be found in Figures D1 to D8 in Appendix D.

Looking at the development of the emotions over seven days (Figure 8), it also becomes apparent that happiness, relaxation and partly satisfaction have similar trajectories over the course of the intervention. They increase and decrease simultaneously, possibly even in association with each other. Furthermore, a series of paired samples t-tests with mood scores on day 1 and day 7 showed that several emotions were improved after the intervention (Table 3): A slight, but significant increase was found for happiness compared to before. Also, a small, but significant decrease was found for worry, irritation/anger, guilt/embarrassment and sadness. Thus, the participants generally showed fewer negative emotions and were in a slightly better mood after the intervention-phase compared to before. However, there is no evidence that this is associated with playing #SelfCare.
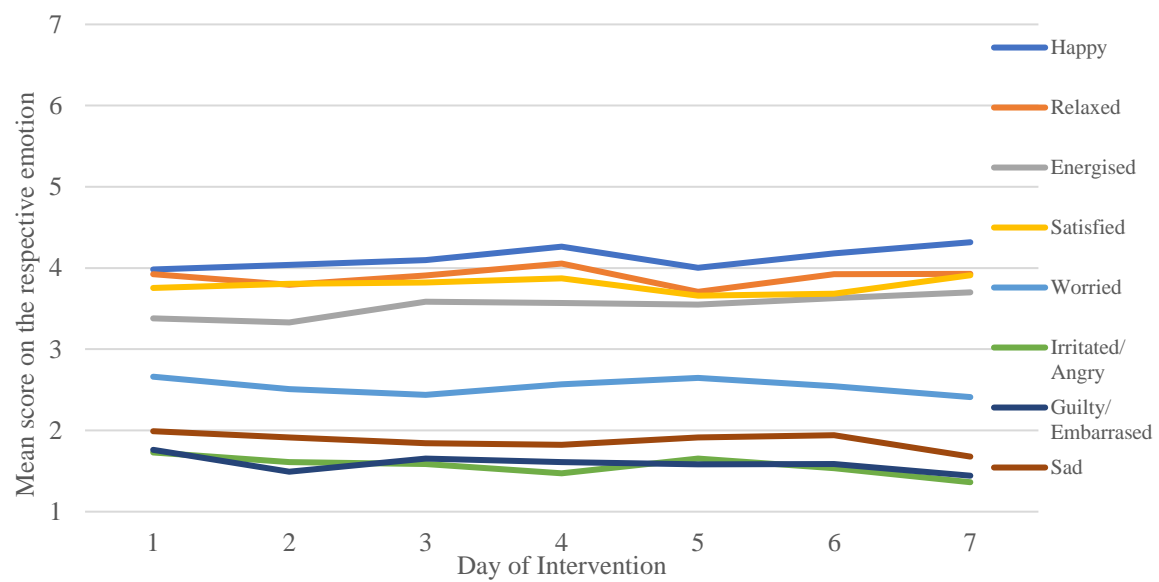
Figure 7

Trajectories of all Eight Emotions in Relation to Each Other Over Time of the Day
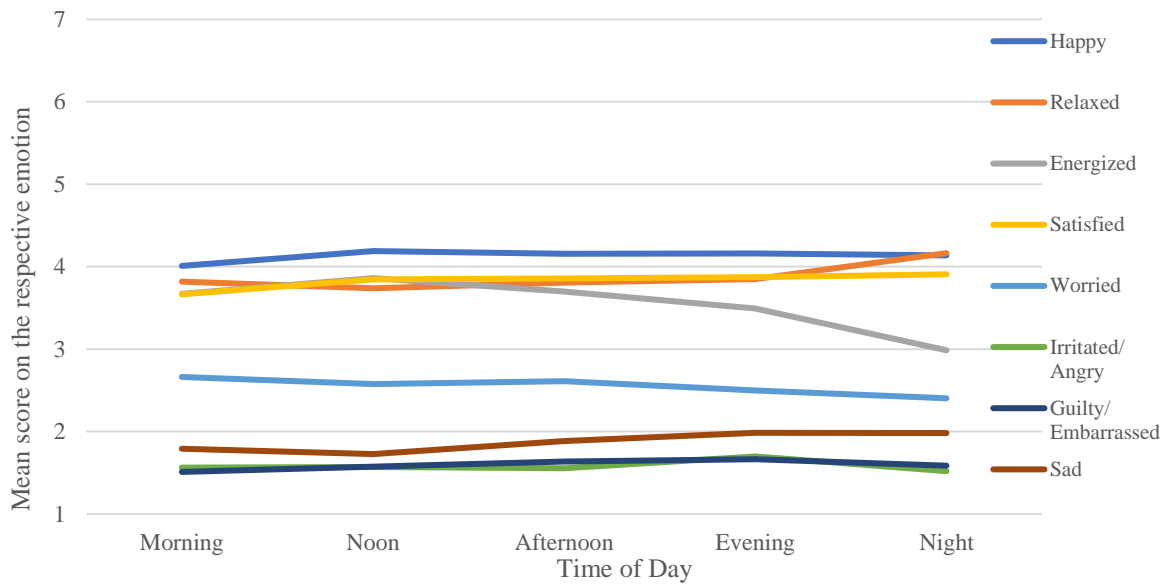
Figure 8

