Master's Thesis

A love letter to my smartphone – what kind of positive emotions do people experience toward their smartphone and do these correlate with user engagement in mHealth apps?
A mixed-methods study

Pauline Sophie Böllert

s1861069

1st Supervisor: Dr. Marcel Pieterse

2nd Supervisor: Dr. Nadine Köhle

Positive Psychology and Technology

Department of Behavioural Sciences

July 2020

UNIVERSITY OF TWENTE.

Abstract

Background. Smartphones are omnipresent in daily life. Much research has focused on investigating their effects on people's health, behaviour, and habits. Mobile health (mHealth), one asset of smartphones, becomes increasingly popular and needed in today's society, making it relevant to investigate how to design mHealth apps in order to make them successful. Low user engagement and dropouts are among the most pressuring issues of mHealth, thus finding ways to support user engagement is essential. As positive emotions, based on Fredrickson's Broaden and Build Theory build resources, it is assumed that positive emotions toward the smartphone build user engagement in mHealth apps. Resulting, the research question is "What kind of positive emotions do people experience toward their smartphone and do these correlate with user engagement in mHealth apps?". **Methods.** This cross-sectional correlational study employs a mixed methods approach by combining qualitative and quantitative research methods. 22 participants, majorly German students, were recruited via the University of Twente Psychology test subject pool (SONA) and via convenience sampling. They were asked to write a love letter to their smartphone to assess their positive emotions. Furthermore, they were instructed to fill in the Twente Engagement with eHealth Technologies Scale (TWEETS) to measure user engagement. The qualitative data was coded de- and inductively, the quantitative data was analysed with correlational analyses. **Results.** Seven positive emotions were extracted from the love letters, of which "*Gratitude*", "*Love*", and "*Inspiration*" were reported most frequently. However, only "*Gratitude*" was shown to correlate significantly (r_s=.69, p-value=.00) with user engagement. Participants referred to their smartphone with three different names indicating that they perceived it to take over a role. Only "*Teacher*" correlated marginally significant (r_s=.53, p-value=.01) with user engagement. Participants frequently mentioned the support their smartphone provides, thus "*Support*" was used as a third coding category but did not appear to correlate with user engagement. **Discussion.** Contrasting to what was expected, user engagement appeared to not be associated with positive emotions as such, but only with "*Gratitude*". A reason could be that gratitude is linked with happiness and proven to increase motivation and thus appears to be crucial for mHealth development. Furthermore, although "*Support*" was not shown to correlate with user engagement, it appeared relevant to participants and should thus be kept in mind when creating mHealth applications. Future research should aim to validate results and get deeper understanding of the processes of emotions toward smartphones and their effects. Nevertheless, this research provides novel insights into the emotional side of smartphones and the practical relevance of taking into account emotions and user needs to create successful and effective mHealth applications.

Introduction

Smartphones – our daily companions, but what do they do with us and how can we benefit from them? Smartphones are handheld personal computers that store personal information, conversations and memories (Oulasvirta, Rattenbury, Ma, & Raita, 2011). Smartphones also appeal to people because they are "portable, convenient and versatile", offering sheer unlimited possibilities (Li, Liu, & Dong, 2019). The popularity of smartphones has increased rapidly throughout the past years with 78% of the German population owning a smartphone in 2018 and numbers expected to rise further (Silver, 2019).

Due to the increasing number of people using smartphones on a regular basis, research has focused on what implications are caused by it. Horwood and Anglim (2019) found that smartphones can make people feel stressed and enervated, a state the authors term "technostress". Further research by Li, Liu, and Dong (2019) showed that smartphone use is related to physical health impairments, adolescent difficulties with social activities, and behavioural issues like aggression. Furthermore, smartphone use negatively influences academic performance and concentration abilities (Li, Liu, & Dong, 2019). Demirci, Akgönül, and Akpinar (2015) added findings to the list of negative implications of excessive smartphone use. They found vision impairments, joint pain, decreased real-life interactions with others, relationship difficulties as well as increased anxiety and depression. Nevertheless, apart from the negative implications of smartphones, there must be an appeal of smartphones that makes people use and value it.

Only few researchers have focused on positive implications of smartphone use, such as Horwood and Anglim (2019), who found that smartphones can increase feelings of social closeness, safeness and entertainment. Furthermore, they stated that smartphone usage can also have positive implications for subjective well-being by offering new social opportunities (i.e. finding friends online and bonding). Demirci et al. (2015) added that moderate smartphone use can support well-being, help people to communicate and to cope with stressful situations.

Despite negative and positive consequences, smartphones offer many opportunities to users, one of them being the support of physical and mental health, which is why (mental) health apps have received increasing interest over the past years. Mobile health (mHealth) is defined as "medical and public health practice supported by mobile devices" (Bert, Giacometti, Gualano, & Siliquini, 2014). mHealth applications are increasingly popular and expected to be of added value for health care, as the potential of mHealth apps is tremendous, especially as they make health care more accessible (Torous, Nicholas, Larsen, Firth, & Christensen, 2018). Findings by Grady and Gough (2014) underline that increasing (chronic) health conditions

strain the public health system, demanding for self-management of disease and individuals' responsibility for their health. mHealth could thus be a solution for the growing health care demand. Research by Bert et al. (2014) underlines the various positive aspects of smartphones when it comes to improving and supporting user health, such as the relatively low price of smartphones, their high distribution, the omnipresence in daily life, and the fact that they are an easy channel of communication. MHealth apps can fall into different categories according to Kamel Boulos, Brewer, Karimkhani, Buller, and Dellavalle (2014): Apps can help patients cope with their disease (for example blood sugar monitoring and calculation for diabetes mellitus), support in making lifestyle changes (stopping to smoke or lose weight), and encourage and help users to exercise. However, low engagement and drop-out of users is a widely recognized problem (Torous, Lipschitz, Ng, & Firth, 2020). So far, reasons for disengagement and drop-out of mHealth users are, according to Kannisto, Korhonen, Adams, Koivunen, Vahlberg, and Välimäki (2017), lack of motivation, distrust in the device, as well as a lack of interest in mHealth.

Positive Emotions and mHealth

It appears that smartphones can negatively – via excessive use - and positively – via mHealth applications - affect users' physical and mental health. However, not much is known yet about what kind of emotions users hold towards their smartphones, due to a lack of research in that field. Fredrickson and Cohn (2008) stated that emotions are "multicomponent response tendencies – (…) – that unfold over a relatively short time span". They added that emotions evolve when individuals perceive a personal meaning of a situation, which then influences the different forms of changes.

A way to understand positive emotions and their importance is the Broaden and Build Theory by Fredrickson (2004), which states that positive emotions have a broadening and building effect. On the one hand, experiencing positive emotions broadens the individual momentary perception – people think more broadly, get more creative in solving problems and more open-minded in general. On the other hand, positive emotions build resources, such as coping strategies, well-being and enduring positive emotions (Fredrickson, 2004). Other research has shown that experiencing positive emotions, in the manner of the building effect, enhances academic engagement of students (Ouweneel, Le Blanc, & Schaufeli, 2011). According to Ouweneel et al. (2011) positive emotions increase study engagement via creating personal resources (i.e. self-efficacy, hope, and optimism). Cacioppo, Gardner, and Berntson (1999) added to existing knowledge by stating that positive emotions support approach

behaviour, leading to individuals being more engaged with activities by experiencing more interest and motivation towards the stimulus. Johnson, Crosnoe, and Elder (2001), for example, found that experiencing attachment to school as an institution increases academic engagement in students, and vice versa. This implies that increasing one of both variables (i.e. attachment via positive emotions) would result in an increase of the other variable (i.e. engagement).

In terms of technological engagement, Short, Rebar, Plotnikoff, and Vandelanotte (2015) found that user engagement motivation is promoted when positive emotions are created. This implies that people are more inclined to engage with a technology when they hold positive emotions for the device. Griskevicius (2010) added that experiencing anticipatory enthusiasm (i.e. expecting a positive effect) and attachment love (i.e. reliance and trust in the device) when using an app leads to users being more easily persuaded by the app, resulting in people being more inclined to use and engage in an app.

In order to increase the effectiveness of aforementioned mHealth smartphone apps, people need to engage in the apps. User engagement in terms of mHealth applications means that people see the use of the app, accept it and are motivated to use it (Lehmann, Lalmas, Yom-Tov, & Dupret, 2012). Scherer, Ben-Zeev, Li, and Kane (2017) highlighted that studying engagement in technology is of relevance when aiming to develop and improve mHealth interventions. They added that when understanding engagement processes, levels of engagement and influences on engagement, mHealth interventions can be more tailored and designed to meet the needs and wishes of users. Scherer et al. (2017) also stated that the success of interventions is strongly dependent on user engagement. Lie, Karlsen, Oord, Graze, and Oftedal (2017) explained that when feeling that apps are not valuable to oneself, engagement is lowered and drop-out increases. Furthermore, they stated that having a trusting and positive relationship with the smartphone would benefit user engagement in mHealth apps.

