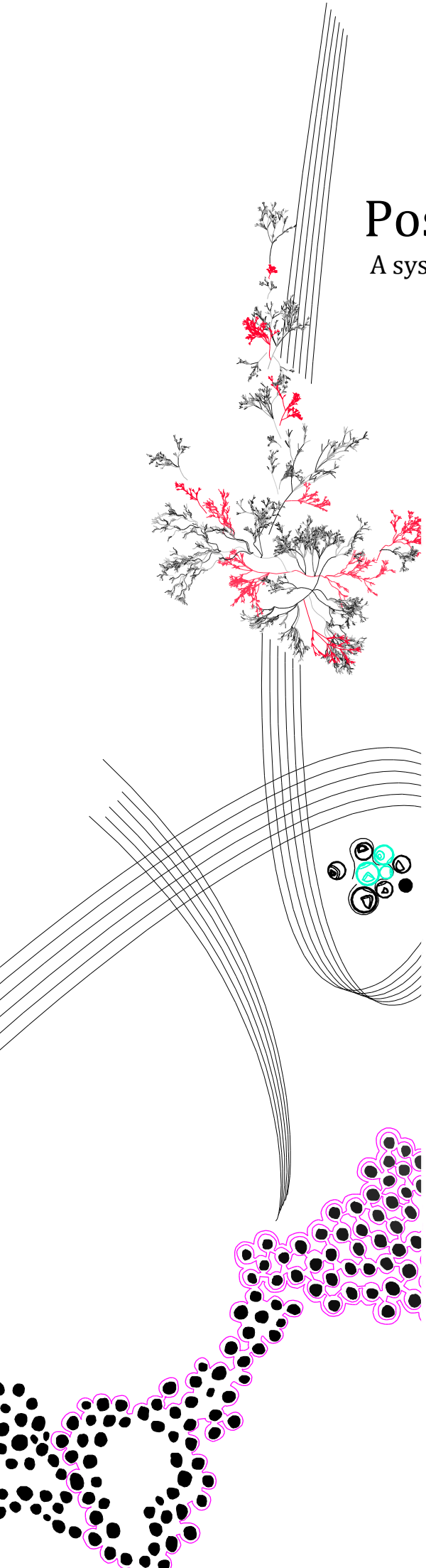

Positive Psychology Apps

A systematic review of current positive psychological apps aiming to increase happiness

Lea Feldmann, s1352792

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Faculty of Behavioral, Management and Social Sciences

University of Twente, Enschede,
The Netherlands

Examination Committee:

1st supervisor: Dr. Peter ten Klooster

2nd supervisor: Dr. Saskia Kelders

UNIVERSITY OF TWENTE.

Abstract

Background: Studies indicate that happiness can have positive effects on physical and mental health as well as on cognitive functioning. To offer everyone face-to-face help to develop greater happiness, more psychologists, time and money would be needed. Mobile applications could be a solution to this problem. Unfortunately, until now, only few studies concerning the evaluation of quality of these applications exist. This study examined the quality of a selection of apps based on the following criteria: Theoretical background, use of persuasive system design principles and subjective quality.

Methods: A systematic approach was applied to the search and assessment of apps available in the German Google Play Store aiming to enhance the user's level of happiness. Finally, after a detailed selection process based on several in- and exclusion criteria concerning the apps' relevance for this study, 11 apps were assessed for further analysis. By using a preliminary developed coding scheme, the researcher evaluated the extent to which theoretical elements of Authentic Happiness Theory (AHT) as well as empirically supported positive psychological exercises and Persuasive System Design (PSD) elements were used within the apps. Subjective quality was assessed using the Mobile Application Rating Scale (MARS) as well as user information provided by the Google Play Store.

Results: Most apps had a moderate theoretical background since they included only a few elements of AHT. Additionally, only a few established positive psychological exercises were used to promote happiness. Persuasive System Design Elements were incorporated to a moderate extent. Expert ratings on subjective app quality were also moderate whereas the average app store rating by real users tended to be higher. No significant relationship could be found between the subjective expert ratings of app quality and the average app store ratings of real users or the number of downloads.

Conclusion: Most apps aiming to promote happiness still lack theoretical foundation. Additionally, the use of Persuasive System Design elements could be improved to increase adherence. Most apps were not highly rated on subjective quality which could be due to the fact that they often lack interactivity within their features. Given that app stores still lack a standardized quality rating for users, it would be advantageous to develop a professional quality seal for the extent to which an app is based on theory as well as how subjective quality is rated. Through this study, a first step to the development of such a framework has been made.

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1. Introduction

1.1 The concept of "happiness" in Positive Psychology

In the year 1998, when Positive Psychology was born, a paradigm shift in the field of Psychology began to develop. Two of the founders of this approach, Martin Seligman and Mihaly Csikszentmihalyi were appealing to focus more on happiness and wellbeing and on how people may "flourish" in their lives than simply concentrating on mental illnesses like traditional psychology does. So, one aim of Positive Psychology is to increase people's happiness instead of correcting their weaknesses.

Happiness has been a topic of interest for centuries. Aristotle described happiness (Eudaimonia) as "the ultimate purpose of human existence" and this has not changed until today, more than 2300 years later. However, what it means to be happy is different for everyone. People want to be *happy*, to have a "good life", to be satisfied and to feel well. Some people would say that their happiest vision of life would include a shiny new car, a big house with a pool and a high amount of money on their bank account. Others would name health as indication for happiness and some would describe it as having a cup of hot chocolate on a winter day or a holiday with their loved ones.

Consequently, finding a concrete definition for the concept of happiness is difficult. Many researchers avoid using it as a term, because of its vagueness, while others do not make any distinctions between happiness, well-being or life satisfaction. Lyubormirsky, Sheldon and Schkade (2005) refer to happiness as *subjective*. This may be due to the fact that the perception of happiness can differ across cultures and even individuals. Also, Myers and Diener (1995) argue that the final judge of his or her own happiness should be "whoever lives inside a person's skin"(Myers & Diener, 1995, p.11).

Although a clear definition of happiness does not exist, Martin Seligman's (2002) Authentic Happiness Theory tries to explain a way to increase an individual's happiness. Within this theory, three paths to happiness are presented: (1) Positive Emotion (Pleasure), (2) Engagement and (3) Meaning. Even though each path can be pursued independently, all of them contribute positively to happiness, according to Seligman's theory.

Seligman bases his hypothesis, that positive emotions may predict the longevity of people's lives, on a study by Danner, Snowdon and Friesen (2001), which showed that two nuns who lived their lives in the same cloister under the same living conditions had different life expectancies. One of the nuns died at the age of fifty-nine of a heart stroke and the other

one was still alive at the age of ninety-eight. To have a retrospective look at their life history the nun's novitiate essays were read. It was striking that the one who died very early did not mention any words representing positive emotions. Unlike the one who still lived at the age of ninety-eight. Seligman's (2002) conclusion was that the happier people, the higher their life expectancies are.

Beside positive emotions, there are two other paths to happiness according to Authentic Happiness Theory (Seligman, 2002). Engagement is the second one. People who are engaged in activities which really immerse them may get into a state of flow when the self is lost and attention is solely focused on the activity. The experience of flow will strengthen the one experiencing it (Csikszentmihalyi, 2014). According to Seligman (2002), engagement will heighten people's life satisfaction, especially when people engage into their own strengths.

The third path to happiness, meaning, plays a big role in people's lives. The pursuit of meaning is widely endorsed. *"You must be the change you wish to see in the world"* said Gandhi once and his quote confirms the importance of purpose in life. When individuals undertake activities that contribute to a life goal they feel that their life has sense. Such activities may be raising a child or volunteering for a hospital. How people find meaning in their lives may differ, but according to Authentic Happiness Theory it is crucial for everyone to be happy. Seligman's theory has been supported through research conducted by Peterson, Park and Seligman (2013). 845 adults responded to internet surveys which measured to what extend the three orientations to happiness (positive emotions, engagement and meaning) predicted a good, and thus happy life. All three paths to happiness correlated independently from each other with life satisfaction.

In particular, the effects of positive emotions have been researched widely. Next to the study by Danner et al. (2001), much research has been done to show that positive emotions can be associated with advantageous physical and psychological health outcomes such as a better functioning immune system, benefits for people with cardiovascular disease, enhanced creativity, better cognitive functioning and more stable relationships (Isen, 1987; Lyubormirsky, King & Diener, 2005; Mahoney, Burroughs, & Lippman, 2002; Tugade, Fredrickson & Barrett, 2004).

Barbara Fredrickson (2004) developed the 'Broaden-and-Build Theory', a specific theory on how positive emotions contribute to people's happiness. According to her theory, positive emotions broaden our mind so that we are able to think and act in new creative ways. Negative emotions in contrast narrow the mind (fight-or flight). The 'build-effect' is a

consequence of the broadened mindset. Ghaye (2011) explained it the following way: “by broadening an individual's momentary thought-action repertoire-whether through play, exploration or similar activities, positive emotions promote discovery of novel and creative actions, ideas and social bonds, which in turn build that individual's personal resources; ranging from physical and intellectual resources, to social and psychological resources”(Ghaye, 2011, p.71). Thus, the Broaden-and-Build Theory suggests that positive emotions broaden our mind to function in a better, more creative way which then causes that more physical, intellectual, psychological, and social resources are built. In conclusion, positive emotions seem to have a great influence on people’s happiness.

Thus, the importance of addressing happiness lies in the fact that happier people are often healthier people, not only physically, but also psychologically. As research has shown, happier people are also more creative and have a better cognitive ability so that also workplace functioning may be enhanced. More happiness caused by more positive emotions may even predict a longer live. Happy people have a purpose in life and thus see a meaning in their existence.

1.2 Momentary or enduring happiness

Through Authentic Happiness Theory, several factors which may contribute to people’s happiness have been explained. Nevertheless, the effect of contextual and biological factors needs to be clarified. There are still many people who would name ‘money’ as the main factor of context influencing their level of happiness. However, research has shown that circumstances like winning a high amount of money in the lottery may increase one’s level of happiness, but only for a short time. A couple of months later, happiness will be at the same level as it was before (Brickman, Coates & Janoff-Bulman, 1978). According to Seligman (2002), it is therefore important to distinguish between ‘momentary happiness’ which can be increased by eating chocolate, watching a comedy film or new clothes and ‘enduring happiness’ which describes the general state of happiness in an individual’s life. Thus, reaching a higher level of ‘general happiness’ is more important than increasing short moments of it.

1.3 Intentional self-help activities to promote happiness

Lyubormirsky et al. (2005) developed a theory which may explain the impact of biological and contextual factors but also to what extent people may be able to change their level of general happiness by their own voluntary actions. The "Architecture of sustainable happiness" describes that the genetic happiness set point is responsible for 50% of our enduring happiness level, while contextual factors only account for 10%. The last factor, named 'positive cognitive, behavioral and goal based activities' counts for 40% of an individual's happiness level (Lyubormirsky et al., 2005). So, it seems to be possible to change people's level of enduring happiness through intentional activities. Intentional activities are "discrete actions or practices in which people can choose to engage" (Lyubormirsky et al., 2005, p.118). Thus, they define these positive activities as "simple, intentional, and regular practices meant to mimic the myriad of healthy thoughts and behaviors associated with naturally happy people." (Lyubormirsky & Layous, 2013, p.57) An example for such an activity may be „being kind to another person". As research suggests, kindness makes people feel happier (Otake, Shimai, Tanaka-Matsumi, Otsui & Fredrickson, 2006). Lyubormirsky and Layous (2013) and Sin and Lyubormirsky (2009) found empirical evidence that the following activities may enhance happiness and wellbeing and decrease depressive symptoms: *(1) writing gratitude letters (2) counting one's blessings (3) being kind, (4) cultivate strengths (5) visualize ideal future selves and (6) meditate*. A huge advantage of these practices besides increased happiness is that the activities do not cost much time and are cost-effective as well since they are self-administered (Lyubormirsky & Layous, 2013).

Seligman, Steen, Park and Peterson (2005) were also searching for self-help activities which may increase one's level of happiness and found the following six exercises which agree largely with the findings of Lyubormirsky and Layous (2013): *(1)Writing down early life memories, (2)writing gratitude letters, (3) writing about three good things that happened each day and why they happened, (4) writing a story about one's best possible self, (5) using signature strengths of character in a new way, (6) writing down five highest strengths and to use them more often*. Sin and Lyubormirsky (2009) did a meta-analysis on the effectiveness of such positive activities and concluded that "clinicians should encourage their clients to regularly practice and keep a record of positive strategies, to incorporate these strategies into their everyday lives, and to turn these strategies into habits" (Sin & Lyubormirsky, 2009, p.14) . They also found that it is more effective to engage in multiple different positive activities instead of doing only one exercise. In contrast to that, another study by Schueller and Parks (2012) suggests that too many choices of exercises might overwhelm the user.

These studies show that it is possible to pursuit happiness. Even if the set point of people's happiness level is determined by genetics for 50%, there is 40% room for improvement of happiness through positive actions.

1.4 Mobile interventions for greater happiness

To enhance happiness in the overall population using traditional intervention strategies, many psychologists and much time and money would be needed. Those resources are generally not available in the necessary amount. The term "mental health gap" refers to the problem that many people with subclinical symptoms of distress have no access to quality interventions. To close this gap a way through which everybody can get access to interventions without ever being used up has to be developed. Thus, interventions have to be designed in a way that makes them "non-consumable" (Muñoz, 2010).

Online Positive Psychological Interventions (OPPI's) offer the service of a psychological intervention using an online environment to reach more people within short time and at little costs. Unlike therapists or medications they cannot be used up because of too much request (Bolier & Abello, 2014).

Online interventions aim to promote people's well-being and thereby prevent people from developing mental illnesses by using online technology in the general population as well as "to improve human experience and engage people to reach their targets in real life, which is clearly aligned with the goals of positive psychology" (Bolier & Abello, 2014, p.289).

Instead of sitting at home in front of computer screens, people nowadays make more and more use of mobile technologies like tablets or smartphones. The combination of mobile devices and online self-help-interventions is described by the term "mHealth" (mobile health) and is defined as " medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDA's) and other wireless devices" (WHO, 2011).

Since it was introduced 20 years ago, mHealth is growing rapidly (Hussein, Harun & Oon, 2016). Mobile technology offers many advantages. People are no longer bound to a specific place; they are able to integrate health interventions into their daily routine. Hussein et al. (2016) state that the use of mobile gadgets may have the power to deliver health care to every individual across the globe.

Apps stores are offering a huge amount of mHealth applications. According to statistics published by 'The mobile health global market report' (2013–2017**)** more than

97,000 mHealth applications are listed on 62 full catalogue app stores. “By 2017, the mHealth market will be a mass market with a reach of more than 3.4 billion smartphones and tablets with access to mobile applications. By that time, 50% of these users will have downloaded mHealth applications.”(Research2Guidance, 2013). Every smartphone or tablet offers the possibility to run apps, small programs with the ability to function on mobile devices with a touchscreen. Because they are independent from any location, health interventions which are implemented into a smartphone application overcome difficulties like limited time.

The variety of health related apps is huge. They help people to engage in fitness programs with guidance on diet and nutrition or motivate to work out or even to relax (Hussein et al., 2016). People who are seeking greater wellbeing can engage with thousands of downloadable self-help applications too (Howells, Ivtzan & Eiroa-Orosa, 2014). However, there is hardly any evidence of the quality of mhealth apps in general. Since everybody is allowed to create an application they do not need to be based on any scientific theory or based on specific guidelines. Bolier and Abello (2014) appeal for more research on the quality of those applications and to give the user the possibility to choose one on the basis of quality evaluations. For instance, research has shown that apps which are based on scientific theories tend to be more effective than the ones which do not have any theoretical background (Bolier & Abello, 2014). Thus, it seems to be important to investigate the theoretical background of apps claiming to enhance happiness. Until now, no study tried to find out which kind of apps can be found in an app store when searching for apps promoting happiness. Also the extent to which apps which are aiming to enhance happiness are based on psychological theories or positive psychological exercises with the same purpose has not been investigated.