Trajectories of all Eight Emotions in Relation to Each Other per Timepoint/Day of Intervention

Table 3

Results of the Paired Samples T-test Comparing Mood Scores on Day 1 and Day 7

Emotion	Day 1		Day 7				*t*-test		
	Mean	*SD*	*Mean*	*SD*	*M. Diff.*	*SD*	*t*	df	*p*
Happy	4.07	1.30	4.33	1.28	.33	1.83	3.04	289	**.003**
Relaxed	3.92	1.41	3.99	1.46	.07	2.04	.60	289	.547
Energized	3.49	1.35	3.66	1.39	.21	2.02	1.77	289	.078
Satisfied	3.86	1.39	3.98	1.47	.14	1.95	1.23	289	.218
Worried	2.66	1.44	2.34	1.31	-.33	1.96	-2.85	289	**.005**
Irritated/angry	1.70	1.23	1.36	.79	-.35	1.50	-3.99	289	**.000**
Guilty/emb.	1.68	1.21	1.41	.91	-.29	1.53	-3.19	289	**.002**
Sad	1.96	1.35	1.69	1.11	-.29	1.84	-2.71	289	**.007**

Note. SD = Standard Deviation.

p-values smaller than 0.05 are considered significant and are bolded in the Table.

#SelfCare and mood

For the effect of #SelfCare on each mood, eight respective LMMs were conducted with the dichotomous using variable "Use_selfcare" as the fixed covariate. Most effects were not significant (Table 4). The effect of playing #Selfcare on happy mood was significant (*p* = *.019*) but, given a 7-point scale, rather small with a mean difference of 0.15 (*SE* = .06). If #Selfcare was used before, the mean of the emotion 'happy' was 4.15 (95% CI [4.08, 4.22]) and 4.00 (95% CI [3.87, 4.13]) when it was not. Both values indicate a moderate happiness.

Second, the effect of #Selfcare on relaxation was significant (*p* = .011; see Table 3). The mean of the emotion 'relaxed' if #Selfcare was used before was 3.92 (95% CI [3.84, 3.99] and 3.73 (95% CI [3.58, 3.87] if the app was not used. With a mean difference of .19 (*SE* = .08), the effect is also rather small and relaxation remains at level 'slight'. To conclude, small effects of the use of #Selfcare on relaxation and happiness were found but not on energy, satisfaction, worry, irritation/anger, guilt/embarrassment and sadness.

Table 4

Results of the Linear Mixed Models With "Use_selfcare" as the Fixed Factor and its Effect on the Eight Emotions

Dependent Variable	Mean	95% CI	Mean difference (*SE*)	[df1, df2] = *F*	*p*
Happy	4.15	[4.08, 4.22]	.15 (.06)	[1, 2254.13) = 5.47	**.019**
Relaxed	3.92	[3.84, 3.99]	.19 (.08)	[1, 2400.77] = 6.44	**.011**
Energized	3.53	[3.46, 3.59]	.05 (.08)	[1, 2551.65] = .52	.469
Satisfied	3.84	[3.76, 3.91]	.03 (.07)	[1, 2385.46] = .15	.695
Worried	2.54	[2.46, 2.62]	-.05 (.06)	[1, 2245.24] = .67	.414
Irritated/angry	1.58	[1.52, 1.63]	.00 (.06)	[1, 2557.91] = .00	.976
Guilty/emb.	1.59	[1.53, 1.64]	-.04 (.06)	[1, 2413.01] = .60	.438
Sad	1.88	[1.81, 1.94]	.01 (.07)	[1, 2393.62] = .01	.930

Note. P-values less than 0.05 are considered significant and are bolded in the table.

Discussion

The aim of this study was to investigate the effect of playing #Selfcare on mood. The findings suggest that playing #SelfCare has a small positive effect on happiness and relaxation but was not able to improve negative mood and energy and satisfaction levels.

Key findings and interpretation

In association with playing #SelfCare, the positive emotions happiness and relaxation were found to be significantly improved. This is in accordance with earlier studies on the effects of distraction, relaxation, reappraisal and goal-setting, which are features of #SelfCare: Wellbeing was found to be positively influenced by goal-setting (Coote & MacLeod, 2012), mindfulness and self-compassion (Mak et al., 2018). Reappraisal as emotional regulation strategy is essential for positive emotions (Liu et al., 2020), relaxation is known to improve mood (Jain et al., 2007), and, as depicted in several studies, self-compassion and self-esteem can contribute to positive mental health (Diedrich et al., 2014; Körner et al., 2015; Mak et al., 2018; Zhang et al., 2017). The present results indicate the potential of #SelfCare to help users be happier and more relaxed.

None of the negative emotions assessed in the present study was found to be significantly improved by playing #SelfCare which contradicts findings of earlier studies,

suggesting that distraction (Nolen-Hoeksema & Morrow, 1993), goal setting and goal-oriented coping can protect against negative mood (Breton et al., 2015). However, the sample consisted of women scoring only "mild" to "moderate" on the DASS, which is why levels of, for example, sadness and worry were not expected to be high. Indeed, results showed that levels of negative emotions were consistently at a very low level, which might even indicate a floor effect (Jones et al., 2018; Spijkerman et al., 2016). This limits the possibilities of #SelfCare to further reduce these emotions. Hence, no conclusion can be drawn on the effect of the app use on negative emotions. Furthermore, although negative mood is a major symptom associated with depression (Aldao et al., 2010; Diedrich et al., 2014), no conclusions can be drawn in regard to the effect of #SelfCare on depression or depressive symptoms based on the less burdened sample in the present study.