Looking at the existing literature, it appears that existing models of user engagement focus on cognitive determinants, neglecting the affective components of motivation and user engagement. Thus, investigating the relationship between affection and user engagement is crucial to broaden the existing knowledge and facilitate appropriate mHealth development. The Unified Theory of Acceptance and use of Technology (UTAUT) by Venkatesh, Morris, Davis, and Davis (2003) proposes that use and acceptance of technology are determined by performance and effort expectancy, social influence, and facilitating conditions, which underlines the cognitive dominance in the field of technological usage and acceptance research. Thus, Venkatesh et al. (2003) stressed that perceived usefulness (performance expectancy), perceived ease of use (effort expectancy), the opinion of others (social influence) and suitable

external circumstances (facilitating conditions) impact people's motivation to use technology, which are all allocated to the cognitive ratio of determinants.

Present research

Research on smartphones has so far focused on observable and measurable effects of smartphone use, such as behavioural and physical changes, leading to a lack of research addressing the affective side of smartphones, the emotions people experience toward their smartphone. However, as shown by other fields of research, experiencing positive emotions has many effects on individuals as discussed in the Broaden and Build Theory. This research employs the theoretical foundation of Fredrickson's Broaden and Build Theory, that underlines the building effect of positive emotions. As discussed, mHealth is a promising addition to public health care and user engagement is its most relevant issue. In order to complement existing knowledge about user engagement and add to future developments of successful mHealth, this research aims to find out whether the apparent effect of positive emotions on engagement can be translated to user engagement in health-related smartphone use. It is expected that experiencing positive emotions toward the smartphone, i.e. due to the supportive role it plays in maintaining and improving health, is associated with user engagement in mHealth apps, which will be measured using the Twente Engagement with eHealth Technologies Scale (TWEETS; Kelders and Kip, 2019). By revealing this information, user engagement can be directly targeted and increased by promoting people's positive emotions toward their smartphone. Finding a solution for the challenge of low engagement and dropout from health applications would benefit the development of new apps that aim to support people with their mental and physical health issues. Eventually, by increasing engagement to mHealth apps via positive emotions, more people would benefit from their existence.

In this research, a mixed-methods approach is employed to achieve a broader picture of the field of smartphones and user engagement in mHealth. The novel and innovative method of letting participants write a love letter to their smartphone will be employed, as it is a relatively open form of collecting qualitative data that is enriched with people's personal experiences and emotions (Hannington and Martin, 2012). Hannington and Martin (2012) add that the method is especially useful for usability research, where it reveals the kind of emotional relationship people have with their technological device. McCarthy, Rodriguez Ramirez, and Robinson (2017) state that the love letter method enables the researcher to receive an in-depth description of emotional experiences. Due to these findings, the love letter method is very suitable for this

research. As this paper focuses on the positive emotions people experience toward their smartphone, it appears applicable that people share their experiences by means of a love letter.

Resulting, the research question for this thesis is "What kind of positive emotions do people experience toward their smartphone and do these correlate with user engagement in mHealth apps?".

Methods

Study Design

A correlational study design was employed. By means of a mixed-methods design, qualitative data via love letters and quantitative data via the TWEETS (see appendix C) was collected. Mixed methods research is employed when the combination of quantitative and qualitative research facilitates improved understanding of the topic and increases the depth of insight (Creswell & Plano Clark, 2007). Collecting qualitative and quantitative data combined allows for deeper insight into and stronger conclusions about the interplay and connection between user engagement and positive emotions (Schoonenboom & Johnson, 2017).

Participants

Convenience sampling was used to recruit participants. The link to the study was published on social media sites of the researchers as well as on SONA, a test subject pool website for Psychology students at the University of Twente.

An inclusion criterion for participants was to be adult to circumvent ethical issues arising by working with minors. Furthermore, participants had to own a smartphone and have internet access. Owning a smartphone was necessary, because the research explicitly aimed at smartphone users and their emotions. Additionally, an inclusion criterion was that participants use social media as well as mHealth apps on their smartphone. Social media use was necessary because the study was conducted in cooperation with a second researcher investigating social media behaviour.

Materials

The TWEETS (Kelders and Kip, 2019) was employed in order to measure how far people engage with mHealth apps. The scale was initially divided into three components, each being suitable for different moments of time (i.e. before using mHealth apps, during using it or after using it). For this research, the component that measures engagement during usage (i.e. current engagement) was employed, as it was assumed that participants were already using the

mHealth apps when participating in the study. Participants were informed that "mHealth apps" in this research entail apps that support physical and mental health as well as well-being. The TWEETS current engagement scale is composed of nine items in three categories – behavioural, cognitive, and affective engagement. All three categories are represented by three items. An example item of the TWEETS' current engagement affective items is: "*The mHealth application fits me as a person.*". Participants could indicate their degree of agreement on a 5-point Likert scale, ranging from "*strongly disagree*" (zero) to "*strongly agree*" (four). The TWEETS score for each participant was calculated by adding the values for each statement, a total score of 36 could thus be achieved. The TWEETS appears to have high reliability with a Cronbach's Alpha of .86 (Kelders, Kip, & Greeff, paper submitted and under review). Analyses of the current sample revealed a Cronbach's alpha of .68, which represents an acceptable internal consistency (Blanz, 2015).

Participants were asked to write a love letter addressed to their smartphone in which they describe their loving feelings for the smartphone and how it helps them in terms of their mental and/ or physical health. They were asked to not spend more than 10 minutes on the writing process to minimize participant burden and were reminded that there were no right or wrong answers. Moreover, participants could either write the letter in English or German, depending on their preference (see appendix B).

Further information collected were gender, nationality and age of participants. Moreover, participants were asked whether they use mHealth apps on their smartphone (i.e. disease management apps, fitness apps, pedometers, mindfulness or meditation apps) and if yes, which ones. This question gave more insight into the smartphone health-related behaviour of participants. Furthermore, participants were asked two questions about their mHealth usage - how many times a week they used mHealth apps and how many hours a day. The frequency of usage question could be answered on a five-point scale from zero ("*Less than once a week*") to four ("*Everyday*"). For the second question, participants could further indicate how many hours a day they spend on mHealth by choosing a number of hours, subsequently weighed as its value (i.e. three hours of usage were weighed as three) or the option "Less than an hour", which was weighed as zero. The whole questionnaire, including the instructions for the love letter, has been pilot tested and adjusted by the researcher based on remarks and recommendations.

Procedure

Prior to recruiting participants for this research, the study was approved by the Ethical Committee of the University of Twente in April 2020. Before starting their participation,

participants were informed about the nature and purpose of the research (see appendix A). They were told that filling out the questionnaire would take 30 minutes and was on a voluntary basis, thus could be ended without giving reasons. Furthermore, the confidentiality, data storage and anonymisation was pointed out. Participants also received information about who to contact in case of arising questions or concerns. They were then asked to indicate their agreement to participation.

After agreeing to the online informed consent, participants were invited to answer the questions about their demographics, the mHealth apps they used and the frequency of usage. Following that, they were asked to write a love letter to their smartphone (see appendix B) and fill in the TWEETS questionnaire. Each of the nine items of the TWEETS had to be answered in order to be able to terminate the survey. Eventually, participants could see a page in which the researchers thanked them for their participation and again provided their contact details as well as those of the Ethics Committee of the Faculty of Behavioural Sciences at the University of Twente in case of complaints.

Data Analysis

At the end of the data collection period, the data was downloaded. Qualitative text data, i.e. the love letters, were imported into ATLAS.ti version 8.4.4, a program used for coding qualitative data. A coding scheme (see appendix D) was deductively, inductively, and iteratively developed based on the received love letters. Three categories were created – positive emotions with deductive coding based on the Broaden and Build Theory, roles of smartphone, and additionally striking findings that could not fit in either of the two other categories, the latter two having been created inductively. Deductive coding was also performed based on Griskevicius' (2010) findings, thus "*experiencing anticipatory enthusiasm*", "*attachment love*", and "*amusement*" were included into the coding scheme. The coding scheme was adjusted twice after consulting with a second coder, resulting in a Krippendorff's alpha of .84, which implies high inter-coder reliability (De Swert, 2012). When all text data was coded, the frequencies of each category were calculated.

Quantitative data of the demographic questions as well as resulting from the TWEETS were uploaded to SPSS, a software for analyzing quantitative data. Descriptive statistics in form of means and standard deviations were calculated in order to have an overview over participants' demographic data. For the frequency of mHealth use and hours per day spent on mHealth usage, percentages were calculated as a means to get an insight into the mHealth user behaviour of the sample.