In addition to the theoretical background and the use of positive psychological exercises, another quality criterion of mobile applications may be the use of persuasive technology which can be defined as interactive information technology designed to change users’ attitudes or behavior (Fogg, 2003). According to Bolier and Abello (2014) persuasive elements “promote adherence and improve effectiveness by helping people to stay involved” (Bolier & Abello, 2014, p.301). Thus, persuasive elements in technology seem to account for a significant amount of variance in adherence and intervention effectiveness. Research has shown that online interventions still are not as effective as they could be and that this could be countered by using persuasive technology (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012).

To overcome the lack of adherence in online interventions, a model presenting a variety of persuasive design principles has been created. The Persuasive System Design

Model (PSD; Oinas-Kukkonen & Harjumaa, 2009) gives an overview of four different categories of design principles which should be taken into account when creating web-based interventions. As mobile health apps can also be regarded as web-based interventions, this model can be applied to smartphone apps too. The four categories of the PSD are (1) Primary Task Support (2) Dialogue Support, (3) Credibility Support and (4) Social Support. Each of these categories include seven design principles which serve as guidelines for the design of mobile applications, such as the use of ‘reminders’, ‘personalization’, ‘expertise’ or ‘social facilitation’ . These design principles should also be taken into account when evaluating mobile happiness applications since they try to establish attitudes and behaviors that promote the user’s happiness. As the use of Persuasive System Design elements influences the user’s motivation to stay involved (Kelders et al., 2012), it is integrated into this study as the third quality criterion of mobile health apps aiming to increase happiness.

Finally, the subjective evaluation and rating of apps by different users is an important indicator for quality. Further, it is the only possibility for the lay user himself to get an impression of an app’s quality before downloading it. Generally, apps stores present the approximate amount of downloads, the number of reviews as well as the average user ratings represented by stars with a numeric value between 1 and 5. Those reviews provide the user with information on the grade of an App's quality as judged by real users.

But fake reviews written by collaborators of the developer or the developers themselves are frequently used to bring the app to a higher ranking position (Stoyanov, Hides, Kavanagh, Zelenko, Tjondronegoro & Mani, 2015). Another way to rate the subjective quality of mHealth Apps is to have experts rate all apps, for instance by using the ‘Mobile App Rating Scale”(MARS) developed by Stoyanov et al. (2015) . The scale is a multidimensional tool for classifying and assessing the quality of mobile health apps. By using this tool, the researchers are able to compare their own expert rating with the average rating in the particular app store as well as the amount of downloads. It is still not clear to what extent users may get a reliable measure of an app’s quality by focusing on the amount of downloads or the average star ratings when searching for an app aiming to promote happiness. Therefore it would be interesting to examine the validity of this data as compared with expert ratings of subjective quality and the use of Persuasive System Design elements.

1.5 Research questions

The preceding literature review has shown that happiness is an important issue in everyone's life. Although happiness is still a vague concept, several theories have found a way to describe this term or how to improve happiness. Research has shown how important it is to address happiness because of its benefits for mental and physical health as well as its positive impact on cognitive functioning and creativity. In consideration of the fact that mHealth is a fast growing field in the health sector and because of its potential to minimize the mental health gap, it seems necessary to investigate this topic. Even though the relevance of mHealth is emerging, there is hardly any evidence of the quality of those apps.

This study aims to give an overview of currently existing apps aiming to increase their user's happiness and their quality. Quality criteria examined are (1) the theoretical background, (2) the use of Persuasive System Design elements and (3) the subjective quality. By investigating this topic, this study might deliver important insights for future directions in the development of happiness applications. Thus, the research question for this study is "Which apps aiming to enhance happiness are currently available and what is their quality?". This is examined by answering the following sub-questions.

1. Which Apps, providing self-help to increase happiness are available in the German Google Play Store?
2. To what extent are these apps based on positive psychological theories?
3. Which self-help exercises are offered and to what extent are these based on scientific theory or evidence?
4. How are Persuasive System Design elements implemented?
5. How do subjective expert ratings correlate with the real user ratings, the number of downloads, the availability of theoretical elements and self-help exercises and the use of Persuasive System Design elements?

2. Methods

2.1 Selection process

For the selection procedure, a systematic approach was applied to the search and assessment of apps available in the German Google Play Store aiming to enhance the user's level of happiness. The target user group in this study is the general population. Since the App Store does not offer any possibility to sort or refine the search results, the final selection of apps was conducted manually .To get an overview of the search terms delivering the highest amount of relevant apps, some broad search terms were preliminary tested. For this study only search terms in English were chosen. The tested terms were: "positive psychology", "happiness", "happiness positive psychology", "feel happy", "positive emotions", "be happier", "increase happiness", and "gratitude". Terms like "positive psychology" and "happiness" proved too global to provide the desired outcomes. Other terms like "gratitude" were too specific and thus only provided apps concentrating on this topic. Finally "increase happiness" (250 results) and "happiness positive psychology" (126 results) were chosen as final search terms for this study because they provided the highest number of relevant apps. Any specific query to the Google Play Store provides a maximum of 250 apps, thus there may have been more than 250 results for "increase happiness".

On October 25, 2016 a total of 376 apps were found by using the final two search terms. An overview of all 376 results can be found in Appendix A. The total amount of apps was screened for the in- and exclusion criteria. 11 apps were finally selected for evaluation. *Figures 1-2* present a schematic representation of the selection process. The inclusion criteria were: (1) focus on increasing happiness, (2) no costs (free), since the selected apps should be accessible for everyone, (3) available in English to make the apps more comparable (4) average rating available as it was used as a variable to investigate the apps' quality. Exclusion criteria were: (1) obligatory costs, (2) no link to positive psychology, (3) religious background as apps with Hindu or Buddhist messages or symbols in their app store description , (4) one-sided focus on meditation/ mindfulness, (5) one-sided focus on gratitude, resilience or motivation, (6) only providing service to track mood or memories, (7) duplicates (8) in-app language not English, (9) only providing access to a magazine/articles/eBook and (10) technical problems. Apps with a one-sided focus on topics which are related to positive psychology were excluded because the finally selected apps should not be limited to one subtopic but offer a greater variety of features to get a more general impression.

Per search term, there were three steps in the selection process. First, the results were screened on costs, title and rating. From all 376 results of both search terms, 155 apps were

excluded since they included obligatory costs (n=59), were in another language than English (n=83), or had no rating (n=13). The second step involved the screening of the app store description for eligibility. From the remaining 221 apps, 123 were excluded because no apparent link to positive psychology could be found. 36 apps were excluded due to a religious background (n=13) or a main focus on meditation or mindfulness (n=23). Furthermore, the apps were screened on a one-sided focus on one single aspect to promote happiness. 33 apps were excluded due to a one sided focus on gratitude (n=19), resilience (n=2) or motivation (n=12). 12 apps were excluded because they only provided a service to rate mood or happiness (n=4), to collect memories (n=2) or because they were duplicates (n=6) since they were selected through both of the search terms. Finally, the remaining apps were downloaded to a Samsung Galaxy S6 (Android Version 6.0.1) and opened on the device. After this step, 6 apps were excluded due to a different in-app language (n=1), technical problems (n=2) or because they only provided access to an online magazine/eBook/articles (n=3). 11 apps remained for evaluation. Screenshots of this app selection can be found in Appendix A.

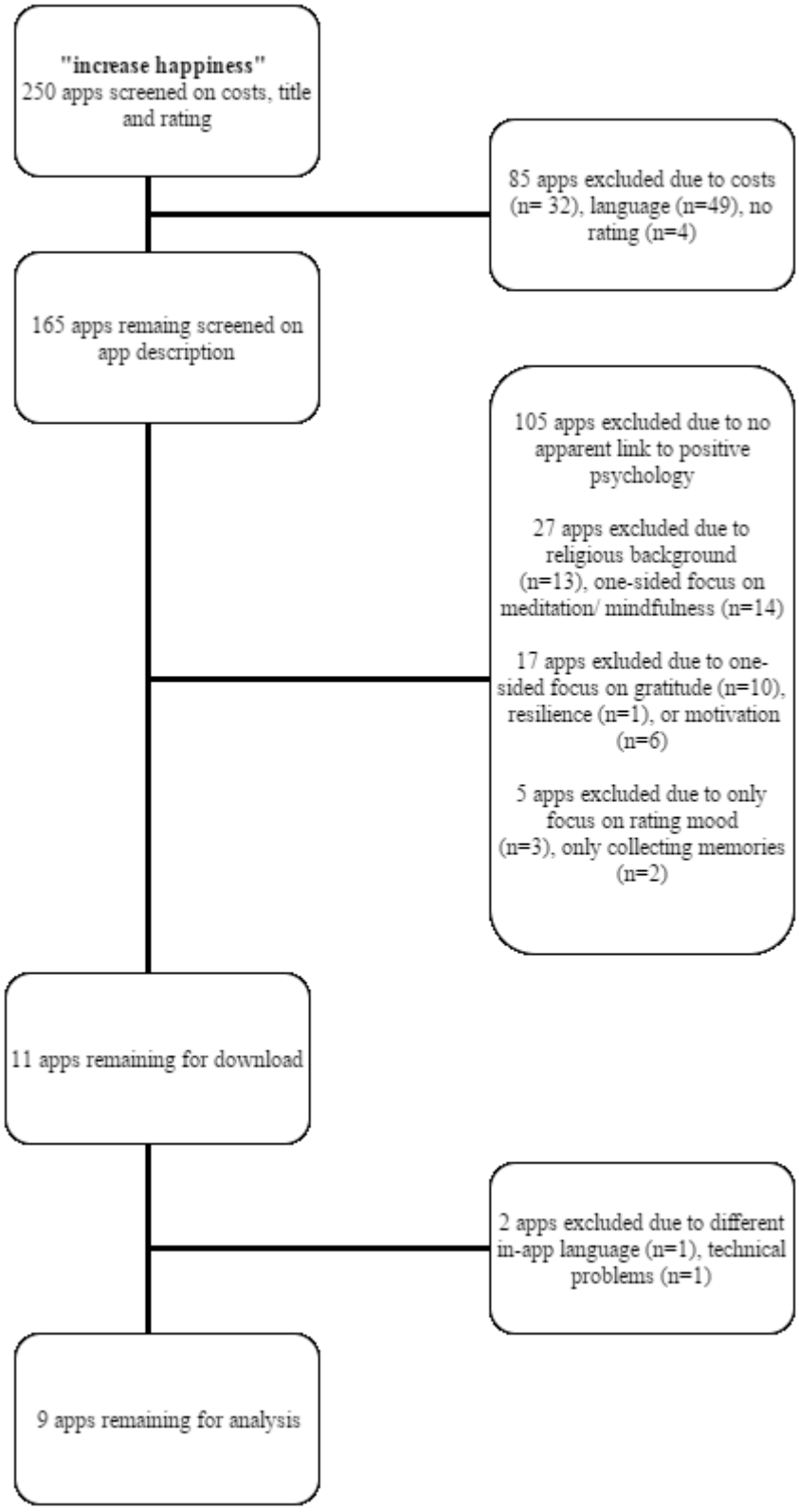

Figure 1. Selection process for the 1st search term "increase happiness"

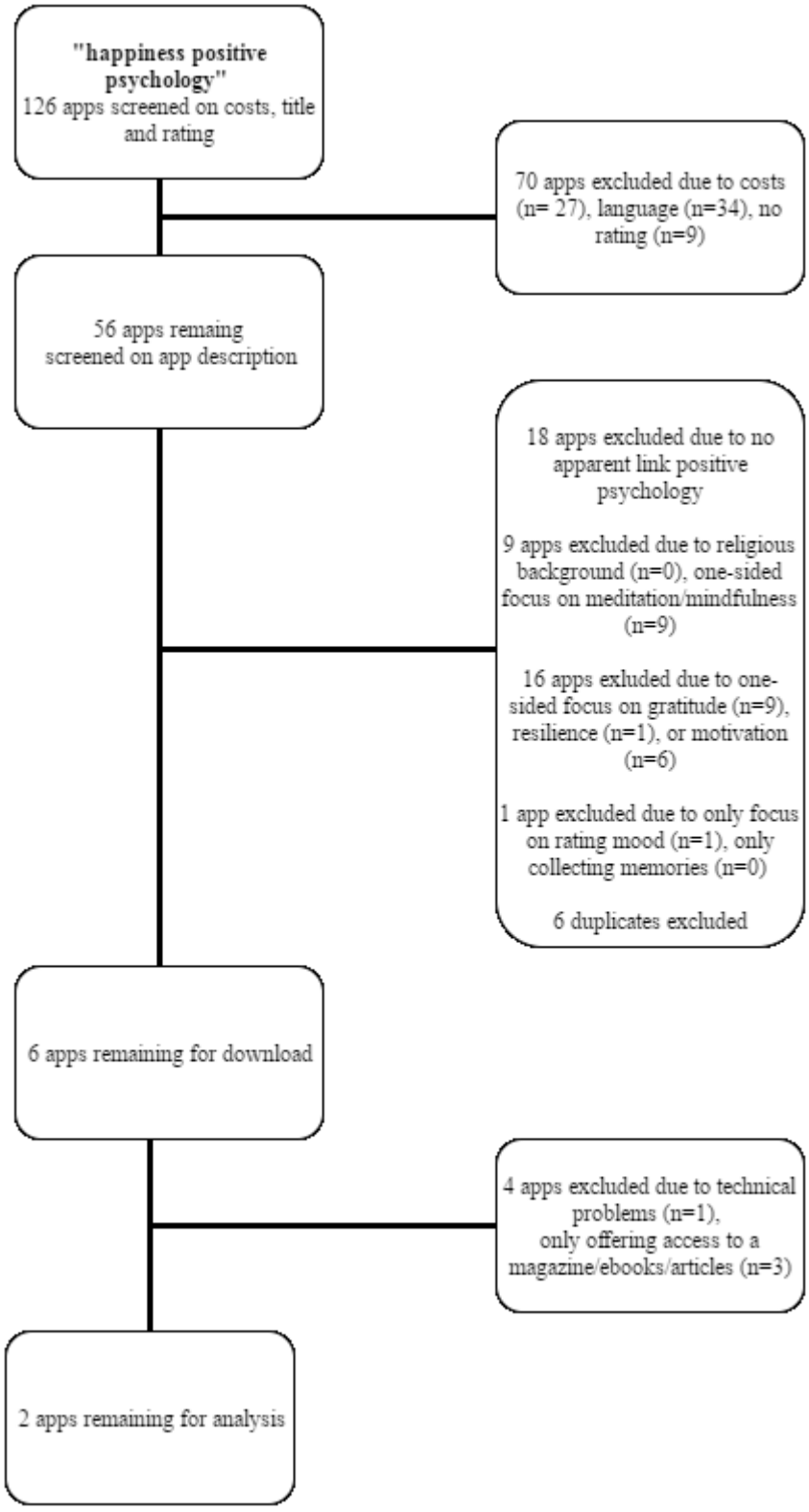

Figure 2. Selection process for the 2nd search term "happiness positive psychology"

2.2 App Evaluation

The selected apps were tested during a period of 7 days. Within this time, the apps were tested on their content by trying out all possible options the apps offered to their users. The criteria on which the apps were tested were: (1) theoretical background (and use of positive psychological exercises), (2) use of Persuasive System Design elements and (3) subjective quality ratings.

2.2.1 Theoretical background

To evaluate the theoretical background of the selected apps the researcher looked for elements from the Authentic Happiness Theory (Seligman, 2002) as well as for empirically supported positive psychological exercises (Seligman, et al., 2005; Lyubormirsky and Layous, 2013) within the apps. To find a systematic way to evaluate the theoretical background, a coding scheme which is based on the theory by Seligman (2002) as well as on the exercises mentioned by Seligman et al. (2005) and Lyubormirsky and Layous (2013) was created. This coding scheme is presented in *Table 1*.

To prevent confusion through overlapping, the different exercises were combined to six brief tasks. Therefore the exercises 'three good things', 'gratitude letter' and 'counting one's blessings (Seligman et al., 2005; Lyubormirsky & Layous, 2013) were combined to *expressing gratitude.* Also all tasks concerning 'strengths', 'using signature strengths of character in a new way', 'writing down five highest strengths and to use them more often' and 'cultivate strengths' (Lyubormirsky & Layous, 2013; Seligman et al., 2005) were summarized into one exercise, *cultivate strengths*. Furthermore, 'writing a story about one's best possible self' (Seligman et al., 2005) and "visualize ideal future selves' (Lyubormirsky & Layous, 2013) were counted as one task; *visualize ideal future selves*. *Mindfulness* was added to 'meditation' (Lyubormirsky & Layous, 2013) because it was also frequently combined within the app features. To get an overview of the total use of all theoretical elements presented in *Table 1*, it was examined which elements of "Authentic happiness Theory" (Seligman, 2002) and positive psychological exercises (Lyubormirsky & Layous, 2013; Seligman et al., 2005) could be identified within the different features of each app. A more detailed overview can be found in Appendix B.