Regardless of the use of #SelfCare, the results of the present study show that levels of positive emotions were generally much more present than negative emotions which is adequate given the rather low DASS-scores of the sample. Significant, albeit small improvements in scores on happiness, worry, irritation/anger, guilt/embarrassment and sadness at the end of the intervention phase compared to before. These developments are not necessarily associated with playing #SelfCare but might be dependent on other reasons, for example events in private life. Another explanation might be reactivity: positive emotions might be enhanced after the participants were asked to pay attention to them multiple times a day for the mood measurement (Verhagen et al., 2017). However, this would not apply to the negative emotions assessed in the present study.

Limitations and recommendations

There are some limitations to the present study. First of all, a one-week-long experience sampling study is only a snapshot of mood development. This study can only indicate short term effects of playing #SelfCare but does not give any information if happiness and relaxation can be improved over a longer period of time. Since multiple studies showed that effects of mindfulness-based interventions persisted for weeks or even months after the intervention (Spijkerman et al., 2016), future longitudinal studies of longer duration could shed light on potential long-term effects and their strength possibly also on whether, and how long effects persist after the participants stopped playing #SelfCare.

Likewise, it was not investigated in the present study whether playing #SelfCare longer or more often also produces more or stronger effects since analyses only used a dichotomous variable indicating whether the app was used or not. For future studies, it is

recommended to include adherence to the intervention in the analyses and to test for a potential dose-response relationship (Jain et al., 2007; Spijkerman et al., 2016) in regard to the duration or frequency of playing #SelfCare and the improvement of mood and specifically, happiness and relaxation.

Another limitation concerns the method of analysis in the present study. Only between-subject analyses were conducted, missing the associations of #SelfCare and mood within individuals over time. Other analyses, for example Multilevel Modeling (Beyens et al., 2020) are recommended for future research to gain a more detailed picture of the associations within individuals over time.

Implications

As part of a larger study investigating the effects of #SelfCare, this work might give directions to future research on the benefits of mobile self-help interventions. The potential beneficial effect of playing #Selfcare on happiness and relaxation emphasizes the importance of looking closer at how #SelfCare can be used to improve mental wellbeing. The finding that no positive emotion decreased and no negative emotion increased might even indicate a preventive effect of #SelfCare. This possibility should be revisited in future research. Furthermore, #SelfCare might be employed in combination with face-to-face therapy, referring to the term *blended therapy* (Baumeister et al., 2020; Fairburn & Patel, 2017; Titzler et al., 2018). This rather new approach combines benefits of internet and mobile-based interventions and face-to-face therapy and might be helpful to improve mental healthcare (Baumeister et al., 2020; Fairburn & Patel, 2017; Wentzel et al., 2016).

Deploying ESM, there were several advantages over one-time assessments and pre- and post-test designs to test the intervention potential of a (digital) intervention: Although ESM studies also cannot test for causality, they can indicate some elements of prediction of a happiness and relaxation due to the lagged assessment of use of #SelfCare as antecedent of mood enhancement (Conner & Lehman, 2012). Further, besides benefits such as the reduction of memory bias and retrieval error (Barrett & Barrett, 2001; Conner & Lehman, 2012; Verhagen et al., 2017), the trajectories of the emotions over the day give additional value and information, for example on the usefulness of specific exercises over time of the day. Given the development of relaxation levels over the day, exercises in #SelfCare enhancing relaxation (e.g., breathing exercise or playing with soap bubbles) might be more useful at noon than at evening or night. Next, the similar development of happiness and relaxation might even indicate a mutual influence of these emotions. Generally, the possibility of interdependent

variables should be considered in future research on emotions. On the other hand, results showed that several different facets of positive mood can evolve differently and independently from each other over time. Thus, focusing on specific aspects of mental health rather than whole constructs gives more valuable information on which individual emotions fluctuate and how (Fried & Nesse, 2015). Summing up scores might be misleading and information on underlying processed might get lost (Fried & Nesse, 2015). Also, no significant effect might have been found in the present study. To that end, it is recommended to differentiate between scores at different times of the day also in future research. However, experience sampling entails a higher participant burden compared to one-time assessments (Barrett & Barrett, 2001; Conner & Lehman, 2012), which needs to be taken into account when designing such a study.

Conclusion

The aim of the current study was to test whether there is an association between playing #SelfCare and mood. There was a significant, albeit small, association found between playing #SelfCare and happiness and relaxation: when participants played #SelfCare they reported slightly higher happiness and relaxation levels compared to moments they did not play #SelfCare. However, no associations between playing #SelfCare and energy, satisfaction, worry, irritation/anger, guilt/embarrassment and sadness were found. Still, #SelfCare might prevent positive mood from decreasing and negative mood from increasing. Experience Sampling was a useful tool to explore general fluctuations of different emotions over the day and during the intervention phase. It can also be used to shed light on the effectiveness of specific aspects of #SelfCare at different times of the day. No definite conclusion can be drawn based on the current findings but future research might help create a complete picture on the effect of #SelfCare as a prevention tool. The importance of implementing mobile and flexible (self-help) options to improve mental health becomes especially apparent in times of a pandemic and a general decrease of mental wellbeing among the population nowadays.