In SPSS, the frequencies of each code were recorded for each participant, resulting in a merged data set of the quantified qualitative and quantitative data. For each participant, the total score of positive emotion codes was calculated as well. Next, a histogram for each, the PE (positive emotions) and the TWEETS score was created including the normality curve to check for parametric distribution of data (see Figure 1).
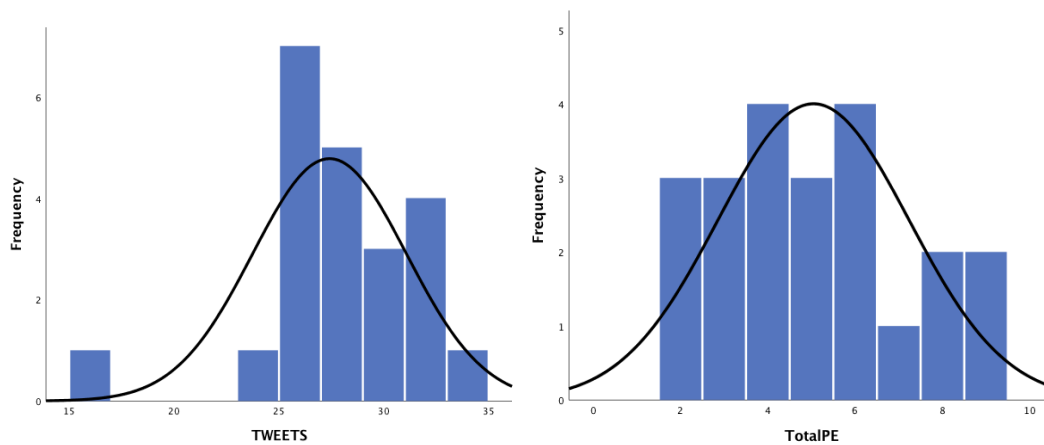

Figure 1. Histogramms for normal distribution check

Furthermore, correlations were computed for the PE score and the TWEETS score, as well as for each positive emotion code and the TWEETS score. Due to the non-parametric distribution of data, the Spearman correlation coefficient was employed to calculate correlations between metric variables (TWEETS score, PE score, each code) (Artusi, Verderio, & Marubini, 2002). A one-tailed test with a significance level of .05 was used, as the research question addresses only a unidirectional relationship between positive emotions and user engagement. According to Khamis (2008), an r_s=1 indicates a strong relationship, the closer r_s to 0, the weaker the relationship. In addition to the within-subject analysis of correlation, a binary between-groups contrasting was aimed at. Thus, a Mann-Whitney-U test was executed to compare the TWEETS score of participants mentioning a certain code and participants not mentioning that code. By doing that, it was checked whether the two groups ("mentioning an emotion"/ "not mentioning an emotion") differed significantly in their TWEETS scores. Thus, it was checked whether the frequency of a code in a participant had an effect on the correlation with the TWEETS score. Spearman correlation coefficients were also calculated for the codes of the other two categories and the TWEETS score. In order to calculate the correlation coefficient for the frequency of mHealth usage and the TWEETS score, the Kendall's tau was computed, as it is suitable to compute correlations between metric and ordinal variables (Khamis, 2008). Kendall's tau was also used to infer the correlation between hours per day

spent on mHealth and the TWEETS score. There is no clear information available about how to interpret the effect size of the Kendall's tau, so further assumptions about the effect size could not be made.

Finally, to discover whether the participants that indicated a higher use of mHealth a day (more than one hour/ day) also used the mHealth more frequently a week, a crosstab was created with the two variables. All participants were then distributed in the crosstab to receive insight into the assumed relationship between the two variables.

Results

Descriptive Statistics

A total of 22 participants took part in the research. Participants were between 18 and 37 years old (M=23,45, SD=3,43). 77,3% of all participants were female, 22,7% male. 90% of participants were of German nationality, 5% indicated each a Dutch and a Chinese nationality.

Participants named several different mHealth applications that they used, pedometers and general fitness tracking apps being most frequently employed by 50% of the individuals. General health apps (i.e. pre-installed health apps) and mindfulness apps were both used by 30% of the individuals, disease management apps and weight loss apps were each used by 10%.

The frequency of mHealth use and hours per day spent on mHealth were calculated by means of percentages (see Table 1).

The participants' scores on the TWEETS had a mean of 27.42 (SD=3.67), the maximum score that could be achieved was 36, indicating that participants were overall moderately strong engaged in their mHealth.

Table 1

Descriptive Statistics of mHealth usage

	n	%	mean	SD
Frequency of mHealth usage			2.23	1.28
Everyday	3	13.6		
Several times a week	9	40.9		
2-3 times a week	3	13.6		
Once a week	4	18.3		
Less than once a week	3	13.6		
Hours per day			0.18	0.39
More than 3 hours	0	0.0		
3 hours	0	0.0		
2 hours	0	0.0		
1 hour	4	18.2		
Less than 1 hour	18	81.8		

Coding of the love letters

In the iterative, de- and inductive coding process, several codes and different categories were developed. The three categories were named "Positive Emotions", "Roles of Smartphone", and "Personal Assistant". In the "Positive Emotions" category, the codes "*Love*" and "*Enthusiasm*" were deducted from Griskevicius' (2010) findings. The other codes in that category were deducted from the Broaden and Build Theory as well as inducted from the letters. The codes in the categories "Roles of Smartphone" and "Personal Assistant" were developed inductively based on the letters.

Positive Emotions

The category was called positive emotions as it only encompasses codes that represent positive emotions experienced by the user toward the smartphone. In total, seven codes could be retrieved from the letters that represented different positive emotions. The one that was coded most frequently, 29 times in total, was "*Gratitude*". This code was used for all statements in which participants referred to a feeling of thankfulness for the service and opportunities their smartphone offers them. Sixteen participants overtly expressed their gratitude by writing "*I am thankful for…*" or "*I am grateful that you…*".

The code that was mentioned second most frequently, 21 times in total, in the love letters was "*Love*". Parts of letters were coded as "*Love*" when the participant expressed affection and a strong relationship to the smartphone. One participant stated "*I miss you already when you are not with me for a few minutes*" (participant five) another wrote that he and the smartphone "*grew closer and closer*" (participant eight). Five participants also overtly expressed their affection by addressing the smartphone directly ("*I love you!*").

The third code of positive emotions was "*Inspiration*", which was detected 17 times, in 15 unique participants. Expressions were labelled inspiring when individuals stated that they felt motivated by their smartphone. This could refer to motivation that kept up healthy habits ("*You motivate me to stay active and drink enough water every single day.*", participant four), while other participants felt even inspired by their smartphone to try out new things ("*You offer so many possibilities to be used, thanks to you, I discovered meditation to be beneficial for myself.*", participant twelve).

"*(Anticipatory) Enthusiasm*" occurred 16 times in the 22 letters. This code was defined as a feeling of happiness and excitement created by the smartphone. One participant stated that her "*life would be a lot less enjoyable without*" (participant 16) the smartphone. Participant nine added that he is "*excited about the information you provide about my health, I would not know that without you*".

"*Achievement*" was coded 14 times. This code entails expressions by individuals who felt a sense of pleasure and success due to achieving a goal with the help of the smartphone. One participant wrote "*Before I used you I was never this successful – I lost so much weight, even others notice it and reassure me.*" (participant five), which directly refers to the feeling of success and achievement.

A further positive emotion that participants expressed in their love letters was "*Trust*", defined by a great reliance on the smartphone. "*Trust*" was coded nine times in total. Participant 22 wrote openly "*I heavily rely on* you", participant 14 stated "*You know everything about me, probably more than some of my friends.*", indicating a strong bond and a deep confidence in the smartphone.

The last positive emotion that was detected in the letters was "*Hope*", referring to optimistic thoughts about the future with the smartphone, as well as about the possibilities the smartphone holds. One of the five statements that were coded with "*Hope*" was "*I hope to keep you in my life and experience many more fun moments.*" (participant 17). Participant 19 stated that she hoped "*that you develop more options to support me in my diabetes management, so that I have to go to the doctor's less.*".

Roles of the Smartphone

In this category, codes were created that appeared to represent relevant roles the smartphone fulfills for the users. Three codes were developed in which the different statements were grouped.

The first and most frequently mentioned code was "*Partner*", which was mentioned six times. This code refers to statements in which the participants wrote about the smartphone being a partner that followed the same goals. "*You are a reliable partner for my physical health*" (participant 13) is a representative quote for this code.

"*Teacher*" was coded five times in five participants and was defined as statements in which participants mentioned that their smartphone took over the role of a coach or teacher that motivates, educates and keeps track. Participant 19 wrote that the smartphone "*took the role of my yoga teacher in teaching me and reminding me to practice.*".