Table 1. Coding scheme

Categories and codes	Theory and source that supports effectiveness and/or relevance
Authentic Happiness Theory	
Positive Emotion	Authentic Happiness Theory, Seligman (2002)
Engagement	Authentic Happiness Theory, Seligman (2002)
Meaning	Authentic Happiness Theory, Seligman (2002)
Self-help exercises promoting happiness	
Expressing gratitude	Seligman, Steen, Park and Peterson (2005) Lyubormirsky and Layous (2013)
Being kind	Lyubormirsky and Layous (2013)
Cultivate strengths	Seligman, Steen, Park and Peterson (2005); Lyubormirsky and Layous (2013)
Visualize ideal future selves	Seligman, Steen, Park and Peterson (2005) Lyubormirsky and Layous (2013)
Meditation/Mindfulness	Lyubormirsky and Layous (2013)
Writing down early life memories	Seligman, Steen, Park and Peterson (2005)

2.2.2 Persuasive System Design

Besides the theoretical background, the use of Persuasive System Design elements is an important factor to evaluate when assessing the quality of apps. To study the extent to which Persuasive System Design is implemented in each of the apps, the Persuasive System Design Model (PSD) by Oinas-Kukkonen and Harjumaa (2009) was applied. The four categories of the PSD are (1) Primary Task Support (2) Dialogue Support, (3) Credibility Support and (4) Social Support. There are seven corresponding principles for each category. An overview of all principles is presented in Appendix C.

By following the principles of the first category, “Primary Task Support”, app developers make sure that the user is lead to the primary task by the features of the system. The principles of the second category, “Dialogue Support”, help the users to keep moving towards their goal by giving system feedback. “Credibility Support” includes principles which ensure that the system is credible enough and thus based on authentic references or scientific

theories to be persuasive. Finally the principles of the last category "Social Support" describe how to design a system so that it motivates its users by offering social support (Oinas-Kukkonen & Harjumaa, 2009).

To measure the extent to which those principles were applied within the apps, per app the number of used principles was counted for each category of the PSD. Further a second score was calculated giving different codes for *non-availability* (score= 0), *availability to some extent* (score=1) and *availability to great extent* (score=2). By grading the extent to which a principle was applied, a more accurate score could be achieved. 'Available to some extent' means that the principle was applied but in a less professional or intensive way than principles which were 'available to great extent'. An example is that some apps provided only one reminder per day while others reminded the user several times a day. Some apps provided options to personalize the app content whereas others only included settings to customize the time of reminders. This shows the need for different graduations of availability rather than only a classification in availability or non-availability. A detailed overview of the scoring procedure is presented in Appendix C.

2.2.3 Subjective quality

A rating for the subjective quality rated by real users can be found in the app descriptions of common app stores provided that the particular app has been rated. The Google Play Store provides a measure for the average rating and the number of ratings as well as the approximate number of downloads. The average user ratings in the Google Play Store are represented by stars with a numeric value between 1 and 5. On what criteria these ratings are based is impossible to reconstruct and therefore remains unknown.

To gain deeper insight of the subjective app quality, an expert rating could deliver a measure which provides more detailed information based on different criteria. The 'Mobile App Rating Scale" (MARS) developed by Stoyanov et al. (2015) is such an instrument. The MARS is a validated and reliable scale which was developed to assess the quality of health apps. It consists of five quality scales which include 23 items in total. The first scale 'Engagement' consists of items concerning entertainment, interest, customization, interactivity, and target group; The second scale is about 'Functionality' with items about performance, ease of use, navigation and gestural design. 'Aesthetics' is the topic of the third scale with items concerning layout, graphics as well as visual appeal. The fourth scale, "Information quality" includes items relating to accuracy of app description, goals, quality

and quantity of information, visual information, credibility as well as evidence base. Additionally, the MARS provides a fifth scale measuring the overall conclusion the rater gives for an app with four items concerning recommendation, approximate time of use in future, willingness to pay for the app and overall star rating. All 23 items are measured on a 5-point scale, from 1= inadequate to 5=Excellent (Stoyanov et al., 2015). A score for each quality scale is calculated as the mean of the items in the particular scale; the overall score is the average score across the different scales.

By incorporating the MARS scale into this study, an expert rating of an app's subjective quality could be compared to the average user rating and the number of downloads provided by the app store. It was filled in by the researcher after seven days of app testing. When filling in the scale, the researcher tried to put herself in the position of an average user.

All 11 apps in this study were rated on the MARS by the researcher. Additionally a co-researcher filled in the same rating scale for five of the selected apps after testing the apps for the same time as the researcher. The inter-rater reliability coefficient for the average total scores per app was computed using the intra-class correlation coefficient (ICC). A high reliability was found between the two raters. The ICC for absolute agreement was .859 with a 95% confidence interval from .107 to .985 ($F(4.4)= 23.653$, $p=.005$) for single measures. *Figure 3* presents the averages of the total MARS ratings per app scored by the the two different raters in comparison to one another.

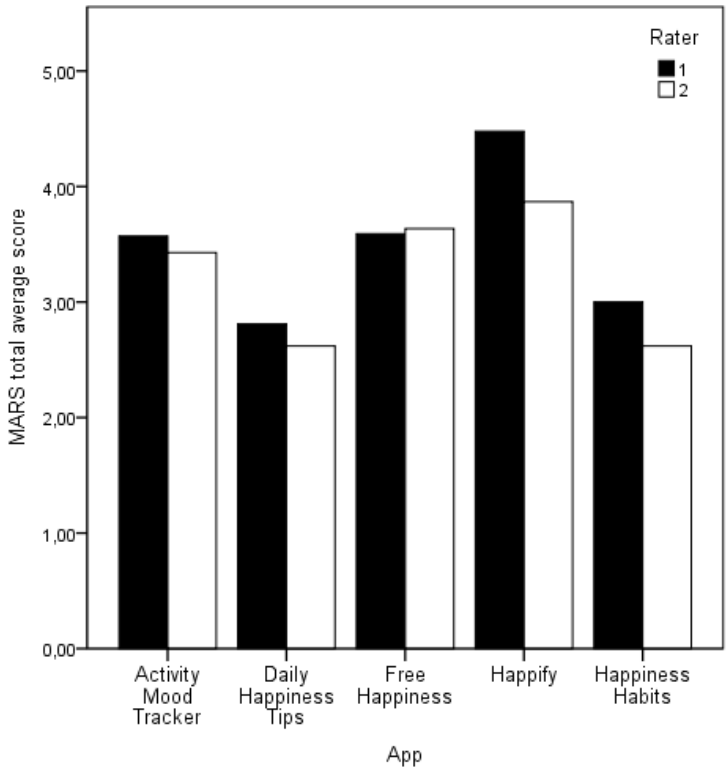

Figure 3. Compared average total MARS scores per app for the two different raters

3. Results

3.1 Availability of apps aiming to promote happiness

An overview of all 11 apps which were finally analyzed for this study is presented in *Table 2*. Additionally, the version number and the developers' names are stated below. Screenshots of the presentation of each app in the app store can be found in Appendix A.

Within this app selection, nearly half of the apps (Free Happiness, Happy Habits, Secret of Happiness, Jus'be happy, Activity Mood Tracker) provided a feature to either track current mood states like rating the happiness level by clicking on the appropriate smiley button as in the app 'Free Happiness' or to capture happy moments by writing down the positive things of a day as in 'Secret of Happiness' or by taking photos or voice recordings of those moments as in 'Jus'be happy'. Together with 'Happify', these apps ask the user to interact with them. Although 'Happify' does not provide a feature to log positive memories or emotions, it provided the highest number of interactive features within its numerous tracks and games. No other app provided an own social community platform within the app. In contrast to the more interactive apps, five other apps (Happy App, Happiness Habits, Daily Happiness Tips, Happiness Tips, Happiness Booster) only provided information via quotes or tips or also visually by showing funny pictures or videos (Happy App, Happiness Booster). These apps lacked interactivity because they did not demand any direct interaction of the user. Detailed descriptions of each app can be found in Appendix A.

Table 2. App description, version number and name of developers

No.	Title	Developer(s)	Version No.	Description
1	Free Happiness	Wowsery Inc.	1.101	rating of happiness level, gratitude logs and smile reminder, progress charts
2	Happify	Happify, Inc.	1.6.3R6832.d621565	different "tracks" to choose, different topics become happier, progress tracking, free happiness games, strength assessment, happify community
3	Happy Habits	Excel at Life	2.2.1	happiness assessment, happiness/emotion/relaxation audio guides, happiness journal, 50 suggestions to increase happiness, progress tracker
4	Happiness Tips	Waikiki Sky	1.01	hundreds of happiness tips which can be saved or shared with friends
5	Happiness Habits	Arrowshark	1.02	list of activities to increase happiness, reminder each day
6	Secret of Happiness	ShreeK	2.1	30 day challenge, reminder to do happiness exercises in the morning (enter 3 good things & one thing you wish to accomplish that day) and in the evening (enter one thought/person/event you are happy about)
7	Daily Happiness Tips	Chris Croft Training	1.0	practical guide for more happiness, everyday a new suggestion to get more happiness in life
8	Jus' be happy	Ashok Kumar V	1.4	customize happiness activities, create own activities or use suggested, rate happiness intensity after each activity, happiness meter to see progress, goal setting, happiness quotes can be edited, deleted or created, capture happy moments

9	Happy App	Jrim software	1.0	provides inspiring quotes, funny videos or pictures and stress relieving tips to increase happiness
10	Happiness Booster	Meewolti Studio	2.2	by shaking the device, funny pictures and sentences displayed in four stages (changing perception, embedding smile, initializing happiness) to increase happiness
11	Activity Mood Tracker	MoodTools	1.2	personalized random activity generator, suggests different activities, own activities can be added, mood rating before and after activity, activity history can be viewed

3.2 Overview of findings

The overall findings of this study in detail are presented in a table in Appendix E. All Apps included at least one element of Seligman's Authentic Happiness Theory (2002). Furthermore, in most apps several features resembled one or more established positive psychological exercises described by Seligman et al. (2005) and Lyubormirsky and Layous (2013). Persuasive System Design (PSD) elements (Oinas-Kukkonen & Harjumaa, 2009) could be identified in every App. The number of incorporated principles varied between 2 and 22. Also the scores which give a more detailed measure of the extent to which those principles were incorporated, differed widely between 3 and 40 points in total. The mean scores of the different scales of the Mobile Application Rating Scale (MARS) varied between an average score of 2.43 and 4.48. Compared to that, average app store ratings only varied between 3.4 and 4.9. The number of downloads is only given as an approximate orientation which differed from 100 to 100,000 downloads per app.

3.3 Theoretical background

All 11 apps, which were selected for this study, were analyzed for the extent to which they are based on scientific theories. Only 4 of the apps stated in their app description in the app store or within the app itself that they are based on scientific theories. Besides one app, which refers to Cognitive Behavioral Therapy, all of these stated to be based on positive psychology. One of the apps, *Happiness Habits,* explicitly mentioned to be based on the work of Lyubormirsky as well as Fredrickson and Biswas-Diener. Seligman's Authentic Happiness

Theory (2002) was not explicitly mentioned by any of the apps. However, in every app at least one theoretical element of AHT could be found. Furthermore, most apps (n=9) included at least one exercise that could be coded as resembling the self-help exercises by Seligman et al. (2005) and Lyubormirsky and Layous (2013). *Table 3* gives an overview of the theoretical elements of AHT by Seligman (2002) with the respective numbers and percentages of the apps within which the elements could be recognized. Additionally the positive psychological exercises by Seligman et al. (2005) and Lyubormirsky and Layous (2013) are listed together with the respective numbers and percentages of their appearance within the particular app

Table 3. Theoretical basis of apps promoting happiness

Theoretical background	Number of apps including element
Authentic Happiness Theory by Seligman (2002)	
Positive Emotion	11 (100%)
Engagement	5 (45.4%)
Meaning	1 (9.1%)
Self-help exercises promoting happiness by Seligman et al. (2005) and Lyubormirsky & Layous (2013)	
Expressing gratitude	7 (63.6%)
Being kind	5 (45.4%)
Cultivate strengths	1 (9.1%)
Visualize ideal future selves	0 (0%)
Meditation/Mindfulness	4 (36.4%)
Writing down early life memories	3 (27.3%)

3.3.1 Authentic Happiness Theory

Although AHT was not mentioned in any of the apps explicitly, in each app at least one element could be recognized. The only element of AHT which was found in all apps was Positive Emotion (n=11). A link to positive emotions was found within features like the 'Smile Reminder' from Free Happiness which asked the user to smile. Likewise, the Happy App tried to make the user laugh or smile by showing funny pictures, videos or jokes and the Happiness Booster asked the user to hold a smile for three seconds. A different feature

relating to positive emotions was the 'Uplift Game' within Happify. Here, the user had to collect points by clicking on balloons with positive words on them, including words associated with positive emotions. *Figure 4* shows a screenshot of this game. Other apps like Happy Habits, Happiness Tips, Happiness Habits, Daily Happiness Tips and Activity Mood Tracker were linked to positive emotions within their suggestions presented in the App. A screenshot of one example of such a suggestion is presented in *Figure 5*. Other apps like Secret of Happiness and Jus'be happy included features to record happy moments and look back at them. Thus, a link to positive emotions was found in enjoyable and funny features which aim to make the user smile or feel happy through amusement, fun or focusing on happy occasions. The second element of AHT, engagement, was identified in almost half of the apps (n=5). Features which are linked to engagement were found in Happy Habits, Secret of Happiness, Daily Happiness Tips, Jus'be happy and Activity Mood Tracker which included different features to encourage the user to engage in different activities which even might lead him or her to a state of flow. As an example, Activity Mood Tracker and Jus' be happy both listed different activities which might enhance the user's mood. The third element of AHT, meaning, was found only in the Happy Habits apps. The App encouraged the user to "act as if what I do makes a difference". Happy Habits was also the only app, within which all three elements of AHT could be identified.

Figure 4. Screenshot of the Uplift Game

Figure 5. Screenshot Happy Habits

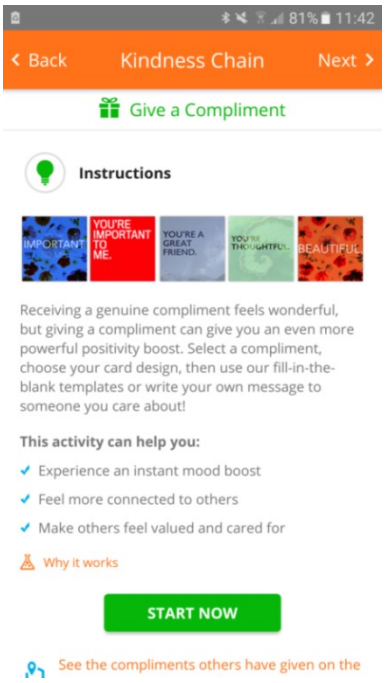

Figure 6. Screenshot of 'kindness chain' from Happify

3.3.2 Self-help exercises to enhance happiness

The number of identified features resembling positive psychological self-help exercises differed between no exercises at all and 4 in total per app. Thus, the researched apps included 1-2 exercises per app (M=1.81, SD= 1.25). The App with the highest number of incorporated exercises (n=4) was Happy Habits, followed by Happify and Activity Mood Tracker which incorporated 3 exercises each. Further, Happiness Tips and Happiness Habits provided the third highest number of incorporated self-help exercises to enhance happiness. The remaining apps included either only one exercise (Free Happiness , Secret of Happiness, Daily Happiness Tips, Jus'be Happy) or no one at all (Happy App, Happiness Booster). Of all six self-help exercises by Seligman et al. (2005) and Lyubormirsky and Layous (2013) looked for in this study, 'expressing gratitude' was provided in most of the apps (n=7) as shown in *Table 3*. Apps including this exercise provided either a gratitude log ("Each night before you sleep, complete the following statement: I am thankful for…", "enter three good things you are grateful about") or asked the user to think of the things he or she is grateful about ("Set up a screensaver on your computer to remind you that you have a good life"). Also the exercise 'being kind' could be found in nearly half of the apps (n=5). Apps including this task, mostly gave suggestions to do something for another person, such as "Make at least 3 people smile each day". The Happify app even has a feature named "kindness chain" which gives enables the user to send a 'compliment card' to a friend. A screenshot of the 'kindness chain' is

presented in *Figure 6*. The exercise ‘cultivating strengths’ could only be recognized in one app (Happify) which included an assessment to discover signature strengths. Features resembling the task ‘visualize ideal future selves’ could not be found in any of the apps. Compared to that, ‘Meditation or Mindfulness’ exercises could be found within some more apps (n=4). Apps including meditation mostly provided, guided meditation through audio files or asked the user to watch a guided meditation video on another platform (YouTube). The Happify app even provided a screen showing an animated ‘serenity scene’ as a calm beach including all its sounds. Three apps had features implemented which resembled the task ‘writing down early life memories’. This was mostly done by suggestions as to ” look at old photos and remember the fun times you had” or by interactive features which enabled the user to record his or her happy moments via photos, videos or a voice record and to look back at them later. *Table 4* presents an overview of the availability of self-help exercises for each app.