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Appendices:

Appendix A: Information letter

INFORMATION LETTER
For participation in the scientific study:
#SelfCare

1a. Introduction/Aim of the study

We are researchers at the Behavioural Science Institute of the Radboud University Nijmegen. In this study, we would like to examine how your social media use and your mood and psychological well-being are influencing each other. Besides these general effects of social media use, we are also interested in what you do on social media. Which apps do you use for instance, and why? Finally, we are interested in a specific app, called #SelfCare. This app is developed to help young adults regulate their stress and anxiety levels. We are curious to see whether you will use the app, which parts of the app you like the most, and of course whether the app was able to you through busy or stressful days.

1b. The study

The study will consist of several phases, of which you have already done the first part - the screening. You can do the rest of the study at home. In total, you will spend 2-3 hours on the full study and your participation does not come with any potential risks or inconveniences. The study is approved by the Ethics Committee of the Faculty of Social Sciences of the Radboud University.

If you indicate by e-mail or telephone that you are interested in participating in this study, we will contact you to discuss the study and answer any questions. If you still want to participate, you will receive a link with the first questionnaire that you can fill out completely. After completing that questionnaire, we will call you to help you install two apps on your phone. The first app - the EARS tool - is used to track your app usage in the background and send you short questionnaires. When tracking your app usage, we only have access to how often and for how long you use certain apps, for example how often you are on a news app like Nu.nl, how long you use YouTube, or how often you use WhatsApp. What you do in these apps, for example the content of your WhatsApp messages or your music choice on YouTube, is not recorded. Thus, the tool will only record the duration and frequency of your app usage, not the content of your app usage. Other information, such as your location or your images and videos, are also not recorded by the tool. More detailed information about the EARS tool can be found under point 1c below.

In addition to the EARS tool, we will also ask you to install the app #SelfCare on your mobile phone. #SelfCare is an app aimed at alleviating feelings of stress and anxiety. The app includes mini-games that can help you take your mind off a busy study or work week and a journal in which you can write down how you feel. For this app we also track how often and how long you use it, which mini-games you use etc. After both apps are installed, you can get started. During a week (7 days) you will receive short questionnaires five times a day, which you can then complete. These questionnaires only last 1 to 2 minutes and are about how you feel at the time and what your experiences with social media are at that moment. Try to complete these questionnaires as soon as possible after you receive them. After this week we

will contact you again to help you delete the apps from your mobile phone. After this, you will complete another questionnaire via a link that we will send you. Finally, three months later you will receive a final and very short questionnaire with some questions about how you feel at that moment.

1c. The EARS tool
Here is some more information about what the EARS tool does, what you need to do and what the risks/discomforts might be for participating in this study:

If you agree to be in this study, we would ask you to do the following things:
- ***Install EARS using in-app instructions, and use your phone freely for a week following installation:*** We will collect the frequency and duration of your app usage from your phone. This data will be encrypted (stored in way that is unreadable by anyone who does not have the "keys") on a secure server.
- ***Fill out short questionnaires:*** Over the course of the study, you will be asked to participate in one week of repeated short surveys 5 times a day. These one-minute surveys will ask several questions about how you are feeling and whether you used social media and will appear on your phone every few hours. They will appear between the hours of 9AM to midnight. You may decline to answer any of the surveys.

The following types of information will be collected via the EARS application:
- *App usage*. EARS will collect the frequency and duration of each application usage, as well as the total time that your screen is in use per day.

Risks/Discomforts of participating in the study:

- Although data collection of this type may raise privacy concerns, because of the sensitivity of mobile phone data, the EARS team and Radboud University have highly skilled teams of programmers and data scientists whose job it is to ensure the privacy of your data. Only staff associated with this research project will have access to your data. A set of unique IDs will connect your mobile phone data to data collected from other sources. Your name and contact information will not be connected to your data and will be kept in locked, password-protected databases at Radboud University (only accessible for the research team of this study). All of your mobile phone data and survey responses will be encrypted (locked) after being uploaded to secure servers for storage and processing. The upload process uses secure methods as well, so your data is protected in transfer. Therefore, although it is technically possible that your private information could be lost or stolen (as with any research study), this is very unlikely because your data is transferred, stored, and accessed in an extremely secure manner.
- If at any time after the application is installed you wish to discontinue the study, we ask you to contact us so we can make sure that the tool is completely uninstalled from your phone. At that time, you can let us know whether it is okay for us to keep the data we already have, or whether you want us to destroy it.

- We recommend that you add a passcode to open your phone if you do not already use one. This will help prevent the data on your phone from being stolen.

2a. Usage and storage of your personal data

In order to execute the study, we need to collect, use and store some of your personal data. These are the following personal data: questionnaires about your social media use and game experience, activities and social support in times of social distancing, social support that you receive, self-compassion, fear of missing out, emotion regulation, rejection sensitivity, avoidance, rumination, your expectations regarding this study, your values, frequency and duration of app use, frequency and duration of #SelfCare use, and opinion on the app #SelfCare. The use and storage of these personal data are necessary for scientific purposes, but also because of administrative purposes. We need to register your active consent for participation in this study and we are obliged to inform you (through your telephone number) in case of clinically relevant findings.