The last role, "*Friend*", was coded three times but appeared highly relevant for those three participants. It was coded when participants called their smartphone a close friend that they could rely on and confide in. Participant four wrote "*You are my best friend, my steady companion and the one that knows me the best.*".

Personal assistant

One topic that was striking while reading and coding the love letters could not be categorized in either of the two other categories. Nevertheless, it appeared to be relevant and prominent enough to still be mentioned. Participants referred 23 times to ways in which their smartphone supports and assists them in their daily life. Statements such as "*You remind me to take my medication and handle my work shifts*" (participant four) and "*You help me go to sleep listening to meditation.*" (participant ten) appeared in 15 of the 22 letters and thus represented the variety and importance of ways in which the smartphone supports the user.

Different types of how the smartphone supports the participants in their lives could be identified. Firstly, it was mentioned 14 times that it provides support in everyday life to achieve health goals. Participant seven stated that her smartphone supports her "*every single day to drink enough water, move enough and eat in a healthy and balanced way*". Five more participants mentioned that their smartphone assists them in managing their disease by reminding them to take their medication and to be less dependent on doctors. Participant 19 wrote that her smartphone "*reminds to take medication and to take care of my needs, I would otherwise neglect them*". Finally, four times participants referred to their smartphone's support

in relaxing and falling asleep. Participant 15 wrote that her smartphone helps "*to fall asleep and take my time to calm down, making me less stressed from everyday life*".

Correlational Analyses

Positive Emotions and TWEETS

   The correlation between the total score of positive emotions and the TWEETS score was shown to be not significant (see table 2) indicating that positive emotions as a construct did not have a relationship with user engagement. When computing correlations between each positive emotion and the TWEETS score, only "*Gratitude*" appeared to be significantly correlated with the TWEETS score (r_s=.69, p-value=.00, 95% CI [.35, .91]), meaning that experiencing gratitude toward the smartphone appears to be associated with user engagement in mHealth apps . Thus, "*Gratitude*" and the TWEETS score appear to have a medium to strong correlation.

   As can be seen in table 2, the other six positive emotions did not show to be correlated with the TWEETS score.

Table 2

Six positive emotions and the total score of positive emotions without correlation with TWEETS score

Positive Emotion	Spearman rho	p-value (Spearman)	95% Confidence Interval	Mann-Whitney U	p-value
Love	.09	.34	-.54, .40	54.00	.92
Inspiration	.06	.39	-.52, .41	53.50	.87
Hope	.08	.37	-.51, .54	41.50	.94
Trust	.21	.18	-.56, .25	45.50	.48
Achievement	.22	.17	-.34, .59	46.50	.53
Enthusiasm	.24	.12	-.17, .58	48.50	.44
Total PE	.27	.11	-.19, .66		

   The Mann-Whitney U test underlines the findings of the Spearman correlation analysis that the other six positive emotions do not correlate significantly with the TWEETS score. Thus, the frequency with which a positive emotion was mentioned in a participant's love letter had no effect on their TWEETS score. For the total score of positive emotions the Mann-Whitney

U statistic was not computed as all participant displayed at least two positive emotions in their letters, making it redundant to assess whether there is a difference in the TWEETS score between participants who mentioned positive emotions and those who did not. Thus, only "*Gratitude*" appeared to have a statistically significant correlation with user engagement.

Roles of Smartphone and TWEETS

The Spearman coefficient for correlation was computed for each of the three roles of a smartphone and the TWEETS score. "*Teacher*" appeared to correlate positively and significantly with the TWEETS score (r_s=.53, p-value=.01, 95% CI [.23, .77]), meaning that perceiving the smartphone as a teacher appears to affect user engagement in mHealth apps. According to Khamis (2008), the relationship thus is of medium strength. The Mann-Whitney U test reproduced that result, as TWEETS score was significantly higher for participants who mentioned "*Teacher*" as a role (Mdn=17.7) than for those who did not (Mdn=9,7), U=11,5, p-value=.01. "*Partner*" (r_s=.06, p-value=.39, 95% CI [-.37, .40]) and "*Friend*" (r_s=-.05, p-value=.41, 95% CI [-.45, .43]) were found to have no correlations with the TWEETS score. Thus, "*Teacher*" was the only role of the smartphone that appeared to be associated with user engagement.

The results of the Mann-Whitney U test, showed that the TWEETS score did not differ significantly for participants who mentioned "*Partner*" (Mdn=11,6) and those who did not mention "*Partner*" (Mdn=11,5), U=47,5, p-value=.97, which implied that the frequency of mentioning "*Partner*" had no effect on the TWEETS score either. When conducting the Mann-Whitney U test for "*Friend*", it showed that the TWEETS score did not differ significantly between participants mentioning the role (Mdn=10,7) and those who did not (Mdn=11,6), U=26,0, p-value=.86, indicating that the frequency of mentioning "*Friend*" was not associated with the TWEETS score.

Personal assistant and TWEETS

The statistical analysis of correlation between "*Support*" and the TWEETS score indicated no correlation between the two variables (r_s=.12, p-value=.29, 95% CI [-.38, .60]). The Mann-Whitney U test implied that the TWEETS score was not significantly different for participants mentioning "*Support*" (Mdn=10,5) than for those not mentioning "*Support*" (Mdn=6,9), U=20,5, p-value=.16.

Frequency of mHealth usage and TWEETS

The Kendall's tau correlation coefficient indicated a significant correlation between "Frequency of mHealth usage" and the TWEETS score (r_τ=.39, p-value=.01, 95% CI [.07, .64]). Thus, the correlation appeared to be low to moderate.

Hours per day of mHealth usage and TWEETS

The Kendall's tau correlation coefficient implies no correlation between "Hours per day of mHealth usage" and the TWEETS score (r_τ=-.07, p-value=.35, 95% CI [-41, .27]).

Crosstab of mHealth usage

A crosstab of "Frequency of mHealth usage" and "Hours per day of mHealth usage" implied that the four participants that indicated an mHealth usage of more than one hour a day were not located in the group of participants that indicated a high frequency mHealth usage a week (i.e. "*Everyday*" or "*Several times a week*") (see table 3).

Table 3

Crosstab of participant distribution: Hours per day and frequency of usage

		Hours	a day	Total
		Less than one hour	One hour	
Frequency	Less than once a week	3	0	3
	Once a week	3	1	4
	2-3 times a week	2	1	3
	Several times a week	7	2	9
	Everyday	3	0	3
Total		18	4	22

Discussion

This study aimed to investigate which positive emotions people experience toward their smartphones and how these are related to user engagement in mHealth apps. For this aim, the innovative narrative method of letting participants write a love letter was used. In total, seven positive emotions were found to be experienced by users toward their smartphone. "*Gratitude*" was shown to be the most important emotion in terms of its effect on user engagement.

Positive Emotions

The most prominent positive emotions being "*Gratitude*", "*Love*", "*Inspiration*", and "*Enthusiasm*", followed by "*Achievement*", "*Trust*", and "*Hope*". However, only showing a sense of gratitude toward one's smartphone is related to higher user engagement in mHealth apps. A reason for gratitude being the one positive emotion with a significant effect on user engagement might be that gratitude is mostly present when there is a liking for the receiver (i.e. the smartphone) (Algoe, Haidt, & Gable, 2008). Thus, participants liked and valued their smartphone, which created the feeling of gratitude, in turn increasing their user engagement. This is in line with Short et al. (2015) who state that a positive relationship with the device for mHealth increases user engagement motivation. People experience gratitude after receiving benefits considered as valuable (Wood, Maltby, Stewart, Linley, & Joseph, 2008) or when they appreciate the facilitation of successful work through situational or contextual factors (Graham & Barker, 1990). Thus, participants might have felt like they were successful and facilitated by their smartphone, eliciting feelings of gratitude. Furthermore, Kerr, O'Donovan, and Pepping (2015) explain that gratitude can enhance motivation, which corresponds with the findings of this study. Moreover, they add that in terms of Fredrickson's (2004) Broaden and Build Theory, gratitude appears to play a crucial role in promoting a lasting development of personal resources, in this case user engagement in mHealth applications. This finding is of relevance as Scherer et al. (2017) mentioned that user engagement is crucial for creating a successful and promising mHealth application. Thus, by creating gratitude toward the smartphone and targeting that in mHealth, user engagement would be higher, which would in turn lead to more people properly using and adhering to mHealth. Hence, knowing what kind of emotions need to be fostered and created with the purpose to increase user engagement benefits mHealth development and improves the impact of mHealth.