Table 4. Availability of self-help exercises per app

		Type of exercise						
No.	Title	PG	BK	CS	VS	M	EM	Total
1	Free Happiness	**x**						1
2	Happify		**x**	**x**		**x**		3
3	Happy Habits	**x**	**x**			**x**	**x**	4
4	Happiness Tips	**x**	**x**					2
5	Happiness Habits		**x**			**x**		2
6	Secret of Happiness	**x**						1
7	Daily Happiness	**x**					**x**	2
8	Jus' be happy	**x**					**x**	2
9	Happy App							0
10	Happiness Booster							0
11	Activity Mood Tracker	**x**	**x**			**x**		3
	Total	7	5	1	0	4	3	20

Note: Abbreviations stand for: Practicing gratitude (PG), being kind (BK), cultivating strengths (Cs), visualizing ideal future selves (VS), meditation or mindfulness (M), early life memories (EM)

3.4 Use of persuasive technology

Table 5 summarizes all Persuasive System Design principles together with the number of apps that used the particular principle. Furthermore, *Table 5* shows the total scores per principle computed by means of the coding scheme. How the individual apps scored on the different principles as well as further explanation of the implementation within the different apps is presented in Appendix C. Overall, the number of used principles across all 11 apps shows, that in total, the principles of PSD were implemented moderately. In contrast to that, the extent to which those principles were implemented tended to be higher.

The principles in Primary Task Support were most frequently used within the apps,

whereas Social Support principles were implemented least. The categories Dialogue Support and System Credibility Support were used to a moderate extent.

Table 5: Use of Persuasive System Design elements

Categories & principles	N (%)	Total score
Primary Task Support		
Reduction	11 (100%)	22
Tunneling	2 (18%)	3
Tailoring	0 (0%)	0
Personalization	8 (72%)	10
Self-Monitoring	5 (45%)	9
Simulation	1 (11%)	1
Rehearsal	6 (54%)	9
Dialogue Support		
Praise	3 (27%)	5
Rewards	2 (18%)	4
Reminders	6 (54%)	11
Suggestions	8 (72%)	12
Similarity	0 (0%)	0
Liking	6 (54%)	8
Social Role	0 (0%)	0
System Credibility Support		
Trustworthiness	5 (45%)	8
Expertise	4 (36%)	8
Surface Credibility	4 (36%)	6
Real-world feel	6 (54%)	9
Authority	4 (36%)	7
Third-party endorsements	1 (11%)	1
Verifiability	3 (27%)	5
Social Support		
Social learning	1 (11%)	2
Social comparison	1 (11%)	2
Normative influence	0 (0%)	0
Social facilitation	1 (11%)	2
Cooperation	0 (0%)	0
Competition	1 (11%)	2
Recognition	1 (11%)	1
Total	90 (29%)	147

3.4.1 Primary Task Support

The principles in the category 'Primary Task Support' were used most frequently. On average, every app included 3 principles of this category. The app which implemented the most principles of this category (n=4) and to the greatest extent with a score of 10 was Happify. *Figure 7* shows the number of apps that incorporated the particular Primary Task Support principles as well as the total intensity scores which show to what extent the particular principles are used.

The first principle, 'Reduction' was used in every app (n=11) with a score of 22 and was consequently used most to greatest extent. All apps tried to simplify their content by providing overviews or simple steps which are clearly arranged. Furthermore, the principle 'Personalization' (n=8) was frequently implemented and delivered a relatively high intensity score. Apps implemented this principle by providing specific options to create an own profile page as the app Happify did, or by offering personalized content. Furthermore, apps frequently provided settings to clock time adjustment for reminders or to change app design at the request of the user. More than half of the apps (n=6) made use of the principle 'Rehearsal'. This principle was implemented in an intensive way on average. Apps including this principle encouraged the user to rehearse a certain target behavior like smiling or a game that tries to teach the user to pay attention to details in his or her environment. In *Figure 8* a screenshot of this game delivered by the app Happify is presented. Slightly less than half of the apps (n=5) incorporated the principle 'Self-Monitoring' with a relatively high intensity. Apps providing features for 'Self-Monitoring' mostly let the user view back at already conducted tasks or own happiness ratings as well as journal entries or assessment results. An example of such a feature is presented in *Figure 9.* The principle 'Tunneling' was applied rarely (n=2) and to a low extent. 'Simulation' (n=1) and 'Tailoring' (n=0) were used rarely and to almost no extent or not at all.

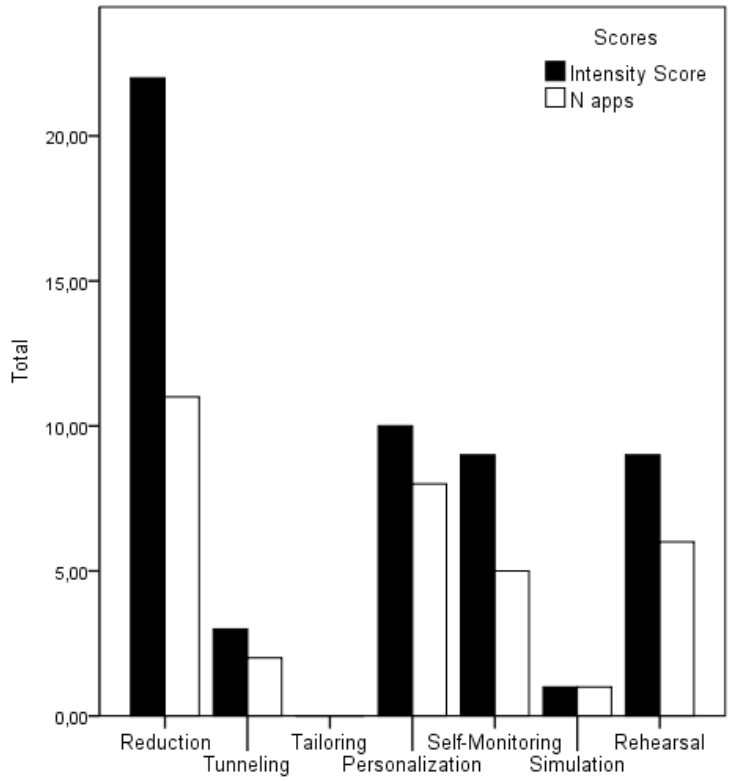

Figure 7. Number of Apps and total intensity scores per principle of Primary Task Support

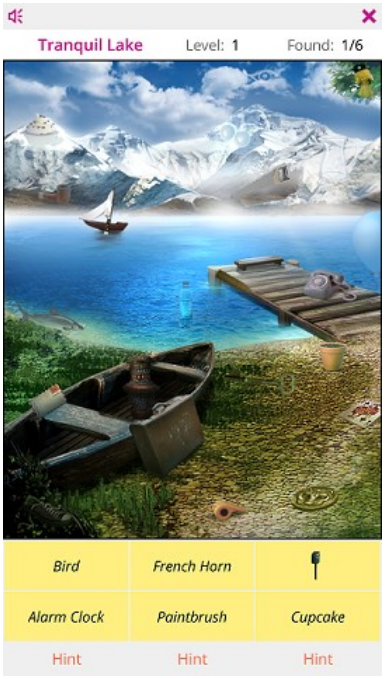

Figure 8. Screenshot of Happify's Savor Quest

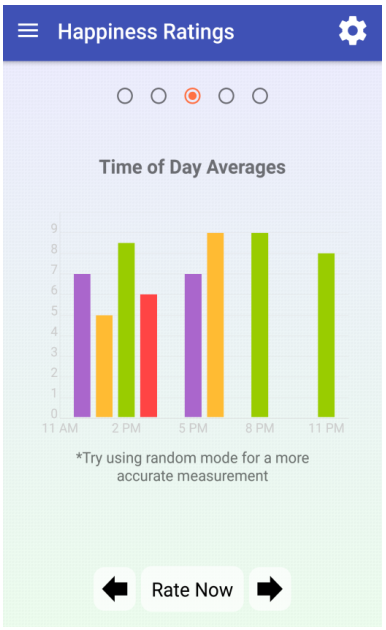

Figure 9. Screenshot of a graph from Free Happiness

3.4.2 Dialogue Support

Every app included more than 2 principles on average of the category 'Dialogue Support'. Again, Happify incorporated the highest number of principles (n=5) and scored highest with a total score of 10. *Figure10* shows the number of apps that incorporated the particular Dialogue Support principles as well as the total intensity scores which show to what extent the particular principles are used.

The principle 'Suggestions' was found in most of the apps (n=9), since many apps suggested a certain behavior by providing tips to increase happiness. Suggestions were implemented to a great extent. Another principle, 'Reminders', was applied less often (n=6) but with a high intensity. Apps often included different reminders for their features. The principle 'Liking' could also be found within 6 apps but applied in a less intensive way than 'Reminders'. Thus, more than half of the apps applied the principle 'Liking' but only to some extent which means that they mostly had a medium attractive design. The principles 'Praise' (n=3) and 'Rewards' (n=2) were rarely implemented and used to a low extent. 'Similarity' (n=0) and 'Social Role' (n=0) were not recognized in any app.

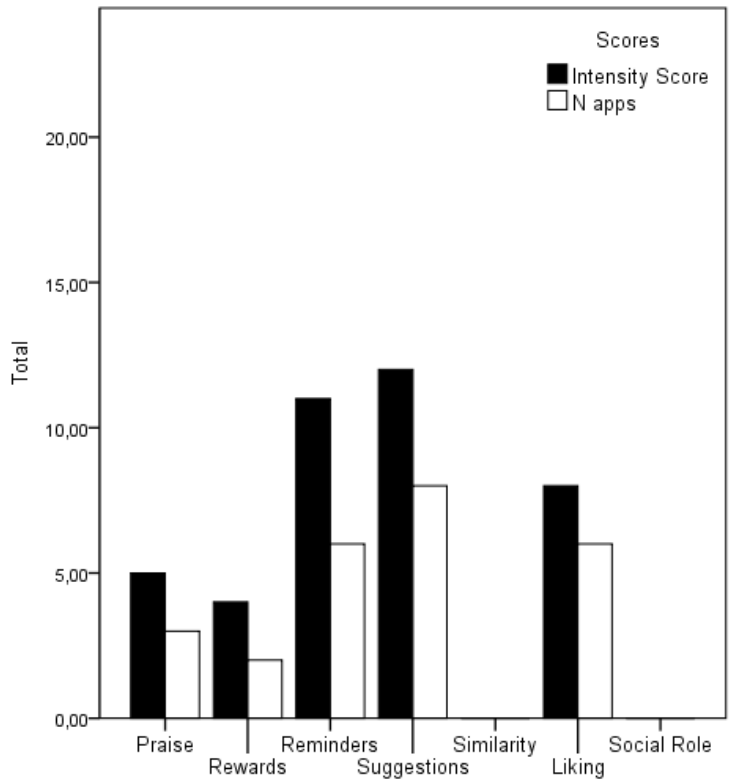

Figure 10. Number of Apps and total intensity scores per principle of Dialogue Support

3.4.3 System Credibility Support

On average, each app implemented more than 2 principles of System Credibility Support. Again, Happify was the app which incorporated almost every principle of the category (n=6) to the greatest extent with a score of 11. *Figure 11* shows the number of apps that incorporated the System Credibility Support principles as well as the total intensity scores which show to what extent the particular principles are used.

From all principles of this category, 'Real-World-Feel' was found most (n=6) and applied to the greatest extent. This was mostly incorporated by providing an option within the app to contact the developer directly via e-mail. The principle 'Trustworthiness' was implemented second most (n=5) and to a relatively high extent. Less apps (n=4) incorporated the principle 'Expertise' but to an even great extent on average. Though 'Authority' and 'Surface Credibility' both could be recognized within 4 apps in total (n=4), 'Authority' was applied in a more intensive way than 'Surface Credibility'. 'Verifiability' could be recognized in only a few apps (n=3) and was applied in a less intensive way as well as the principle 'Third Party Endorsements' which was only implemented once (n=1).

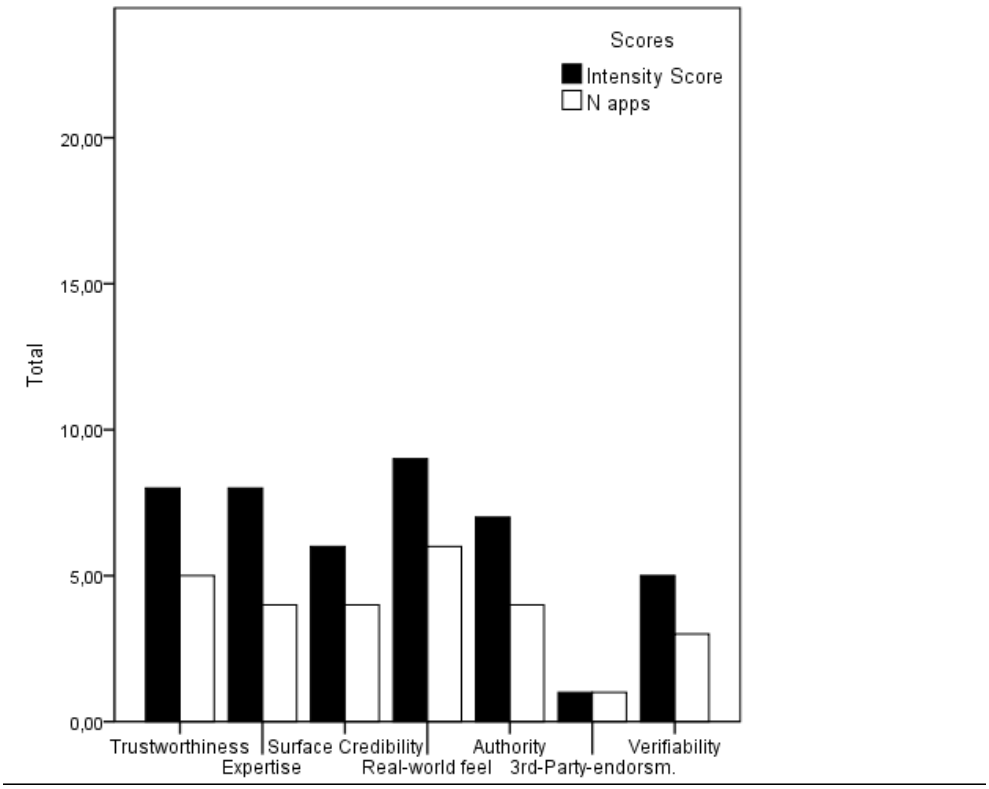

*Figure 11.*Number of Apps and total intensity scores per principle of System Credibility Support

3.4.4. Social Support

The principles of 'Social Support' were used within the smallest number of apps (n=5). On average, each app contained not even one principle of this category. *Figure 12* shows the number of apps that incorporated the Social Support principles as well as the total intensity scores which show to what extent the particular principles are used.