For the present study it is also necessary to collect specific personal data in order to answer the research question and to publish the found results. These specific personal data are your name, age, sex, telephone number, e-mail address, questionnaires regarding your anxiety, depression and/or stress symptoms and questionnaires regarding your mood. In the informed consent form we ask you to give permission for collecting, using and storing all the above mentioned (specific) personal data. In case you do not give permission for this, you cannot participant in the study.

2b. Confidentiality of your data and data processing

The information that you provide for the study will be treated carefully and is only accessible for the qualified researchers. Personal data collect by the researcher during the study, will be confidential. In order to guarantee your privacy, the research stores these personal data coded. Your name and other data that make direct identification possible will be encrypted and stored separately from the scientific data on the secure servers of the Radboud University. Only qualified members of the research group have access to these encrypted data. Other parties involved in the study will not receive any personal data about you. Your scientific data will only be shared with these other parties while coded. It is not possible for other parties to identify you directly. Also in rapports or publications about the study, only your coded scientific data will be mentioned.

Your personal data will be protected following the General Data Protection Regulations (GDPR) and the researcher will make sure that your privacy and other related conditions will be protected. The researcher, while executing this study, will comply with the Netherlands Code of Conduct for Research Integrity and the policy of the university for the storage and management of personal and scientific data (the privacy statement of the Radboud University can be found on https://www.ru.nl/english/vaste-onderdelen/privacy-statement-radboud-university/).

2c. Retaining your data

The informed consent form that you signed and your (anonymised) scientific data will be retained for at least 10 and maximally 15 years after the completion of the study. The file that links your personal data and scientific data will be retained for maximally 1 month after completion of the study. This means that you can request the deletion of your scientific data up to maximally 1 month after completion of the study (by sending an email to h.scholten@pwo.ru.nl). After this

period, scientific data cannot be deleted anymore, because these data are only retained anonymously. Therefore, we do not know anymore which scientific data belong to you.

2d. Sharing your data

For the importance of monitoring, reusability and/or replication of the research findings, your scientific data will be shared or made public in a progressive way. Before sharing any of the scientific data, they will be anonymised. This means that you are (no longer) identifiable based on the scientific data. All data that make direct identification possible (e.g., name or telephone number) will be deleted and the other data (e.g., sex and age) will be retained, under the condition that individuals are not identifiable. All anonymised scientific data of this study will be shared with other researchers on request. The data regarding #SelfCare will be shared with the developers of the app, in order to help them improve the app, using the opinions and comments of participants. If you do not want to share your anonymised scientific data, you can request the deletion of your scientific data up to maximally 1 month after completion of the study.

2e. Access of supervising authorities for monitoring the study.

Some people and organisations need access to your personal and scientific data. This is necessary for monitoring whether the study is executed well and in a reliable manner. These people and organisations that have access to your data for monitoring can be: qualified people of *the Behavioural Science Institute* of the Radboud University (for instance a dean, director or data manager) and (inter)national supervising authorities (for instance the Dutch Data Protection Authority and The Netherlands Board on Research Integrity). They will keep your data confidential. We ask you to give permission for this monitoring. If you do not want to give permission for this, you cannot participate in the study.

2f. More information about your rights regarding the processing of your personal data

The Radboud University is responsible for adhering to the General Data Protection Regulations (GDPR) and protecting your rights related to the processing of your personal data. You always have the right to withdraw your permission for processing your personal data. Your personal data will be deleted when you do so. When you have questions about your privacy, you can contact the Data Protection Officer of the Radboud University through email: privacy@ru.nl. More information about your rights related to the processing of your personal data can be found at https://www.ru.nl/privacy/english/ and on the website of Dutch Data Protection Authority (https://autoriteitpersoonsgegevens.nl/en).

3. Personally and clinically relevant findings

The obtained scientific data will not be examined from a medical and/or clinical view point. Your participation in the study cannot be seen as a medical/clinical test. In exceptional cases new findings can be obtained regarding your well-being. For example, think about alarming scores and/or scores that can be of personal clinical relevance. In these particular cases, you will be informed about this by the researcher, maximally 1 month after your participation in the study. If you do not want to get informed about this, you cannot participate in the study.

4. Future studies

After participation we might want to contact you for future studies related to the further development of the app #SelfCare. On the informed consent form you can indicate whether or not you give permission for this. When you give permission, your contact details will be retained for maximally 2 years. Also, for potential future studies, your participation is completely voluntarily and before participating in a new study you always need to give your informed consent again. You can have your contact details deleted and/or withdraw your permission to be contacted for future studies at any moment.

5. Voluntary participation
Participation in this study is completely voluntarily and you can decide to withdraw your participation at any moment. This will not have any negative consequences for you. If you withdraw from participation, then we are no longer allowed to process your personal data. These will therefore be deleted immediately.

6. Reimbursement
For participation in the whole study, you will receive 25 euros. If you are more interested in obtaining participant credit (ppu), this is also possible and you will receive 4 ppu for your participation. If you decide to withdraw your participation during the study, we will provide you with an amount or a number of ppu that matches the effort you put in the study so far (for instance when you invested one hour in the study, you will receive one ppu or ten euros).