Interestingly, none of the other six positive emotions toward the smartphone extracted from the text samples appeared to be significantly related to user engagement. This contradicts Cacioppo et al.'s (1999) assumptions that positive emotions generally make people more engaged and motivated. In contrast, it was found that different positive emotions had a differential impact on user engagement. "*Love*" and "*Enthusiasm*" for example, were expected to be associated with user engagement in prior research by Griskevicius (2010) but not in this study. The contradicting findings might be due to the fact that user engagement in this research was measured by the TWEETS, which mostly assesses cognitive and behavioural engagement, only partly affective engagement. Thus, although love was experienced by a majority of participants, it might not be statistically related with user engagement due to the different (i.e. cognitive and behavioural) focus of the TWEETS. Hence, experiencing love or enthusiasm

toward the smartphone might still be relevant for user engagement, despite not being associated with the TWEETS score.

Moreover, in this research, 22 participants were acquired and completed both, the love letter and the TWEETS. Due to the low number of participants, interpretations of the strength of associations can only be made tentatively, as correlational analyses are known to be sensitive to sample size (Bates, Zhang, Dufek, & Chen, 1996). To sum up, the assumption that positive emotions in general toward the smartphone are associated with user engagement cannot be supported, as only one out of seven positive emotions appeared to do so.

However, even though associations between user engagement and the other six positive emotions were not shown to be existing based on statistical analyses, it could be argued that the fact that most participants mentioned those positive emotions indicates their importance. Thus, participants presumably felt the need to mention those emotions which allows to assume that they still convey some meaning for this research. Moreover, as all emotions have been mentioned by at least five different participants, it can be inferred that there is a common experience of positive emotions toward the smartphone among individuals. Pope, Ziebland, and Mays (2000) stress that qualitative data, as obtained by the love letters, is usually not quantified and statistically analysed, because it brings across meaning without statistical significance. This underlines the importance of positive emotions in this research, despite not having been shown to be statistically associated with user engagement.

For future development of mHealth applications, these findings implicate that a special focus should be put on creating gratitude in smartphone owners in order to increase their user engagement. A possible way to do so might be to advance applications that instruct people to perform an adjusted version of the "Three Good Things" exercise on a regular basis. This exercise creates gratitude by prompting to look at life with a positive focus, by instructing people to think of and write down three good things that happened to them a day (Mongrain & Anselmo-Matthews, 2012). In the adjusted version, the instruction could be to write down three good things the smartphone did for the owner a day, creating gratitude toward the smartphone. Smartphone owners could be reminded to complete the exercise by push notifications in order to enhance participation and ensure the effect of the exercise. Furthermore, due to the building effect of gratitude, well-being is created as proposed by Fredrickson's Broaden and Build Theory. Moreover, Wood, Joseph, and Linley (2007) state that people that experience gratitude are also happier in general. Thus, creating gratitude in smartphone owners is relevant in two ways: firstly, because it is supposed to have a relation with user engagement in mHealth apps

and secondly, as it already supports individual well-being via the building effect of positive emotions.

Roles of the smartphone

Further findings of this research are that people perceive their smartphone to take over a role in connection to mHealth. "*Teacher*", "*Partner*", and "*Friend*" were the three roles that participants indicated in their letters. Although they were not as frequently coded as some of the positive emotions, they did appear to convey important meaning, because some individuals explicitly labelled their smartphone as their teacher, partner, or friend. This implies that there is an emotional connection to the smartphone, which is underlined by the different positive emotions that were discovered. It can be assumed that a process of anthropomorphism took place for some individuals, meaning that participants attributed "human qualities to non-human beings" (Wang, 2015). Nevertheless, only the role of "*Teacher*" seemed to have a moderate influence on user engagement. Goudey and Bonnin (2016) find that anthropomorphism increases acceptance, which could be the reason why the role of a teacher is related to user engagement, as user engagement presupposes acceptance of the device and mHealth application (Lehmann et al., 2012). Furthermore, the teacher role could also imply that users of mHealth look for guidance of a higher instance (i.e. a teacher) in their health-promoting behaviours. However, this study implies, that the technology on which mHealth is used cannot only be seen as a means to an end to deliver mHealth, but should also be perceived as taking over a role that is personally close to the user and creates and fosters positive emotions. Moreover, as the role of a teacher appeared to be associated with user engagement, it might be inferred that individuals long for a learning effect and a person to rely on when it comes to mHealth, which is in line with Lie et al. (2017) who concluded that a trusting and positive relationship with the smartphone is relevant for user engagement in mHealth.

Based on these findings, future mHealth developments should recognize the importance of the personally close role a smartphone embodies. Therefore, a personal and intimate design in combination with learning and instructing content could be created in order to enhance the positive association of the teacher role on user engagement.

Personal assistant

Furthermore, the data suggest that there seems to be another relevant aspect of smartphones, namely the support that smartphones provide in the context of physical and mental health. Participants of this study mentioned the kinds of support and help they received

from their smartphones in various aspects of their mHealth strikingly often, which is why "*Support*" was employed as an additional category and code in the coding scheme. Different kinds of support appeared to be of relevance for participants, such as helping to achieve health goals, self-manage a disease and relax, which correspond to the three groups of mHealth defined by Kamel Boulos et al. (2014). However, contrary to what was expected during the coding process, "*Support*" did not appear to have an association with user engagement.

Although "*Support*" was not shown to be related with user engagement, it can be inferred that people seek support for their health-promoting behaviour and thus make use of mHealth. A reason for people's need and wish to do so might be that, as stated by Grady and Gough (2014), there is an increasing demand for self-management of disease and individuals taking over responsibility for their health. Participants seemed to seek support in their self-management and self-monitoring behaviour, which was provided by their smartphones and the mHealth applications. Therefore, in future development of mHealth, it should be kept in mind to create a feeling of support in order to appeal to users' need for self-management and self-responsibility.

Usage of mHealth

The hours per day of using mHealth appeared to be of relevance because four participants indicated that they used their mHealth one hour a day, whereas all other 18 participants answered that they used the mHealth less than one hour a day. Therefore, it was assumed that the four people that used their mHealth more, were on the one hand the participants that also used their mHealth more frequently a week, and on the other hand had a higher TWEETS score. The first assumption was rejected as the four individuals with a one-hour-a-day usage were shown to have chosen three different answers of the frequency per week question. This means that individuals that spent more hours a day on mHealth applications did not automatically use mHealth apps more frequently, thus did not necessarily spend more time a week on it than individuals using mHealth apps less than an hour a day. Moreover, a relation between hours per day of mHealth usage and the user engagement could not be proven, implying that using mHealth more than one hour a day does not appear to be associated with higher user engagement.

However, as most of the participants used mHealth less than one hour a day, it can be inferred that mHealth in general might not require more time a day to be effective for the user. Thus, participants that use mHealth might not aim to be entertained and spend their free time

on the application but rather use it as a means to an end, to receive the needed support and achieve their health-related goals.

Methodological Implications

The results of this research have implications on the further usage of the love letter method. The love letter method has been applied in this psychological research, making this study one of the first to make use of the method mostly used in usability research (Hannington & Martin, 2012). It can be concluded that the method did allow for an open qualitative data collection and thus provided rich data for this exploratory research. However, the instructions of the method prompted participants to write love letters, biasing their thoughts and feelings over and toward smartphones. Thus, it is unclear whether the final letters actually represented participants' true thoughts and feelings. The love letters that were written by the participants of this research appeared at first sight to be sincere and reflecting real personal experiences. However, due to not leading follow-up interviews to clarify the content, it cannot be guaranteed that participants were honest. Thus, it must be assumed that, to a certain degree, the letters might have a fictional ratio. Nevertheless, as proposed by Polkinghorne (2007), even if narratives by participants were fictional, there appears to be a true core in them as stories are to be viewed as reactions to actual life events and facts.

Strengths and Limitations

This research was one of the first in several domains and thus contributes to existing knowledge in several ways. Firstly, this study was one of the first to investigate the emotional relationship people have with their smartphones and which emotions are at play. Secondly, this study made use of two methods that are not commonly used in psychological research (i.e. the love letter method) and a newly developed questionnaire measuring user engagement (i.e. the TWEETS). Thirdly, the results of this research contribute to a growing field of research about smartphones and mHealth, making the findings relevant for improvement and future development of successful mHealth applications.

However, some limitations of this study should be discussed. As mentioned above, the method of letting participants write a love letter is novel to the field of psychological research. It is disputable whether the method actually produced sincere and reliable results. Firstly, people were instructed to write a love letter, making them omit their negative or doubting feelings about their smartphone, thus writing an imaginary love letter. Furthermore, the clear variability of letter length allows to scrutinize whether instructions were clear enough for the

participants and whether the different degrees of elaboration within the letters had an effect on the results. Moreover, "Love" as an emotion has been coded 21 times, which might imply that participants have been primed to express this emotion by having been asked to write a love letter. Thus, in order to compensate for the possibility of fiction when using the love letter method, triangulation should be utilized. This could be done conducting a follow-up interview to answer questions and clarify uncertainties, as triangulation is a valid measure to avoid data from qualitative research becoming too one-sided (Steinke, 2004).