Happify was the only app incorporating some of these principles (n=5) at all. The principles 'Social learning' (n=1) 'Social comparison' (n=1), 'Social facilitation' (n=1),'Competition' (n=1) and 'Recognition' (n=1) could be identified within the app, whereas all principles in use were incorporated to the greatest extent with a score of 2 for each. Only 'Recognition' was applied to only some extent with a score of 1.

The principles 'Normative influence' and 'Cooperation' were not found in any of the apps (n=0).

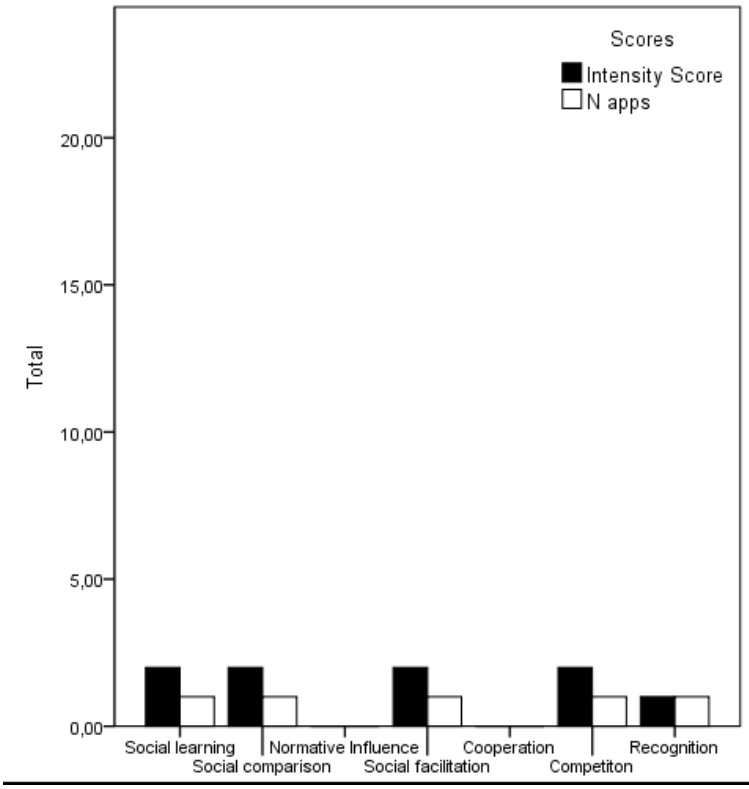

Figure 12. Number of Apps and total intensity scores per principle of Social Support

3.5 Subjective quality

The average app store rating across all apps which were examined in this study was relatively high (*M*=4.12, *SD*=0.51) compared to the average expert ratings scored by means of the MARS scale (*M*=3.24 *SD*=0.57). Jus'be Happy scored highest at the average user ratings

(*M*=4.9), while Happiness Habits was rated with the lowest score (*M*=3.4) by real users.

As presented in *Table 6*, it is striking that the app Happify scored highest on the expert rating through the MARS (*M*=4.48, *SD*=1.3), while it was rated with the second lowest score (*M*=3.5) by the real users. The Happy App delivered the lowest score on the MARS (*M*=2.43, *SD*=1.03) whereas real app users rated it with the third highest score (*M*=4.3).

Table 6: Expert and user ratings of subjective quality with number of downloads

App title	MARS		Average rating app store, (n raters)	Approximate number of downloads
	M	*SD*		
1. Free Happiness	3.59	1.30	4.70 (19)	100
2. Happify	4.48	0.90	3.50 (1251)	100000
3. Happy Habits	2.77	0.92	4.10 (763)	100000
4. Happiness Tips	2.86	1.35	3.90 (26)	1000
5. Happiness Habits	3.00	1.30	3.40 (71)	10000
6. Secret of Happiness	3.36	0.95	4.30 (6545)	100000
7. Daily Happiness Tips	2.81	1.44	4.70 (11)	1000
8. Jus' be happy	3.64	0.95	4.90 (29)	100
9. Happy App	2.43	1.03	4.30 (3)	500
10. Happiness Booster	3.09	1.60	3.70 (124)	5000
11. Activity Mood Tracker	3.57	1.12	3.80 (34)	1000

3.6 Correlations between the different quality indicators

A series of Spearman's rank-order correlations were conducted to determine if any relationships between the different quality ratings of this study existed. The most important findings are described in the following paragraph.

A strong significant negative correlation was found between the number of downloads and the average user ratings provided by the app store (r_s= -.669, p <.05), while no significant correlation could be found between the average expert ratings of subjective quality tested through MARS and the number of downloads (r_s= -.070, p =.839).

A significant relationship was discovered between the total number of Persuasive System Design elements and the number of positive psychological exercises found within the apps (r_s= .611, p <.05).

The number of used principles of the category Primary Task Support from PSD correlated significantly with the total average scores of the expert ratings scale MARS (r_s= .882, p <.01). Additionally, also the total scores of the category Primary Task Support are significantly correlated with the total scores on average of the MARS scale (r_s= .866, p <.01). Furthermore the total scores of the category Dialogue Support from PSD were significantly correlated with the average total scores of MARS (r_s=.672, p <.05).

Relationships were also found between the availability of different positive psychological exercises and the average app store ratings. 'Practicing gratitude' (r_s= .630, p <.05) as well as 'being kind' (r_s= -.696, p <.05) correlated significantly with the average app store rating. A significantly negative correlation was also detected between the availability of a 'Meditation/Mindfulness' exercise and the average app store ratings (r_s= -.660, p <.05). In addition, a strong relationship was also found between the availability of the exercises 'writing down early life memories' and the AHT element 'engagement' (r_s= .671, p <.05). Furthermore, 'Engagement' elements and the availability of the exercise 'practicing gratitude' within the apps were significantly correlated, too (r_s= .690, p <.05).

Additionally, the use of the exercises 'Mediation/Mindfulness' and 'being kind' were also significantly correlated (r_s= .828, p <.01).

4. Conclusion & discussion

Overall conclusion

The main objective of this study was to give insight into the availability and quality of positive psychological apps aiming to promote happiness. Based on the overall findings of this study it can be concluded that the researched apps only had a moderate theoretical background since they included only a few elements of Authentic Happiness Theory (Seligman, 2002) and only a few established positive psychological exercises were used to promote happiness. Furthermore the results suggest that Persuasive System Design Elements were incorporated to a moderate extend. The expert ratings on subjective app quality were also moderate whereas the average app store rating by real users tended to be higher. A further analysis showed that there was no significant relationship between the subjective expert ratings of app quality and the average app store ratings of real users as well as the number of downloads.

Overall score of the selected apps

From all apps tested and analyzed in this study, the Happify app was the one that scored highest on most domains tested by the researcher, even though the average user rating provided by the app store was almost lowest of all apps tested within this study. Happify scored best in total even though it could not be used to full extent due to a premium upgrade which required costs and the time limitation of seven days. Presumably, Happify would have been rated even higher if it would have been tested for longer upgraded to premium. Next to happify, there were three other apps which scored relatively high in general (Happy Habits, Free Happiness, and Happiness Habits). Happy Habits even included more positive psychological exercises than Happify which was the only domain within which Happify did not reach the highest score. The main characteristic of these apps was the implementation of a variety of interactive features like games, journals, assessments or mood ratings which could be carried out directly within the app instead of being less diversified or only providing information without any interactivity.

The app with the lowest overall score was the Happy App. A reason for that might be that it mainly provided links to other websites which should make the user laugh. There were no interactive features within the app. Apps like Daily Happiness Tips, Happiness Tips and Happiness Booster were also rated very low across all aspects. This may be due to the fact that these apps did not provide any interactive features either. They only provided information

in the form of quotes or tips and did not ask for the users' commitment.

Three other apps (Activity Mood Tracker, Jus' be happy, Secret of Happiness) achieved moderate scores across all aspects examined by the researcher. These apps either provided only one feature and therefore less variety than the better rated apps. Based on these findings it can be concluded that interactivity appears to be an important aspect when it comes to app design.

Theoretical background

Earlier research has shown that apps which are in concordance with scientific theories tend to be more effective (Bolier & Abello, 2014). The small number of apps which were analyzed within this study showed that these apps are hardly based on psychological theory or evidence. One reason for this might be that everyone can create an app about any topic regardless of his or her qualification. Furthermore, only very few apps specifically mentioned to be based on a scientific theory although all of them included at least one element of Authentic Happiness Theory (Seligman, 2002).

The element of AHT which was incorporated most across all 11 apps was 'Positive Emotion'. This is no surprise since one of the search terms chosen for the selection was "increase happiness" which might be highly associated with positive emotion by the app store. Another reason might be that the general understanding of happiness is closely linked to positive emotions. Laughter and smiling are indicators of happiness for most people. As described in the literature review, in science, happiness is often used as a synonym for well-being or life satisfaction. Although there is no concrete definition for happiness, in science, it means much more than simply expressing positive emotions. But, since positive emotions are associated with numerous positive effects and research even showed that they benefit people with cardiovascular disease (Tugade et al., 2004) and may even predict a longer life (Danner et al., 2001), this result shows that one very important characteristic is present across all of the apps.

In contrast, the other elements of AHT engagement and meaning were identified to a much lower extent. This could be due to the fact that the implementation of positive emotions within an app might be much easier than the creation of features which focus on engagement or meaning. Since 'meaning' could only be found within one app, it can be assumed that it is not easy to implement within app features. To incorporate positive emotions at a basic level seems relatively easy. The developers only need to make the user smile or laugh when using the app. Furthermore, there is much more information available about positive emotions. This variety of information might have led app developers to many ideas for features which focus

on positive emotions. It might be too one-sided to only focus on positive emotions. For the future development of happiness apps it would be interesting to implement engagement and meaning to a greater extent and evaluate the quality of those apps.

The use of positive psychological self-help exercises described by Seligman et al. (2005) and Lyubormirsky and Layous (2013) was also examined in the analysis of the theoretical background of the apps researched for this study. In general, the presence of these exercises was found to be relatively low even though Sin and Lyubormirsky (2009) found that it is more effective to engage in multiple positive activities instead of doing only one. According to Schueller and Parks (2009), it is in contrast advantageous to only implement a lower number of exercises since the user might be otherwise overwhelmed.

The most provided feature was a gratitude journal or something similar which resembled the exercise 'practicing gratitude'. A reason for the frequent usage of this exercise may be that it is simple to implement within an app. Additionally, a strong positive relationship was observed between the average app store rating and the availability of a gratitude exercise. This finding suggests that apps which implemented a gratitude exercise tend to have a higher average user rating. On the other hand, the results suggest that the use of exercises like 'Mediation/Mindfulness' or 'being kind' is related to a lower average app store rating. To better interpret these findings, the meaning and validity of the average app store ratings needs to be further examined.

Persuasive System Design

Next to the theoretical background and subjective quality, a further quality criterion was studied for this research; the use of Persuasive System Design elements. It has been shown that online interventions still lack adherence and that this could be countered by using persuasive technology (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). For that reason, this study looked at the extent to which Persuasive System Design principles were implemented within the apps.

Overall, persuasive technology was implemented moderately on average. From all design principles developed by Oinas-Kukkonen and Harjumaa (2009), the principles of Primary Task Support were applied in most of the apps to the highest extent. In contrast to that, the principles of the category Social Support were found in the lowest number of apps. This could be due to the fact, that to fulfill those principles, an app needs to include a kind of own social network, as only the app Happify does. Implementing a feature like that might be very complex for developers. A principle like 'Reduction' of the category Primary Task Support which was found very often and implemented in an intensive way might be easier to

apply since apps are generally developed to reduce complex behavior into smaller steps.

Several principles of the PSD could not be found in any app at all. A reason for that might be that their definitions are sometimes very specific or would be very difficult to implement as 'Simulation' which says, that the system should imitate the user in some way.

It is striking that in general, the extent to which the principles are used tended to be higher than the number of apps that incorporated the particular principle. This finding suggests that even though some principles were used in only a few apps, they were implemented in a very intensive way. An example for that is the principle 'expertise' which was found in less than half of the apps, but if available, it was implemented in a very intensive way.

Interestingly, a strong relationship was found between the use of Primary Task Support principles, as well as the Dialogue Support principles and the MARS expert ratings of subjective quality. These findings suggest that especially the implementation of principles of these two categories indicate a higher rating of subjective quality by the MARS. Furthermore, it can be assumed that Primary Task Support and Dialogue Support are the most valid categories of PSD. Additionally, the total numbers of PSD elements correlated significantly with the number of positive psychological exercises found within the apps. These findings show that the different quality criteria used to evaluate the apps selected for this study are related to some extent. Apps which incorporated more self-help exercises also tended to have implemented more persuasive system design elements to increase adherence of these exercises.

Subjective quality ratings

Since it is not reproducible on what criteria the different users based their individual rating in the app store, other users can hardly rely on those ratings when choosing an app. The analysis showed that the average app store rating was correlated negatively with the approximate number of downloads. This means that the higher an app is rated in the app store, the lower its number of downloads tends to be. If the app store rating was valid, one would expect a positive correlation with the number of downloads and this is also what the user would appreciate since a lower download rate might indicate a lower app quality for the user. The finding, that there is no relationship between the average user ratings and expert ratings of subjective quality, is a further argument against the meaningfulness of the user ratings. Thus, the inconsistency of this data shows that for estimating the quality of an app as a user, a more professional rating may be needed.

By rating the apps of this study through the MARS Scale developed by Stoyanov et al.

(2015), it was tried to find a more transparent, valid and consistent measure to rate the apps' subjective quality. The average scores of the MARS scale differed widely from the average app store ratings and were not significantly correlated with each other. Apps like Happify which were rated highest on the MARS, were almost rated worst by the real users. These findings match the statement of Stoyanov et al. (2015) who said that collaborators of the app developer or the developers themselves frequently rate their own app or have others to bring the own app to a higher ranking position. For the user, ratings which are manipulated like that are problematic. A quality seal would not only be reasonable for the theoretical basis of an app, but also, and probably even more important, for the overall rating of subjective quality. To provide a better rating, scales like the MARS could deliver a reliable and valid rating which could be transformed into a quality seal in a standardized manner. This quality seal could inform the user about the quality of the app as rated by an expert. The high inter-rater-reliability between the researcher and the co-researcher and its strong correlation with PSD showed that the MARS could be used as such a standardized instrument.

Strengths & limitations

This study provided deeper insight into the quality of apps aiming to promote happiness on basis of different aspects. Currently, there is no other study that researched these kinds of apps to such an extent. App stores are still lacking a standardized rating for app quality and this study might have made a first step towards the development of a new way of measuring app quality to provide a meaningful rating for future app users. This study not only examined the extent to which those apps are based on theory or how persuasive technology was implemented. For this study the researcher also tried to put herself in the position of the average user to get a more meaningful subjective rating than the one that is provided within the app store. Furthermore a high reliability was found between the researcher and the co-researcher regarding their ratings on subjective app quality.

Although the high inter-rater reliability for subjective quality might be a strength of this study, for future studies, it would be desirable to not only assess the inter-rater reliability for the MARS but also for theoretical background and the use of PSD elements. A second researcher for all ratings might have identified positive psychological exercises, elements of AHT or PSD principles within the apps which the researcher might have missed. Especially the coding procedure regarding the use of Persuasive System Design elements posed a challenge for the researcher. Frequently, the different principles were very complex and hard to recognize within the apps. For future research on the use of persuasive technology within mhealth apps it is desirable to adapt the model developed by Oinas-Kukkonen and Harjumaa

(2009) in a way that might make it is easier to apply.

Another clear limitation of this study was the small sample size of evaluated apps. To get a more meaningful overall picture of the apps aiming to promote happiness which are currently available, a greater sample size would be needed. This is actually problematic since the Google Play Store only provides a limited number of results. A possibility to get a bigger final selection of apps and a more meaningful overall picture of currently available apps to promote happiness would be to not only search for apps in the Google Play Store, but also include apps from the Apple iOS app store. This study might have missed some relevant apps by only searching in one app store.

Another limitation of this study might be that only apps without costs were selected. Apps with costs might have a higher quality because more effort might have been made to create those apps. Thus, for further research it would be interesting to also integrate apps with obligatory costs.