7. Contact information
For questions, comments or worries about this study, you can contact the responsible researcher: Hanneke Scholten (06-23721158 of h.scholten@pwo.ru.nl; see complete contact details below). We are curious about your experiences as a participant in this study at the Behavioural Science Institute of the Radboud University. For this you can, anonymously if you want, fill out an online survey (in English). If you have questions, comments or worries that you do not want to share with the responsible researchers, you can contact the BSI Research Data Officer via dataofficer@bsi.ru.nl. De BSI Research Data Officer is an independent confidant for research related matters and is not involved in this study.

Kind regards,

Hanneke Scholten; 0623721158 or h.scholten@pwo.ru.nl
Nastasia Griffioen; n.griffioen@pwo.ru.nl
Isabela Granic; i.granic@pwo.ru.nl

Behavioural Science Institute
Radboud University Nijmegen
Montessorilaan 3, kamer 06.21
6525 HR Nijmegen

Appendix B: Informed consent form

<u>Participant Informed Consent Form</u>

for participation in the scientific study: *#SelfCare*

I declare that:
- o I was satisfactory informed, both verbally and on paper, about the study;
- o I thoroughly read the information letter;
- o I had the opportunity to ask questions about the study;
- o the questions that I had (if any) were answered satisfactory;
- o I had enough time to thoroughly think about participating in this study;
- o I participate voluntarily in this study.

I give permission for:
- o the collection of my personal (e.g., sex and age) and study related data for scientific goals and that these data will be stored for at least 10 and maximum 15 years, such that they are available for monitoring, re-use, and replication;
- o storing my personal data, that will only be used for administrative purposes, for maximally 1 month after the end of this study. Administrative purposes include for instance: the ability to invite you for follow-up measures of this study (but you can give permission below to retain your data for a longer period for future studies);
- o the use of my personal and study related data by monitoring authorities.

I understand that:
- o I have the right to withdraw my permission at any time without stating any reasons and without any negative consequences for myself, by sending an email to h.scholten@pwo.ru.nl;
- o I have the right to have my study related data destroyed until one month after the end of the study;
- o I have the right to withdraw my permission for processing of my personal data; my personal data are processed according to the European Privacy Laws (General Data Protection Regulation, GDPR);
- o my personal data will be processed according to the privacy statement of the Radboud University (https://www.ru.nl/english/vaste-onderdelen/privacy-statement-radboud-university/);
- o the measurements and questionnaires that are administered to me are no medical / clinical tests, but the researchers are obligated to inform me about the scores of these measurements that can be important to me personally.

I understand that I have to answer all the following questions with an asterisk (*) with 'yes' to participate in this study.

I give permission for:
- o processing the following personal data:
  - o sex* | YES | NO |
  - o age* | YES | NO |
  - o depression, anxiety, or stress symptoms (as measured by the STAI and the DASS) * | YES | NO |

    o   mood related questionnaires (as measured by the PANAS) * | YES | NO |

o tracking my smartphone use with the E.A.R.S. tool. * | YES | NO |

o getting contacted by the researchers about scores that can be of personal clinical importance for me*. | YES | NO |

o retaining my contact information for a period of maximally two years, to be contacted for further participation in future studies (thus longer than the normal 1-month period as described above). | YES | NO |

I give my consent to participate in the study.

Name:

Signature: Date:

To be filled out by the researcher:

Undersigned hereby declares that the person named above is both on paper and verbally informed about the before mentioned.

Name:
Role / research institution:
Signature: Date:

Appendix C: Measurements

Appendix C1: Pre-test questionnaire (shortened)

Pre-measure English

T1_intro Thank you for participating in this study. We would like to ask you to read all instructions carefully and complete the following questionnaire in full. The questionnaire is confidential. This means that, apart from the researchers, no one will know what you have completed in this questionnaire. For the following questions, there are no right or wrong answers, it is about your experience. Fill in all questions, even if you are unsure about your answer, and then enter what suits you best. Please fill out the whole questionnaire at once, because your answers will be gone if you try to get back to the questionnaire at some other time point. Thank you!

T1_ppnr Please insert the participant number that we sent you. Please make sure you insert the right number, as this number will be our only way to 'identify' you in the large dataset. Thank you!

_____

T1_date What is the date of today? Format: dd-mm-yyyy

_____

T1_age What is your age?

_____

T1_demo1 What is your country of birth?

_____

T1_demo2 What is your country of residence?

_____

T1_demo3 To which gender identity do you most identify?
- o Female (1)
- o Male (2)
- o Transgender female (3)
- o Transgender male (4)
- o Gender variant/non-conforming (5)
- o Not listed: (6) _____
- o Prefer not to answer (7)

T1_demo4 What is your relationship status?
- o Single (1)
- o In a relationship, but not married (2)
- o Married (3)
- o Divorced (4)
- o Widowed (5)
- o Separated (6)
- o Prefer not to say (7)

T1_demo5 What is your living situation?
- o I live alone (1)
- o I live with my partner (2)
- o I live with my partner and child(ren) (3)
- o I live with my child(ren) (4)
- o I live with my parent(s) (5)
- o I live with my parent(s) and sibling(s) (6)
- o I live with a sibling/multiple siblings (7)
- o I live with a friend/multiple friends (8)
- o I live in a student house (9)
- o Other: (10) _____

T1_demo6 What is your occupation?
- o Student (1)
- o Working in the private sector (2)
- o Government employee (3)
- o Self-employed (4)
- o Unemployed (5)
- o Other: (6) _____

T1_demo7 Are you currently working or studying from home?
- o Yes (1)
- o No, because: (2) _____

T1_thankyou Thank you for filling out this long questionnaire. We will contact you very soon through WhatsApp or phone to explain the continuation of the study and to help you start the next phase of the study. Talk soon!