A further limitation of this research is the homogeneity of participants. There was a clear surplus of German, female, highly educated participants which might have skewed the results. Participants resembled each other a lot, allowing for insight into the positive emotions experienced and their effect on user engagement in the German, female population. However, the generalizability of results is thus impaired. Therefore, in order to prevent homogeneity of a future research's sample, a larger participant number should be aimed at. Thus, a different sampling strategy than convenience sampling should be employed.

Moreover, although employing the newly developed TWEETS as a method for this research was named as a strength, it can also have implications on the findings of this research. As only three of the nine items used for the data collection measured affective engagement in mHealth, it might be possible that other positive emotions were not associated with user engagement in this research even though they might be in reality. This might stem from the fact that positive emotions are associated with affective engagement, thus the effect of positive emotions on user engagement might have been impaired by the underrepresentation of affective engagement items and the presence of behavioural and cognitive engagement items.

Finally, in this research, positive emotions toward the smartphone and positive emotions toward the mHealth application were combined. From the planning stage on, it has been a challenge for the researcher to determine whether only one group of positive emotions (either toward the smartphone or toward the mHealth application) should be investigated. In this research, it was decided to focus on positive emotions toward the smartphone, as suggested by Short et al. (2015). However, it is unclear whether participants were able to distinguish between positive emotions they experience toward their smartphone and positive emotions toward the mHealth application. Therefore, it is debatable whether participants only mentioned the emotions toward their smartphone or confused them with emotions toward their mHealth. This confounds the findings of this research as it implies that not only creating positive emotions toward the smartphone might be of relevance, but possibly also toward the mHealth.

Nevertheless, although it is likely that some participants confused the two levels of positive emotions, it does not necessarily mean that the findings of this research are of reduced value.

Future Research

As this research was one of the first to investigate positive emotions toward smartphones and their effect on user engagement in mHealth, more research is needed to thoroughly understand the associations. In order to deepen the understanding in future research, some recommendations were collected for planning and conducting a further study.

Firstly, instead of only using the "Current Engagement" sub-scale of Kelders' and Kip's (2019) TWEETS, all three components could be employed to measure user engagement. By adding the "Expectations of Engagement" and "Past Engagement" sub-scales of the TWEETS, more reliable and meaningful information about participants user engagement could be extracted. Furthermore, having a closer look at the results of each scale's "affective engagement" items would provide more insight into the emotional engagement with mHealth and its connection to user engagement.

Secondly, as suggested by this research's results, gratitude appears to be associated with user engagement. This should be further explored and validated in future research. It could be of relevance to employ a gratitude questionnaire, such as the six item Gratefulness Questionnaire (GQ-6), developed by McCullough, Emmons, and Tsang (2002). This would allow for insight into the ways in which different degrees of gratitude can be associated with user engagement.

Furthermore, as it turned out that the majority of participants tended to use their mHealth application less than one hour a day, it can be inferred that mHealth does not require daily screen time that can be measured in hours. Rather, daily screen time should be measured in minutes aiming to receive a clearer indication of the time that participants spend on mHealth. Thus, participants should still be asked how many times a week they use mHealth, but should then indicate how many minutes a day they do so.

In future research, the proposed ways to incorporate the findings of this study into mHealth development could be tested. Hence, the "Three Good Things" exercise application could be pilot tested and validated. Furthermore, the love letter writing as such might have an impact on people's perception of gratitude and could thus also be employed to create user engagement via feeling grateful. Therefore, future research could be directed at tackling the method as a means to create positive feelings.

Another suggestion would be to have a more intense look at the letters with regard to the order in which emotions are mentioned, clustering and patterns (i.e. codes that typically occur with each other). That kind of information could be relevant to get a deeper insight into the functioning of positive emotions and their relation with each other.

Conclusion

To summarise, the findings of this research show that people experience different positive emotions toward their smartphone that appear to be of varied relevance in their association with user engagement. Furthermore, this research pointed out that investigating the emotions of users for their smartphones provides valuable data. Moreover, the assumption that the building effect of positive emotions can be transferred to the development of user engagement in mHealth apps could not be supported. Nevertheless, it turned out that experiencing gratitude did have an effect on user engagement in this research, which should be further investigated and indicates that there might be a hierarchy of positive emotions when it comes to their effect on user engagement. The findings contribute to future development of mHealth applications, implying that it should be taken care of creating a feeling of gratitude, keeping in mind users' need for self-management and support, as well as the anthropomorphizing of smartphone.

Reference List

Algoe, S. B., Haidt, J., & Gable, S. L. (2008). Beyond reciprocity: Gratitude and relationships in everyday life. *Emotion, 8*(3). doi: 10.1037/1528-3542.8.3.425

Artusi, R., Verderio, P., & Marubini, E. (2002). Bravais-Pearson and Spearman correlation coefficients: meaning, test of hypothesis and confidence interval. *The International Journal of Biological Markers, 17*(2), 148-151. Retrieved from https://journals.sagepub.com/doi/pdf/10.1177/172460080201700213 on June 3, 2020.

Bates, B. T., Zhang, S., Dufek, J. S., & Chen, F. C. (1996). The effects of sample size and variability on the correlation coefficient. *Medicine & Science in Sports & Exercise, 28*(3), 386-391. Retrieved from https://journals.lww.com/acsm-msse/Pages/articleviewer.aspx?year=1996&issue=03000&article=00015&type=Fulltext on July 2, 2020.

Bert, F., Giacometti, M., Gualano, M. R., & Siliquini, R. (2014). Smartphones and health promotion: A review of the evidence. *Journal of Medical Systems, 38*(1). doi: 10.1007/s10916-013-9995-7

Blanz, M. (2015). *Forschungsmethoden und Statistik für die Soziale Arbeit: Grundlagen und Anwendungen* (1st ed.). Stuttgart, Germany: Kohlhammer.

Cacioppo, J.T., Gardner, W.L., & Berntson, G.G. (1999). The affect system has parallel and integrative processing components: Form follows function. *Journal of Personality and Social Psychology, 76*, 839–855.

Creswell, J. & Plano Clark, V. (2007). *Designing and conducting mixed methods research*. Thousand Oaks CA: Sage.

Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of Behavioral Addictions, 4*(2), 85-92. doi: 10.1556/2006.4.2015.010

De Swert, K. (2012). Calculating inter-coder reliability in media content analysis using Krippendorff's Alpha. Retrieved from https://www.polcomm.org/wp-content/uploads/ICR01022012.pdf on June 2, 2020.

Fredrickson, B. (2004). The broaden-and-build theory of positive emotions. *Philosophical Transactions of the Royal Society B: Biological Sciences, 359*(1449), 1367-1378. doi: https://dx.doi.org/10.1098%2Frstb.2004.1512

Fredrickson, B. L., & Cohn, M. A. (2008). Positive emotions. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *Handbook of emotions* (p.777-796). The Guilford Press.

Goudey, A. & Bonnin, G. (2016). Must smart objects look human? Study of the impact of anthropomorphism on the acceptance of companion robots. *Recherche et Applications en Marketing (English Edition), 31*(2), 2-20. doi: 10.1177/2051570716643961

Grady, P. A. & Gough, L. L. (2014). Self-management: A comprehensive approach to management of chronic conditions. *American Journal of Public Health, 104*(8), 25-31. doi: 10.2105/AJPH.2014.302041

Graham, S. & Barker, G. P. (1990). The down-side of help: An attributional-developmental analysis of helping behavior as low-ability cue. *Journal of Educational Psychology, 82*(1), 7-14. doi: 10.1037/0022-0663.82.1.7

Griskevicius, V. (2010). Influence of different positive emotions on persuasion processing: A functional evolutionary approach. *Emotion, 10*(2), 190-206. doi: 10.1037/a0018421

Hannington, B. & Martin, B. (2012). *Universal methods of design: 100 ways to research complex problems, develop innovative ideas, and design effective solutions.* Beverly, MA: Rockport

Horwood, S. & Anglim, J. (2019). Problematic smartphone usage and subjective and psychological well-being. *Computers in Human Behavior, 97*, 44-50. doi: 10.1016/j.chb.2019.02.028

Johnson, M. K., Crosnoe, R., & Elder, G. H. (2001). Students' attachment and academic engagement: The role of race and ethnicity. *Sociology of Education, 74*(4), 318-340. doi: 10.2307/2673138

Kamel Boulos, M. N., Brewer, A. C., Karimkhan, C., Buller, D. B., & Dellavalle, R. P. (2014). Mobile medical and health apps: State of the art, concerns, regulatory control and certification. *Online Journal of Public Health Informatics, 5*(3). doi: 10.5210/ojphi.v5i3.4814

Kannisto, K. A., Korhonen, J., Adams, C. E., Koivuen, M. H., Vahlberg, T., & Välimäki, M. A. (2017). Factors associated with dropout during recruitment and follow-up periods of a mHealth-based randomized controlled trial for Mobile.Net to encourage treatment adherence for people with serious mental health problems. *Journal of Medical Internet Research, 19*(2). doi: 10.2196/jmir.6417

Kelders, S. M. & Kip, H. (2019, April). *Development and initial validation of a scale to measure engagement with eHealth technologies*. Paper presented at the Conference on Human Factors in Computing Systems in Glasgow, Scotland. Retrieved from https://dl.acm.org/doi/10.1145/3290607.3312917 on June 18, 2020

Kelders, S. M., Kip, H., & Greeff, J. (submitted and under review). Psychometric evaluation of the TWente Engagement with Ehealth Technologies Scale (TWEETS): Evaluation study.