Additionally, since apps which were not rated were also excluded, it is not clear how the quality of those apps would be rated. As this study has shown, the app store ratings might not be meaningful enough to draw conclusions about app quality based on these. Thus, further research might also integrate apps which were not rated at all.

Other problems were caused by the premium upgrades within some apps. Some features were only accessible when upgrading to premium and paying for the service, though downloading the app was free. Those features could not be included in the current evaluation.

Furthermore, for this study, apps in English were searched within the German Google Play Store. Therefore the results included several apps in German which might have biased the selection procedure. For further research it might be better to either search for apps in English within the English Google Play Store or to use German search terms within the German app store.

A further problem might be that the apps were only tested for a relatively short period of time. Many apps were intended to be used more than 7 days, offering a ’30-Day challenge’ to name an example. By quitting the app testing after 7 days, the researcher might have missed information which would have been provided after a longer period of time. Happify provided different tracks to follow whereas only one track could be followed within that period of time. Therefore only one out of numerous tracks could be followed. Thus, the short period of time for app testing might have resulted in a limited evaluation of some apps.

Future research and recommendations

For users who are willing to increase their happiness via an app it could be important to know

that the particular app is based on a scientific theory. But, if this is not mentioned within the app description, the lay user will never know about the evidence based theories the particular app is based on. Thus, for users it would be helpful to get access to apps based on evidence as well as to be informed about the theoretical background. This could be realized by a quality seal for the extent to which an app is based on theoretical background developed by professionals. In that way, the user would be able to choose an app on basis of a standardized quality proof regarding theoretical background and subjective quality.

The extent to which persuasive technology is implemented within the apps might not be very informative for the lay user as this topic mainly addresses app developers. Nevertheless, for the future development of apps aiming to promote happiness it would be advantageous to take Persuasive System Design into account when creating an app since this study showed that the use of Primary Task Support and Dialogue Support principles may contribute to a higher rating of subjective expert quality. Furthermore, it would be desirable that future studies on app quality would include a higher number of raters and, since some PSD principles are either very specific or difficult to implement, an adapted coding scheme for the use of Persuasive System Design elements.

The apps evaluated within this study showed that there is much space for improvement. Future app developers should incorporate more interactive features, especially in the form of evidence-based self-help exercises to promote happiness. Furthermore, it would be interesting to conduct further research on how happiness can be increased to gain further insights for the development of more theory-based apps.

If everyone who feels depressed for a while without access to quality interventions would be able to choose an app with high quality offering interactive self-help interventions based on evidence and supporting adherence through the incorporation of persuasive technology, this would enhance the chance to tighten the mental health gap and to make more people happier in a short period of time and with minimal effort. As Hussein et al. (2016) state, the use of mobile gadgets may have the power to deliver health care to every individual across the globe.

Although it might be a long way until this aim is reached, this study presented a first try to make a step towards a more standardized way of app quality rating and to improve the quality of future apps aiming to promote happiness.

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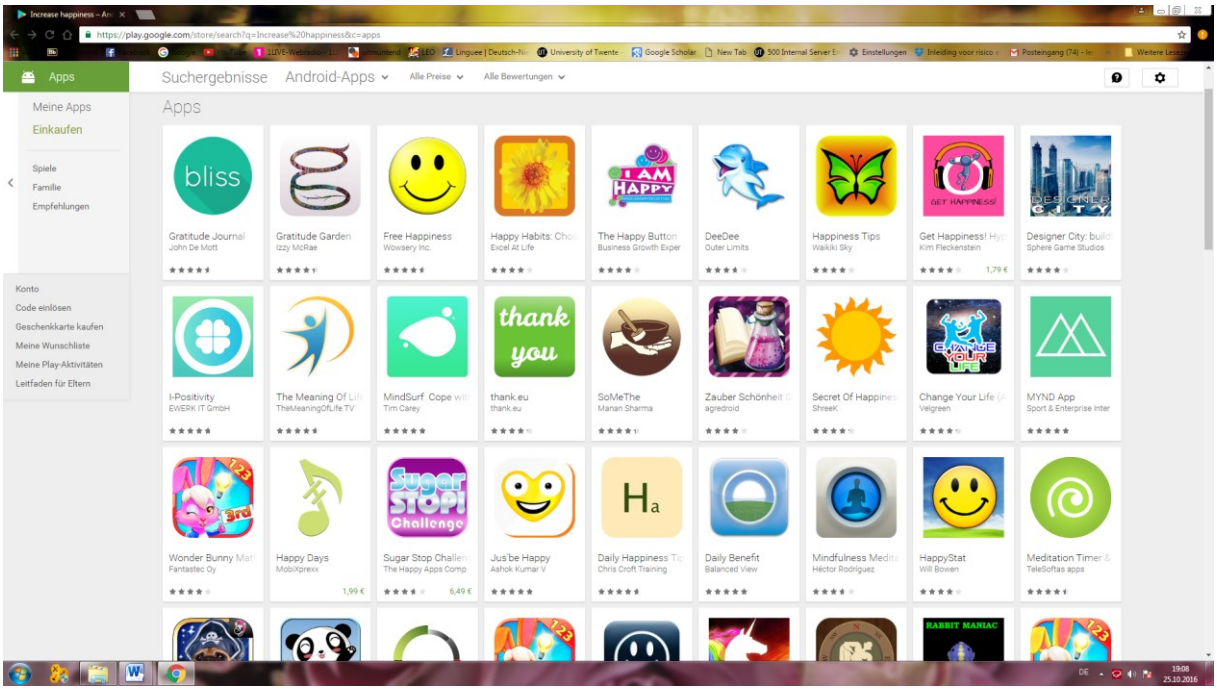
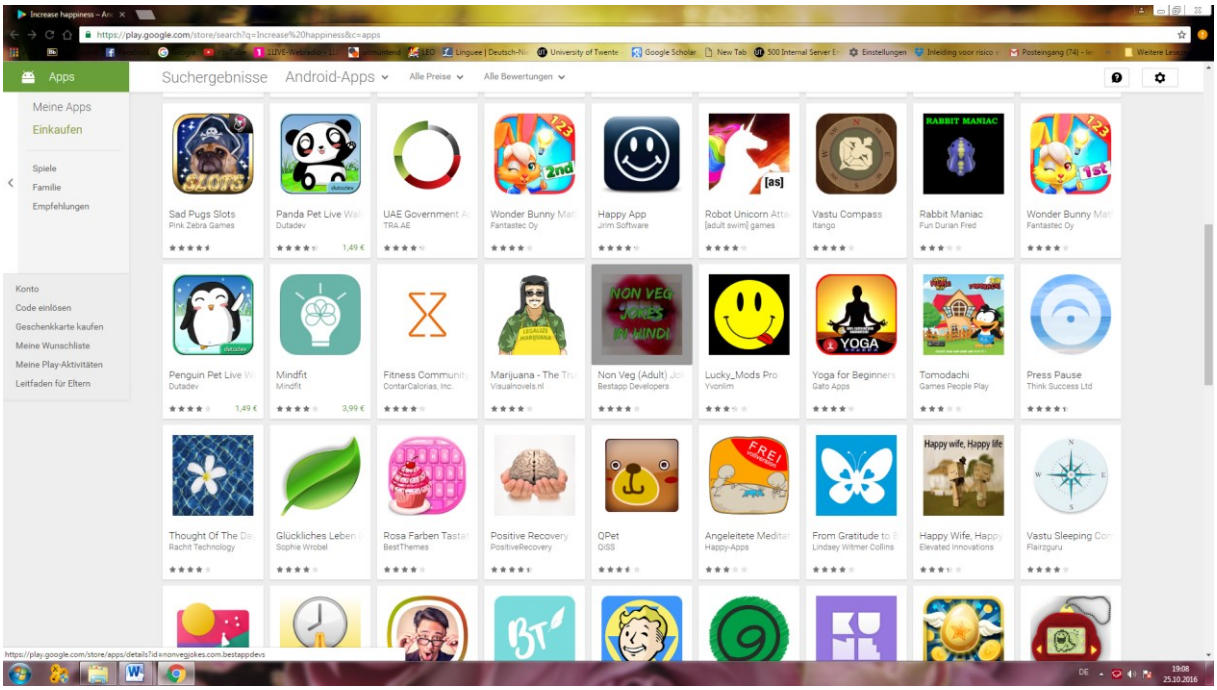
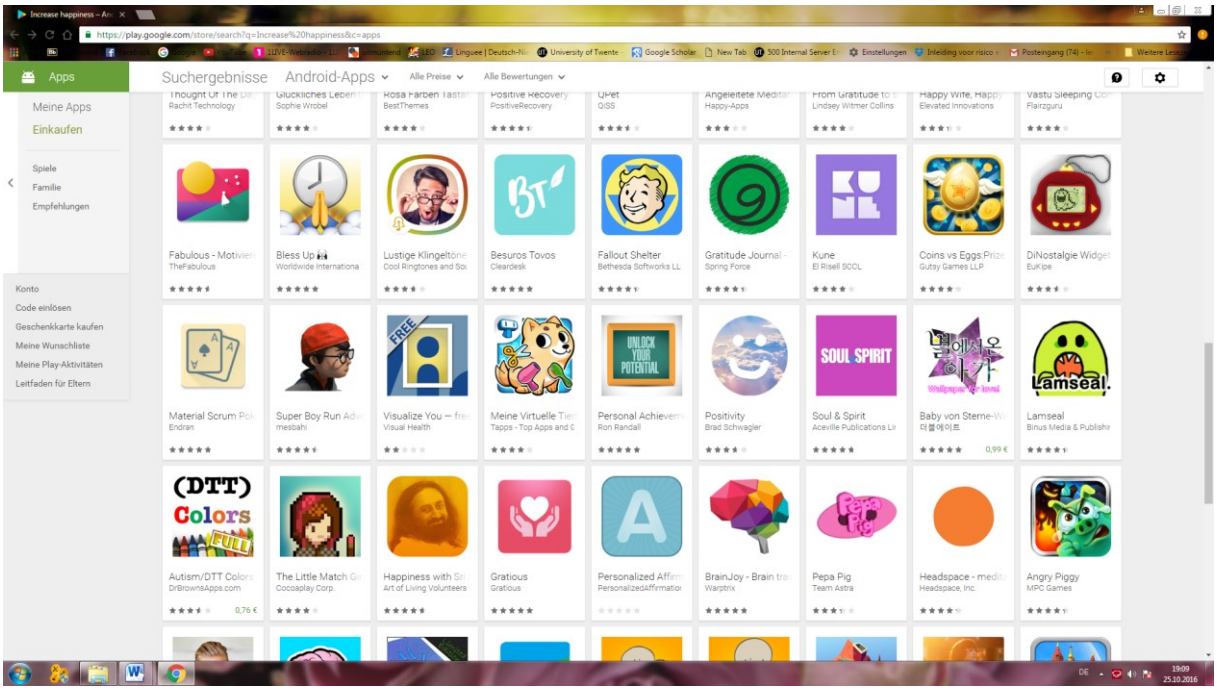
Appendices

A: Screenshots of results and detailed app information

Searchterm 1: “increase happiness” (25.10.2016)