DASS21

Name: Date:

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you **over the past week**. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

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

1 (s)	I found it hard to wind down	0	1	2	3
2 (a)	I was aware of dryness of my mouth	0	1	2	3
3 (d)	I couldn't seem to experience any positive feeling at all	0	1	2	3
4 (a)	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5 (d)	I found it difficult to work up the initiative to do things	0	1	2	3
6 (s)	I tended to over-react to situations	0	1	2	3
7 (a)	I experienced trembling (e.g. in the hands)	0	1	2	3
8 (s)	I felt that I was using a lot of nervous energy	0	1	2	3
9 (a)	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10 (d)	I felt that I had nothing to look forward to	0	1	2	3
11 (s)	I found myself getting agitated	0	1	2	3
12 (s)	I found it difficult to relax	0	1	2	3
13 (d)	I felt down-hearted and blue	0	1	2	3
14 (s)	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15 (a)	I felt I was close to panic	0	1	2	3
16 (d)	I was unable to become enthusiastic about anything	0	1	2	3
17 (d)	I felt I wasn't worth much as a person	0	1	2	3
18 (s)	I felt that I was rather touchy	0	1	2	3
19 (a)	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	0	1	2	3
20 (a)	I felt scared without any good reason	0	1	2	3
21 (d)	I felt that life was meaningless	0	1	2	3

### *Appendix C2: Mood questionnaire*

1. How _____ do you feel right now? [randomized order)
   a. Happy
      (1 = Not at all, 7 = Extremely)
   b. Relaxed
   c. Energised
   d. Satisfied
   e. Worried
   f. Irritated/angry
   g. Guilty/embarrassed
   h. Sad
   i. stressed

2. Who have you been interacting with in the last 30 minutes? Check all that apply
   o No-one
   o Parent(s), face-to-face
   o Friend(s), face-to-face
   o Sibling(s), face-to-face
   o Romantic partner(s), face-to-face
   o Acquaintance(s), face-to-face
   o Stranger(s), face-to-face
   o Parent(s), digitally
   o Friend(s), digitally
   o Sibling(s), digitally
   o Romantic partner(s), digitally
   o Acquaintance(s), digitally
   o Stranger(s), digitally
   o Other, please specify and whether face-to-face or digitally:

3. If you have used social media in the last 30 minutes, how good to you feel about your time on social media
   o Not good at all
   o Not so good
   o It was O.K.
   o Good
   o Very good
   o I have NOT used social media in the last 30 minutes

Appendix D: Figures on Mean Scores on Eight Emotions Throughout the Day
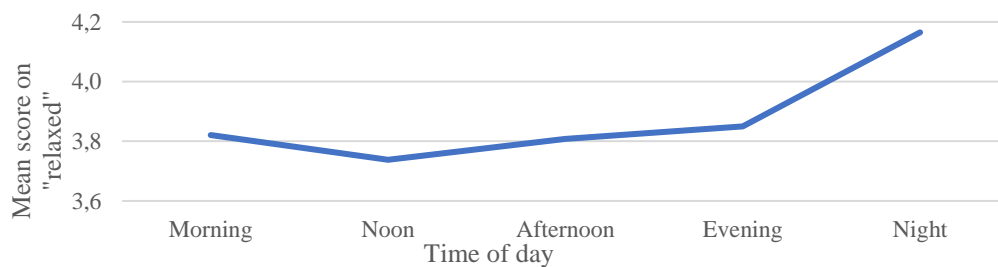
Figure D1

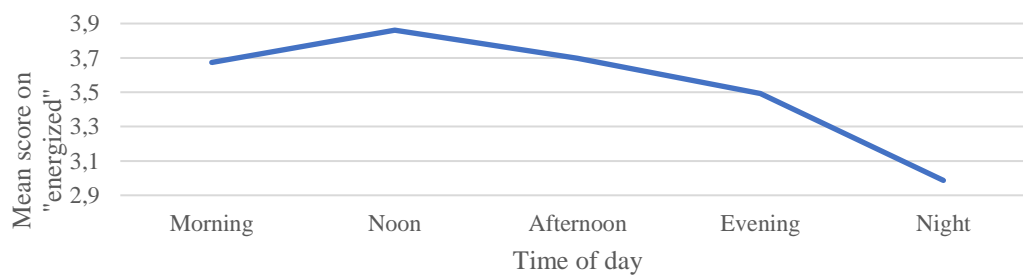*Trajectory of the Emotion "happy" over Time of the Day*
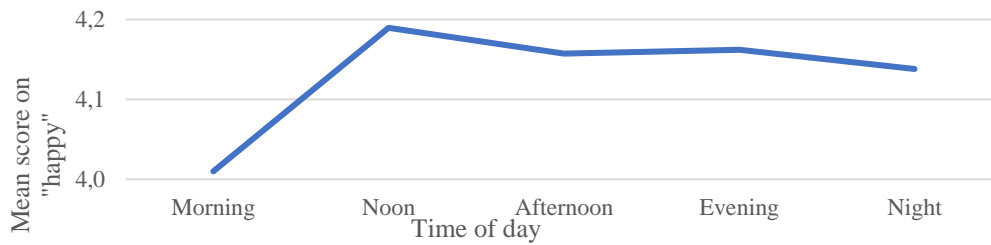
Figure D2