Kerr, S. L., O'Donovan, A., & Pepping, C. A. (2015). Can gratitude and kindness interventions enhance well-being in a clinical sample?. *Journal of Happiness Studies, 16*, 17-36. doi: 10.1007/s10902-013-9492-1.

Khamis, H. (2008). Measure of Association: How to choose?. *Journal of Diagnostic Medical Sonography, 24*(3), 155-162. doi: 10.1177/8756479308317006

Lehmann, J., Lalmas, M., Yom-Tov, E., & Dupret, G. (2012). Models of user engagement. In: Masthoff, J., Mobasher, B., Desmarais, M. C., & Nkambou, R. (eds). User Modeling,

Adaptation, and Personalization. UMAP 2012. Lecture Notes in Computer Science, vol. 7379. Springer, Berlin, Heidelberg. doi: 10.1007/978-3-642-31454-4_14

Li, C., Liu, D., & Dong, Y. (2019). Self-esteem and problematic smartphone use among adolescents: A moderated mediation model of depression and interpersonal trust. *Frontiers in Psychology, 10*. doi: 10.2289/fpsyg.2019.02872

Lie, S. S., Karlsen, B., Oord, E. R., Graue, M., & Oftedal, B. (2017). Dropout from an eHealth intervention for adults with type 2 diabetes: A qualitative study. *Journal of Medical Internet Research, 19*(5). doi: 10.2196/jmir.7479

McCarthy, G. M., Rodriguez Ramirez, E. R., & Robinson, B. J. (2017). Letters to medical devices: A case study on the medical device user requirements of female adolescents and young adults with type a diabetes. In: de Vries, P., Oinas-Kukkonen, H., Siemons, L., Beerlage-de Jong, N., van Gemert-Pijnen, L. (eds) Persuasive Technology: Development and Implementation of Personalized Technologies to Change Attitudes and Behaviors.

McCullough, M. E., Emmons, R. A., & Tsang, J.-A. (2002). The grateful disposition: A conceptual and empirical topography. *Journal of Personality and Social Psychology, 82*(1), 112-127. doi: 10.1037//0022-3514.82.1.112

Mongrain, M. & Anselmo-Matthews, T. (2012). Do positive psychology exercises work? A replication of Seligman et al. *Journal of Clinical Psychology, 68*(4). doi: 10.1002/jclp.21839

Oulasvirta, A., Rattenbury, T., Ma, L., & Raita, E. (2011). Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing, 16*, 105-114.

Ouweneel, E., Le Blanc, P. M., & Schaufeli, W. B. (2011). Flourishing students: A longitudinal study on positive emotions, personal resources, and study engagement. *The Journal of Positive Psychology, 6*(2), 142-153. doi: 10.1080/17439760.2011.558847

Polkinghorne, D. E. (2007). Validity issues in narrative research. *Qualitative Inquiry, 13*(4), 471-486. doi: 10.1177/1077800406297670

Pope, C., Ziebland, S., & Mays, N. (2000). Analysing qualitative data. *British Medical Journal, 320*(114). doi: 10.1136/bmj.320.7227.114

Scherer, E. A., Ben-Zeev, D., Li, Z., & Kane, J. M. (2017). Analyzing mHealth engagement: Joint models for intensively collected user engagement data. *JMIR mHealth and uHealth, 5*(1). doi: 10.2196/mhealth.6474

Schoonenboom, J. & Johnson, R. B. (2017). How to construct a mixed-methods research design. *Kölner Zeitschrift für Soziologie und Sozialpsychologie, 69*, 107-131. doi: 10.1007/s11577-017-0454-1

Short, C. E., Rebar, A. L., Plotnikoff, R. C., & Vandelanotte, C. (2015). Designing engaging online behaviour change interventions: a proposed model of user engagement. *The European Health Psychologist, 17*(1), 32-38. Retrieved from https://digital.library.adelaide.edu.au/dspace/bitstream/2440/97646/3/hdl_97646.pdf on April 12, 2020

Silver, L. (2019, February 5). Smartphone ownership is growing rapidly around the world, but not always equally. Retrieved from: https://www.pewresearch.org/global/2019/02/05/smartphone-ownership-is-growing-rapidly-around-the-world-but-not-always-equally/ on February 19, 2020

Steinke, Ines (2004) Quality criteria in qualitative research. In *A Companion to Qualitative Research*. Edited by Uwe Flick, Ernst von Kardorff and Ines Steinke. Sage publications, London.184–190.

Torous, J., Nicholas, J., Larsen, M. E., Firth, J., & Christensen, H. (2018). Clinical review of user engagement with mental health smartphone apps: evidence, theory and improvements. *Evidence-Based Mental Health, 21*(3), 116-119.

Torous, J., Lipschitz, J., Ng, M., & Firth, J. (2020). Dropout rates in clinical trials of

smartphone apps for depressive symptoms: A systematic review and meta-analysis. *Journal of Affective Disorders, 263*, 413-419. doi: 10.1016/j.jad.2019.11.167

Venkatesh, V., Morris, M. G., Davis, G. B., Davis, F. D. (2003). User acceptance of information Technology: Toward a unified view. *MIS, 27*(3), 425-478. doi: 10.2307/30036540

Wang, W. (2015). Social disposition and anthropomorphism of smartphones. Retrieved from https://scholarsbank.uoregon.edu/xmlui/handle/1794/19285 on June 3, 2020.

Wood, A. M., Stephen, J., & Linley, P. A. (2007). Gratitude – Parent of all virtues. *The Psychologist, 20(*1), 18-21. Retrieved from https://www.researchgate.net/profile/Alex_Wood30/publication/279558245_Gratitude _-_Parent_of_all_virtues/links/5e8a847ea6fdcca789f7ded5/Gratitude-Parent-of-all-virtues.pdf on June 9, 2020.

Wood, A. M., Maltby, J., Stewart, N., Linley, P. A., & Joseph, S. (2008). A social-cognitive model of trait and state levels of gratitude. *Emotion, 8*(2), 281-290. doi: 10.1037/1528-3542.8.2.281

English

Dear participant,

you are being invited to participate in a research study titled "Love letters to our smartphone and social media". Smartphones are omnipresent in today's world, people use it regularly and for different purposes, such as for social media and health promotion.

The purpose of this research is to find out what kind of positive emotions users experience toward their smartphone and social media. This will add to existing research that is more about the other, rather negative side of smartphones and social media. The study will take you approximately 30 minutes to complete.

The information you disclose by writing the letters and answering the questions will serve as data for our master theses at the University of Twente. By agreeing to participate in this study, you allow us to keep your letters and answers for data analysis. The records will only be kept until the end of the master theses, and will thus be deleted after four months.

Your participation is voluntary and you can opt out at any time without having to give any reason. Your data will be handled confidentially. Your personal information will never be published in a way that you can be recognised.

The study is supervised by Dr. Nadine Köhle and Dr. Marcel Pieterse. It has been reviewed and received ethics clearance through the University of Twente Research Ethics Committee. If you have any questions about the study, you can contact us.

Contact persons:

Pauline Sophie Böllert (p.s.bollert@student.utwente.nl)
Sarah Felicia Schmeer (s.f.schmeer@student.utwente.nl)

"I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described by the researchers. My questions have been answered to my satisfaction. I agree voluntarily to participate in this study. I reserve the right to withdraw

from this consent without providing any reasons and I am aware that I may withdraw from the study at any time. If my research results are to be used in scientific publications or made public in any other manner, then they will be made anonymous. My personal data will not be disclosed to third parties without my permission. If I request further information about the research, now or in the future, I may contact the person mentioned."

German

Liebe(r) Teilnehmer(in),

Sie sind eingeladen, an der Studie "Liebesbriefe an unser Smartphone und Social Media" teilzunehmen. Smartphones sind allgegenwärtig in der heutigen Welt und Menschen benutzen sie regelmäßig und für unterschiedliche Zwecke - zum Beispiel für Social Media und zur Gesundheitsförderung.