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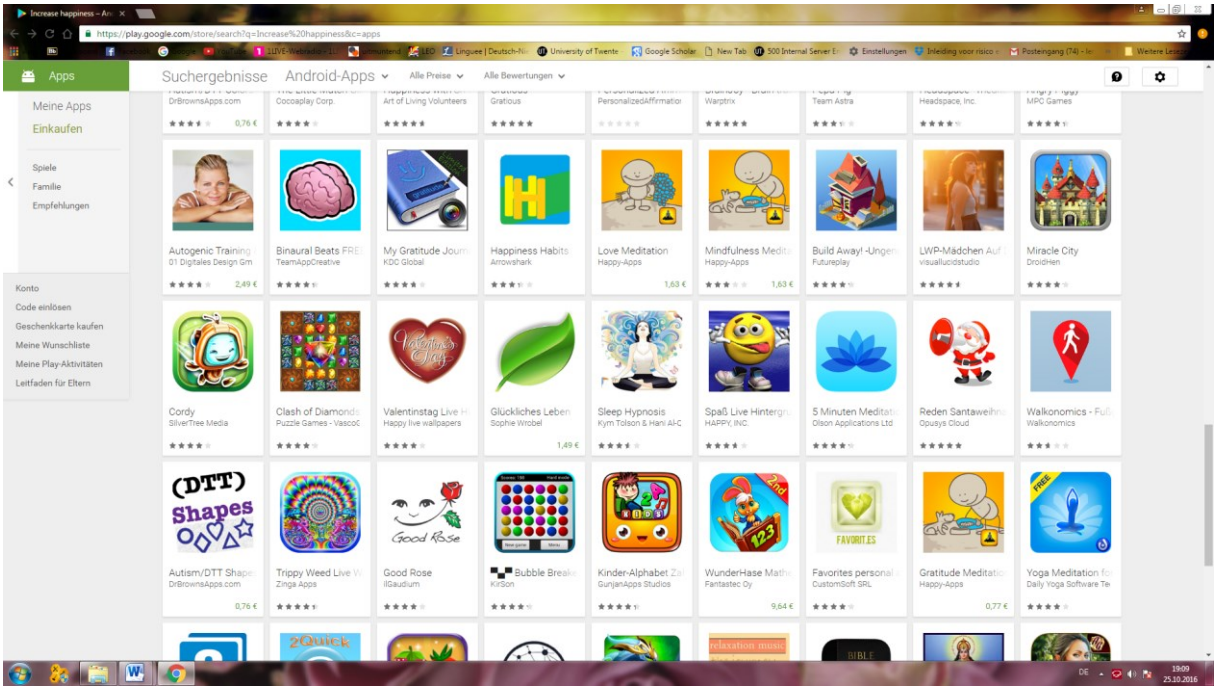
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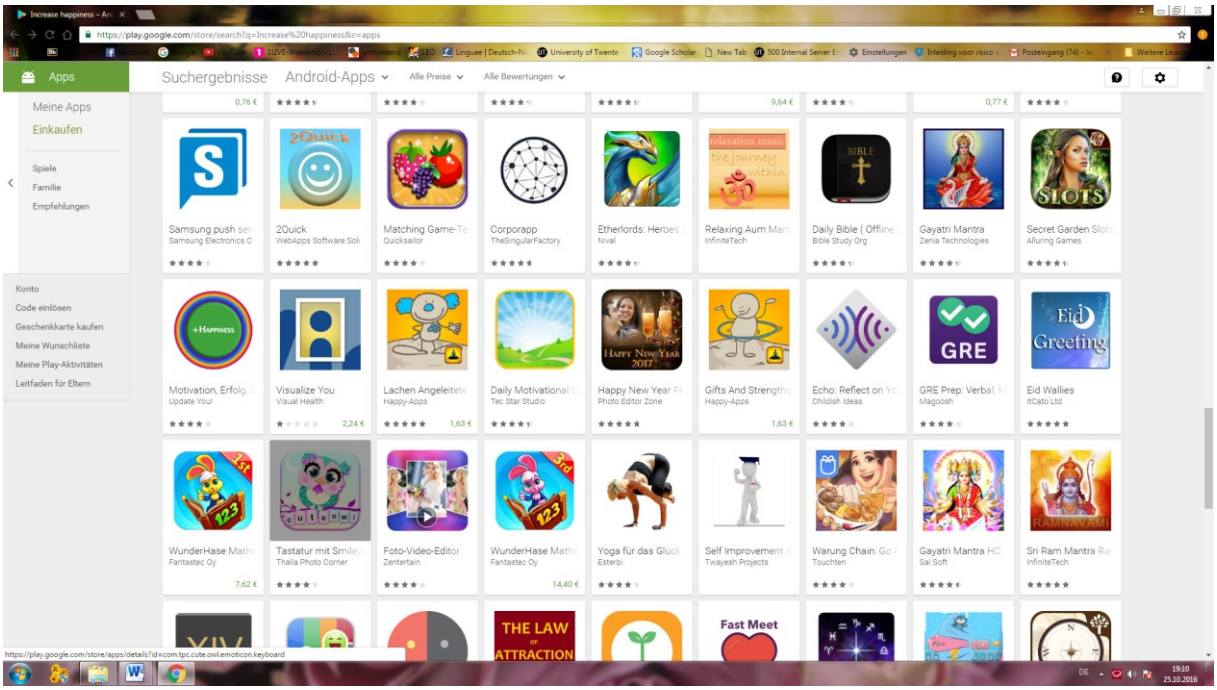
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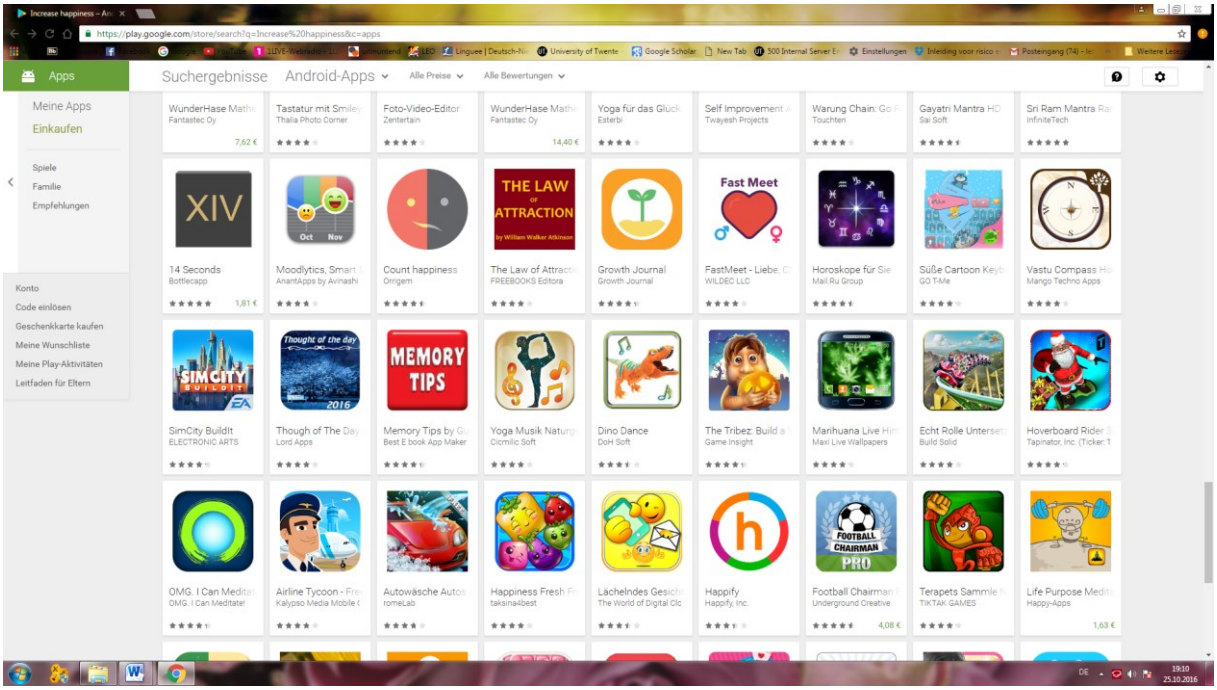
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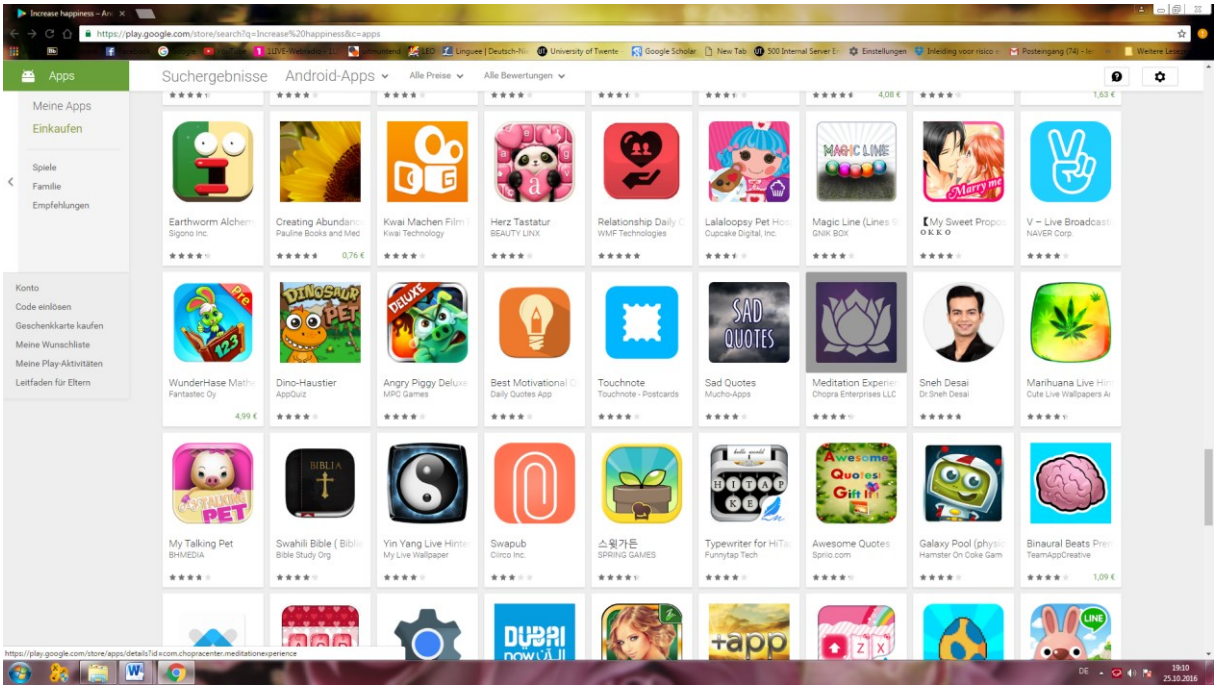
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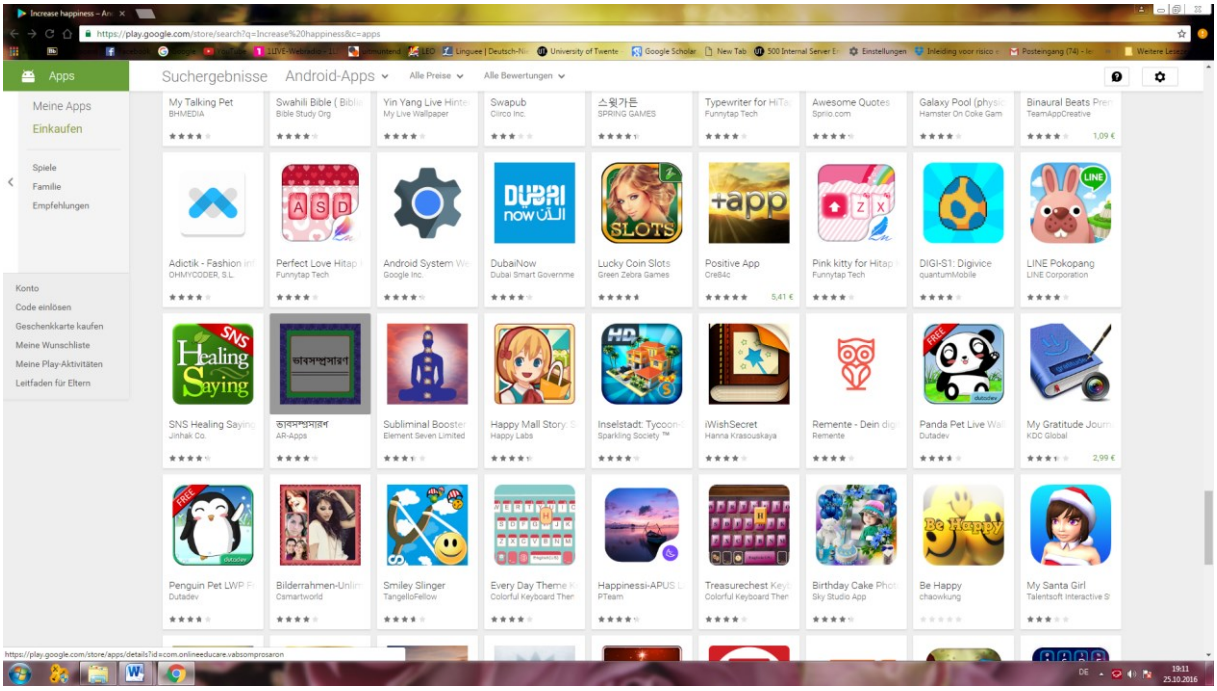
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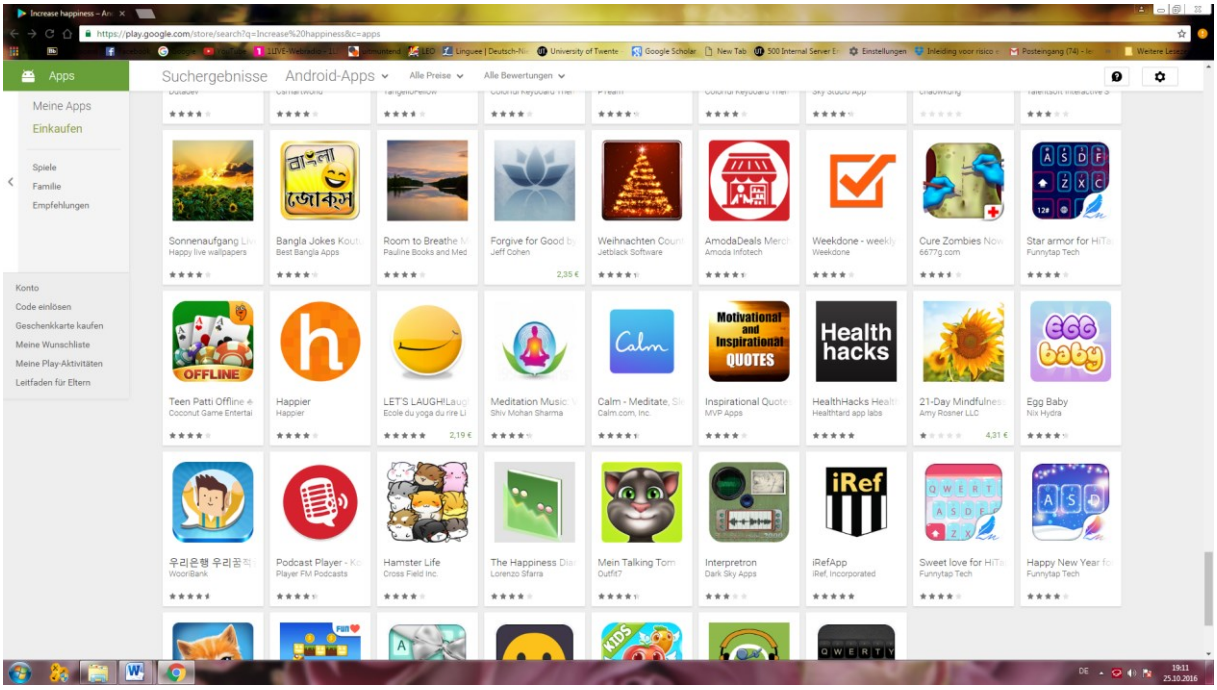
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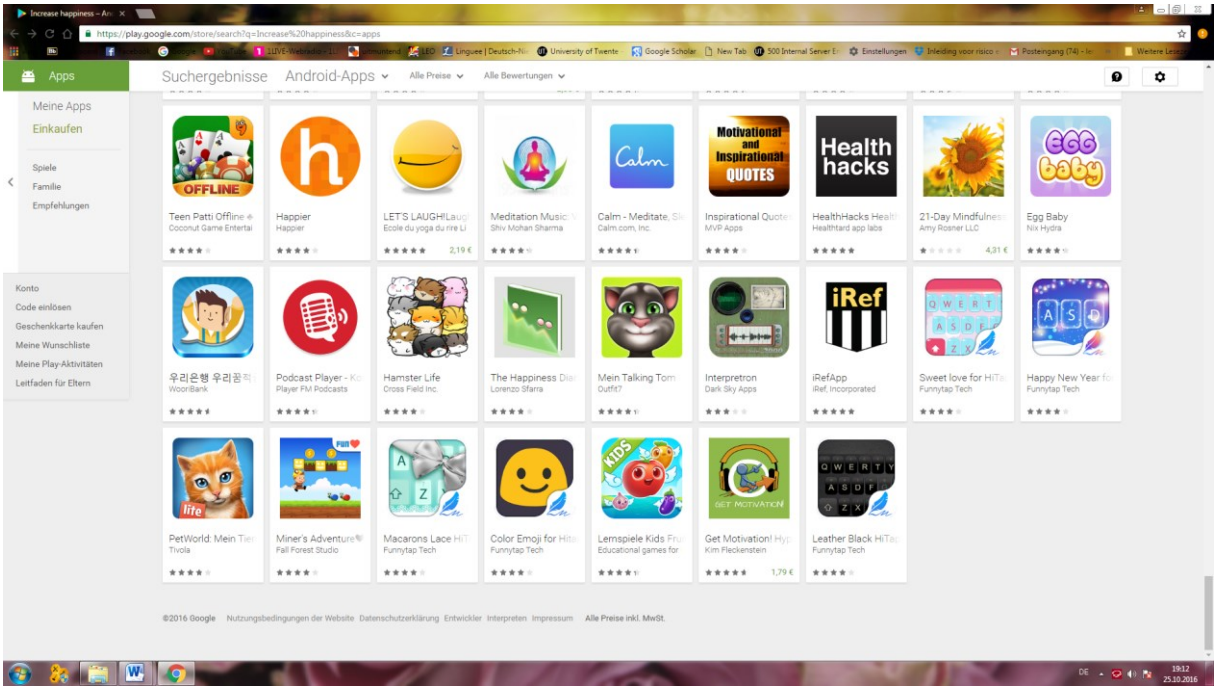
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Sweet love for
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PetWorld: Mein
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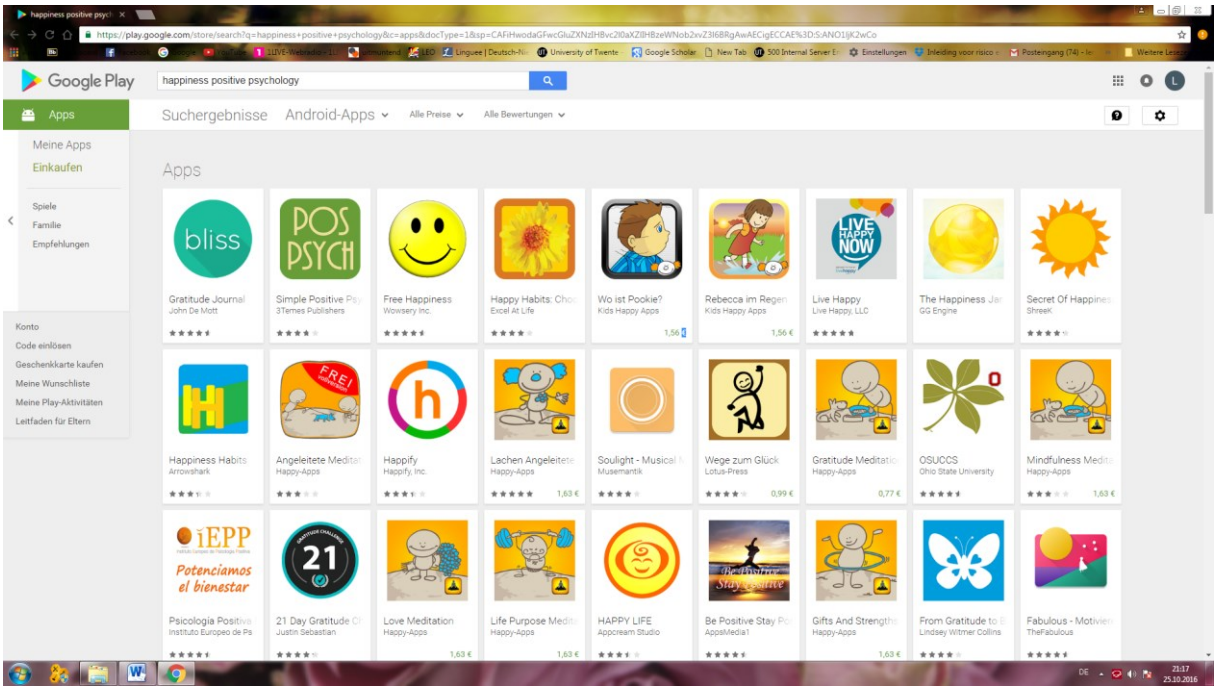
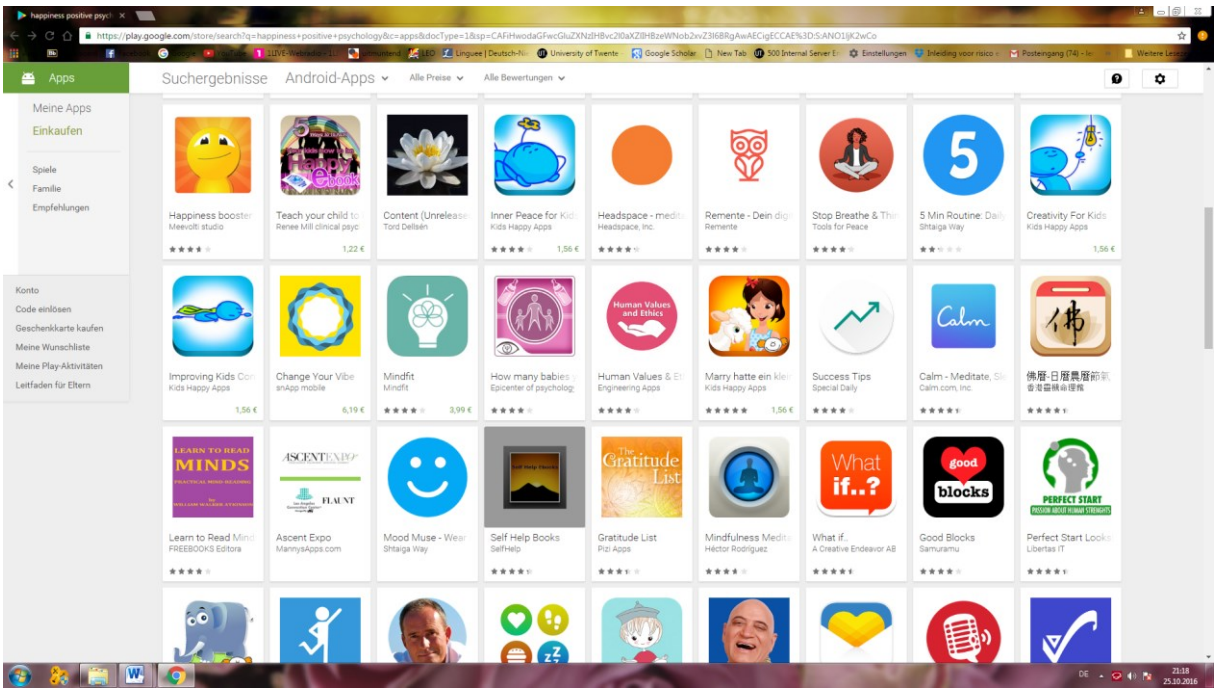
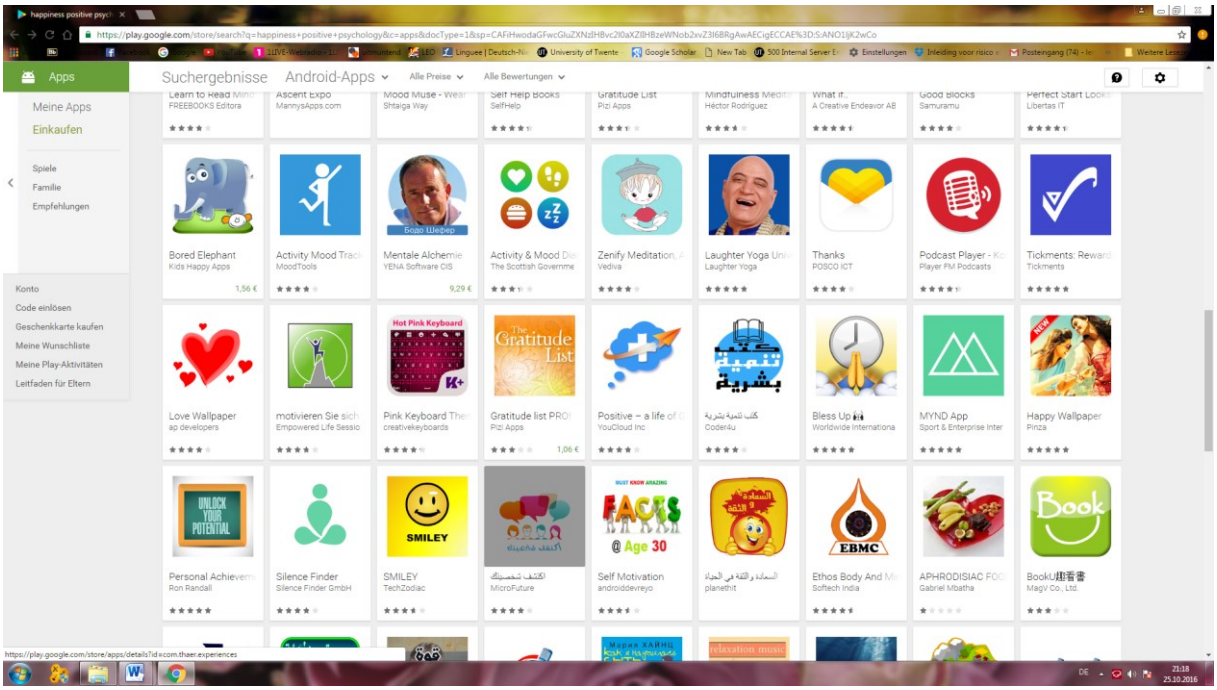
Searchterm 2: “happiness positive psychology” (25.10.2016)