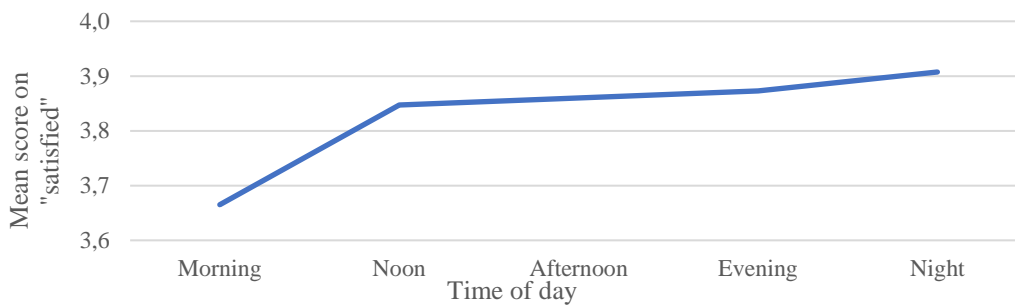*Trajectory of the Emotion "relaxed" over Time of the Day*

Figure D3

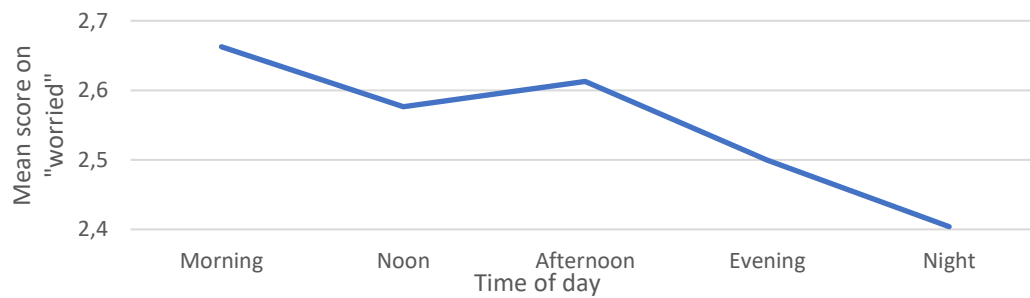*Trajectory of the Emotion "energized" over Time of the Day*

Figure D4

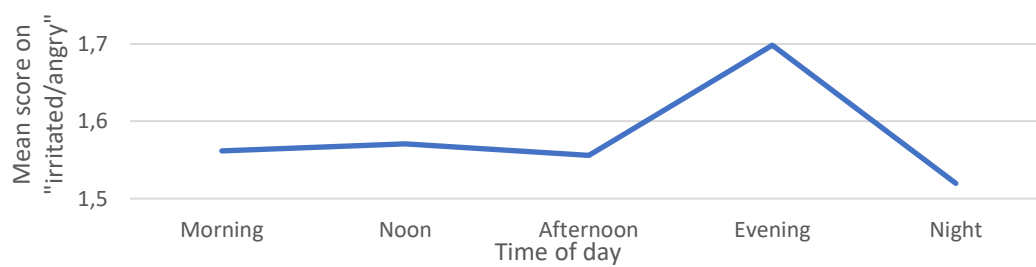*Trajectory of the Emotion "satisfied" over Time of the Day*

Figure D5

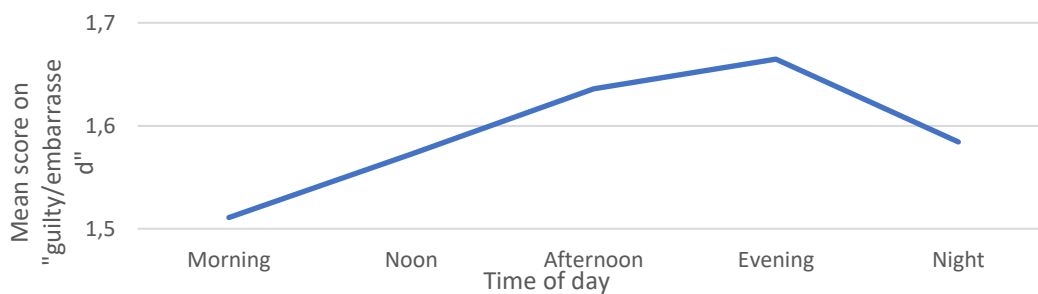*Trajectory of the Emotion "worried" over Time of the Day*

Figure D6

Trajectory of the Emotion "irritated/angry" over Time of the Day

Figure D7

Trajectory of the Emotion "guilty/embarrassed" over Time of the Day

Figure D8

Trajectory of the Emotion "sad" over Time of the Day