Ziel dieser Studie ist es, herauszufinden, welche Art von positiven Emotionen Menschen für ihr Smartphone und Social Media empfinden. Diese Ergebnisse werden die bestehenden Erkenntnisse über die eher negativen Aspekte von Smartphones und Social Media ergänzen. Die Teilnahme an der Studie wird etwa 30 Minuten dauern.

Die Informationen, die Sie durch das Beantworten dieser Fragen mit uns teilen, dienen als Daten für unsere Masterarbeiten an der University of Twente in Enschede, Niederlande. Durch Ihre Einwilligung zu der Teilnahme an dieser Studie erlauben Sie uns, Ihre Briefe und Antworten für die Datenanalyse zu behalten. Die Informationen werden nur bis zum Ende der Masterarbeiten gespeichert und daher nach vier Monaten gelöscht.

Ihre Teilnahme ist freiwillig und Sie können jederzeit ohne Grund die Teilnahme beenden. Ihre Daten werden vertraulich behandelt. Ihre persönlichen Informationen werden nie in einer Weise veröffentlicht, dass Sie damit in Verbindung gebracht werden können.

Die Studie wird von Dr. Nadine Köhle und Dr. Marcel Pieterse beaufsichtigt. Sie wurde überprüft und genehmigt vom Ethik Komitee der Universität Twente. Sollten Sie noch Fragen haben, kontaktieren Sie uns bitte.

Kontaktpersonen:

Pauline Sophie Böllert (p.s.bollert@student.utwente.nl)

Sarah Felicia Schmeer (s.f.schmeer@student.utwente.nl)

„Hiermit erkläre ich, dass ich in einer verständlichen Weise über die Natur und Methoden dieser Forschung durch den Forscher informiert wurde. Meine Fragen wurden zu meiner Zufriedenheit beantwortet. Ich nehme freiwillig an dieser Studie teil. Ich behalte mir das Recht vor, meine Einwilligung zurückzuziehen, zu jeder Zeit und ohne mich erklären zu müssen. Falls die Ergebnisse der Studie veröffentlicht werden, werden meine Aussagen anonymisiert. Meine persönlichen Daten werden nicht ohne meine Erlaubnis an Dritte weitergegeben. Falls ich, jetzt oder in Zukunft, weitere Informationen zu dieser Studie haben möchte, kontaktiere ich die genannten Personen."

Appendix B – Love Letter instructions (Social media and smartphones)

English

On this and the following page, we ask you to write two letters in total (thus, one letter per page). On this page of the study, we are interested in **your personal experiences with and emotions toward social media platforms**. For that, we ask you to write a "**love letter**" to a social media platform (for example Instagram or Facebook) of your choice. You are allowed to write this letter in English or German.

In your letter, we ask you to write about positive experiences you have made and/or are still making with your chosen social media platform. Consider your chosen platform as the person you are having a relationship with.

You are being asked to write about topics such as how you met each other, why you chose to be in this relationship, and what you love about your partner (the social media platform). Feel free to add topics you regard as important. However, you should need **not much more than 10 minutes** to finish your love letter. Thus, it is important that you just write about what comes into your mind first: Be spontaneously and do not think too much about what exactly you write. The letter should be about your personal experiences and arguments, and not about your grammar, spelling, etc. Thus, feel free to write whatever feels right for you in this letter: There are no right or wrong answers!

We now ask you to write a love letter to your smartphone in which you imagine your smartphone as your partner in supporting your physical or mental health (i.e. via a pedometer, a mindfulness or running app). In the letter, please explain your positive, loving feelings for your smartphone and describe how it helps you to promote your health. Again, you can write the letter in English or German, and there are no right or wrong answers. Also keep in mind that you should not spend more than 10 minutes on the writing process.

German

Auf dieser und der nächsten Seite bitten wir Sie darum, insgesamt zwei Briefe zu schreiben (d. h. ein Brief pro Seite). Auf dieser Seite der Studie sind wir interessiert daran, **Ihre persönlichen Erfahrungen mit und Emotionen gegenüber Social Media** zu untersuchen. Dafür bitten wir Sie darum, einen „**Liebesbrief**" an ein soziales Medium (beispielsweise Instagram oder Facebook) Ihrer Wahl zu schreiben. Sie dürfen diesen Brief auf Englisch oder auf Deutsch schreiben.

Sie werden darum gebeten, in diesem Brief über die positiven Erfahrungen zu schreiben, die Sie mit Ihrem gewählten Medium gemacht haben bzw. machen. Sehen Sie das soziale Medium als eine Person, mit der Sie eine Beziehung führen. Schreiben Sie über Themen wie ihr gemeinsames Kennenlernen, wieso Sie sich dazu entschieden haben, eine Beziehung miteinander einzugehen, und was Sie an Ihrem Partner (dem sozialen Medium) lieben. Sie können gerne weitere Themen mit in Ihren persönlichen Brief aufnehmen, jedoch sollten Sie **nicht viel mehr als 10 Minuten** benötigen, um den Liebesbrief zu schreiben. Daher ist es wichtig, dass Sie schreiben, was Ihnen als erstes in den Kopf kommt: Seien Sie spontan und denken Sie nicht so viel darüber nach, was genau Sie schreiben. Der Brief soll um Ihre persönlichen Erfahrungen und Argumente gehen, und nicht um richtige Rechtschreibung, Grammatik o. ä. Fühlen Sie sich daher einfach frei, zu schreiben, was Sie für richtig halten: Es gibt keine richtigen oder falschen Antworten!

Wir bitten Sie nun, einen Liebesbrief an Ihr Smartphone zu schreiben, in dem Sie sich Ihr Smartphone als Ihren unterstützenden Partner für Ihre körperliche oder mentale Gesundheit (z.B. durch einen Schrittzähler, eine Achtsamkeits- oder Laufapp) vorstellen. Bitte beschreiben Sie in dem Brief Ihre positiven, liebevollen Gefühle für Ihr Smartphone und beschreiben Sie, wie es Ihnen hilft ein gesünderes Leben zu führen. Auch diesen Brief können Sie auf Deutsch oder Englisch schreiben. Bitte beachten Sie, dass es keine richtigen oder falschen Antworten gibt und dass Sie nicht länger als 10 Minuten für das Schreiben benötigen sollten.

Appendix C – TWEETS Current Engagement (Kelders and Kip, 2019)

Thinking about using health-promoting apps recently, I feel

1. using health-promoting apps is part of my daily routine
2. the health-promoting apps are easy to use
3. I'm able to use the health-promoting apps as often as needed to achieve my goals
4. the health-promoting apps make it easier for me to work on my goals
5. the health-promoting apps motivate me
6. the health-promoting apps help me to get more insight into my my health
7. I enjoy using health-promoting apps
8. I enjoy seeing the progress I make in health-promoting apps
9. The health-promoting apps fit me as a person

Answers in a 5-point Likert scale (0 = strongly disagree, 1 = disagree, 2 = neutral, 3 = agree, 4 = strongly agree)

Appendix D – Coding Scheme and Frequencies

Category	Code	Definition	Quote	Frequency
Positive Emotions	Gratitude	Participant expresses thankfulness for smartphone	*"I am grateful that you support me in keeping track of my health and my lifestyle."*	29
	Love	Participant expresses deep affection, strong relationship and a kind of dependence to smartphone	*"You are always there for me whenever I need you."*	21

Inspiration	Participant feels engaged and motivated by smartphone	*"You help me to focus on my health and made me try meditation"*	17
(Anticipatory) Enthusiasm	Participant refers to excitement, motivation and engagement created by smartphone	*"My life would be a lot less enjoyable without you and I would know less about the world."*	16
Achievement	Participant refers to a feeling of pleasure in an achievement that was accomplished with help of smartphone	*"Thanks to you, I have my asthma under control and do not need to see the doctor as often anymore."*	14
Trust	Participant expresses great reliance on smartphone	*"You know more about me than anybody else."* *"You are a reliable partner."*	9
Hope	Participant expresses optimistic	*"Here's to many more years together*	5

		thoughts about future and possibilities of smartphones	*in which you accompany me.”*	
Roles of Smartphone	Partner	Participant experiences smartphone as a partner with the same goals	*“You are a reliable partner for my physical health.”*	6
	Teacher	Participant describes smartphone as a coach, that educates, motivates and tracks progress	*“You almost take the role of my yoga teacher.”*	5
	Friend	Participant experiences smartphone as a close friend to confide and rely on	*“You are my best friend.”*	3
Personal Assistant	Support	Participant shows ways in which smartphone offers support in daily life	*“You remind me to take my medication and handle my work shifts.”*	23