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Activity Mood Track
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Laughter Yoga
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Love Wallpaper
motivieren Sie sich
Pink Keyboard
Gratitude list PRO!
Positive – a life of
Bless Up
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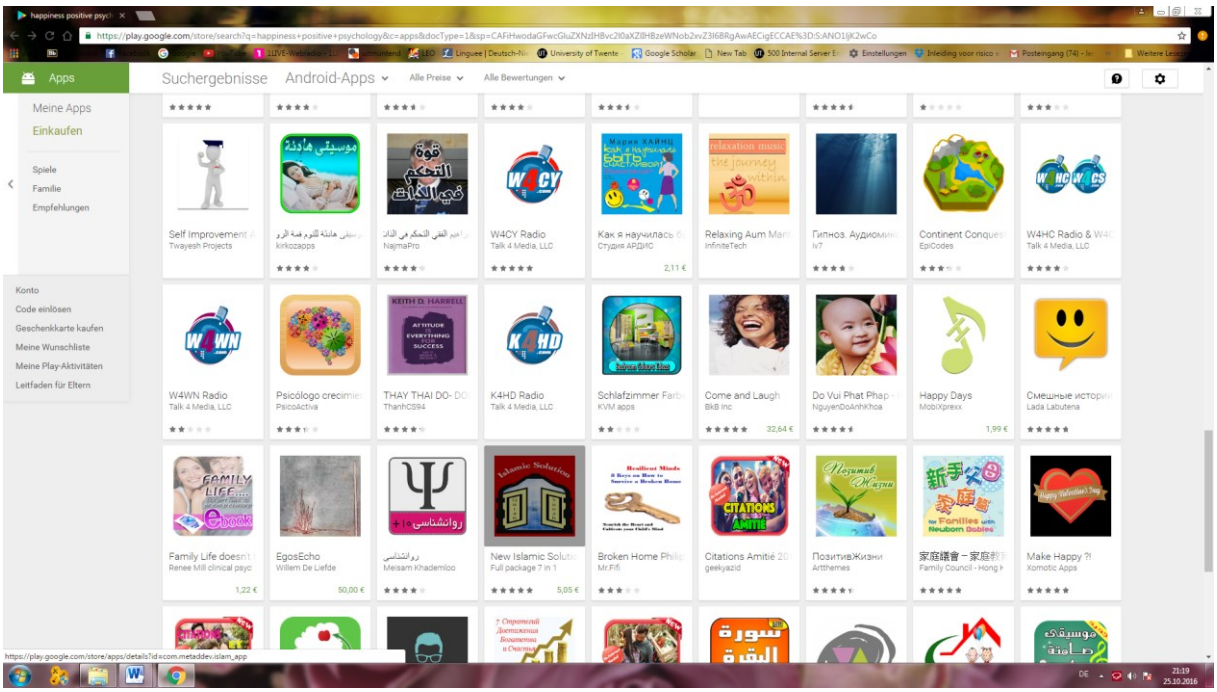
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Continent Conques
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W4WN Radio
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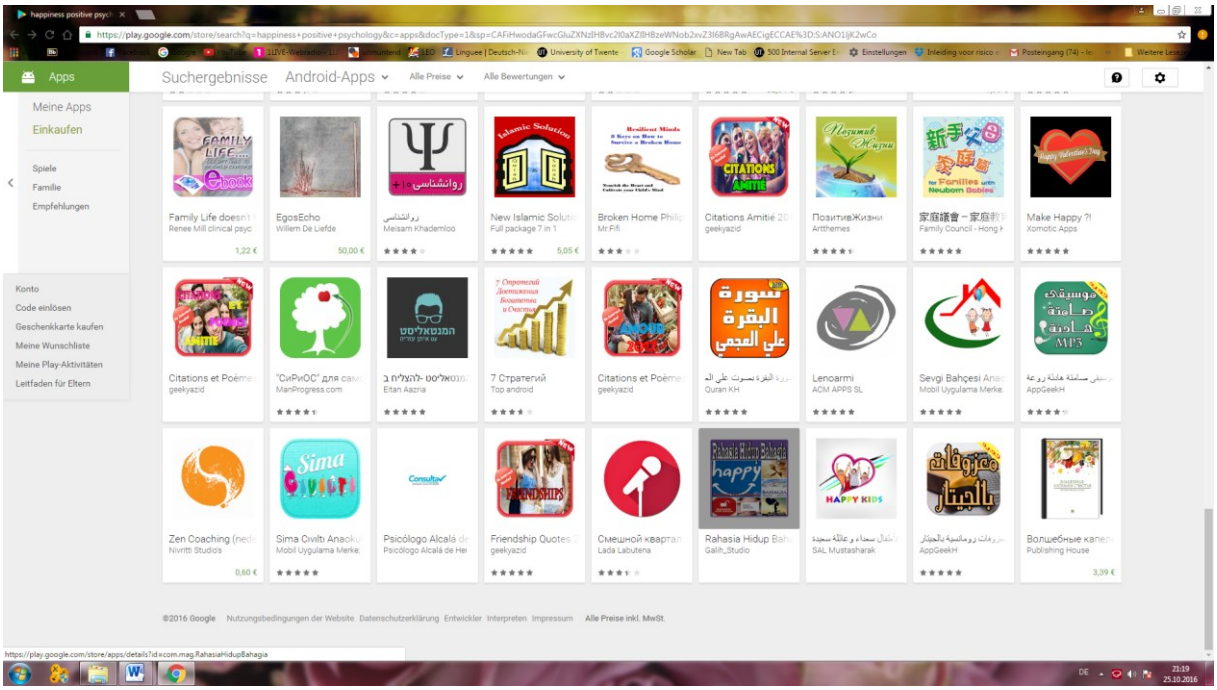
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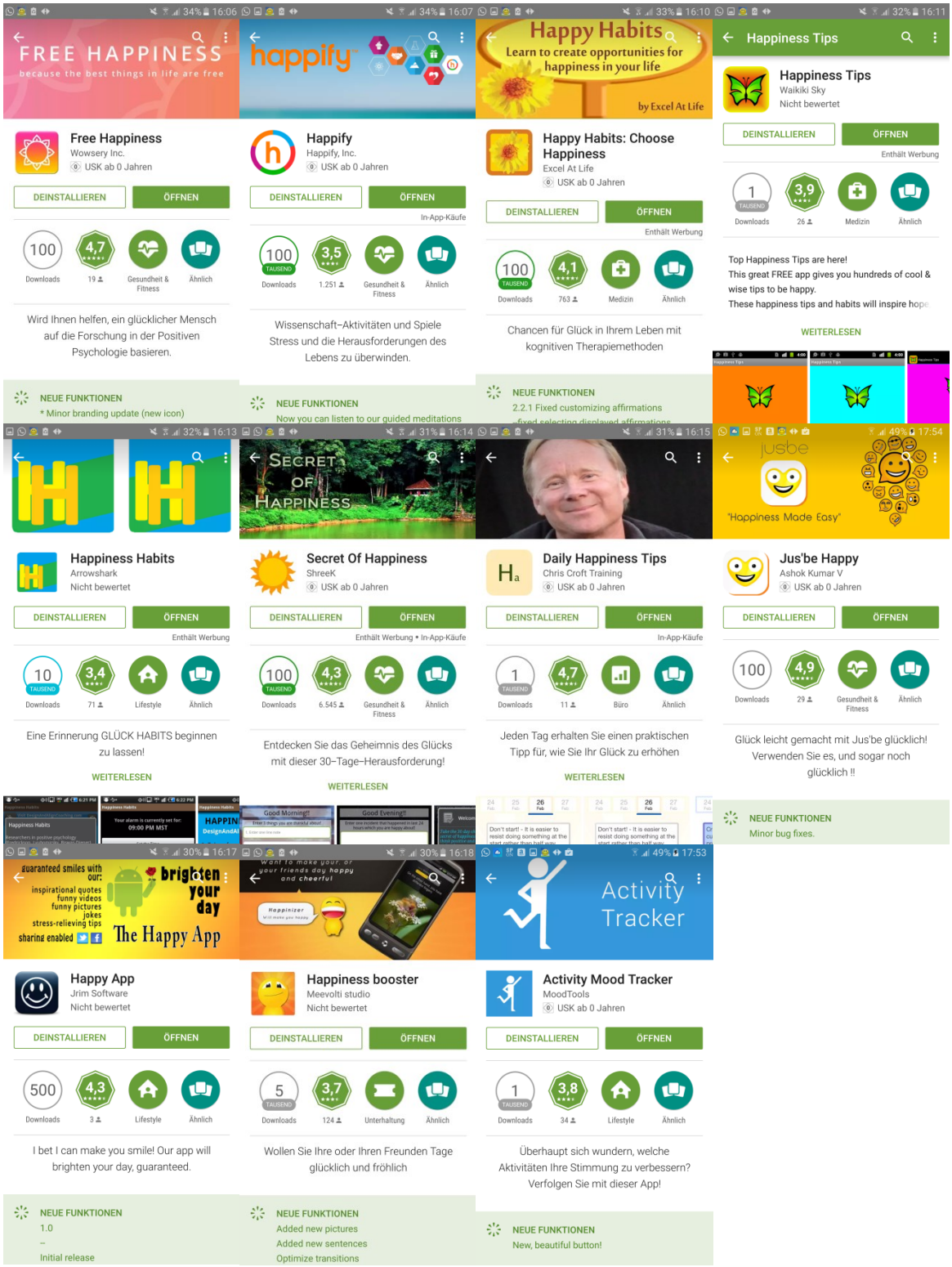
Alle Bewertungen
Meine Apps
Einkaufen
Spiele
Familie
Empfehlungen
Konto
Code einlösen
Geschenkkarte kaufen
Meine Wunschliste
Meine Play-Aktivitäten
Leitfaden für Eltern
Family Life doesn't
Renee Mill clinical psyc
1,22 €
EgosEcho
Willem De Liefde
50,00 €
Islamic Solution
New Islamic Solutio
Full package 7 in 1
5,05 €
Broken Home Philip
Mr.Fifi
Citations Amitié 20
geekyazid
ПозитивЖизни
Artthemes
家庭議會 ~ 家庭教
Family Council - Hong K
Make Happy ?!
Xomotic Apps
Citations et Poème
geekyazid
"СиРиОС" для сай
ManProgress.com
Eitan Aazria
7 Стратегий
Top android
Citations et Poème
geekyazid
Quran KH
Lenoarmi
ACM APPS SL
Sevgi Bahçesi Ana
Mobil Uygulama Merke
AppGeekH
Zen Coaching (ned
Nivritti Studio's
0,60 €
Sima Ovıltı Anaok
Mobil Uygulama Merke
Psicólogo Alcalá de
Psicólogo Alcalá de Hei
Friendship Quotes
geekyazid
Смешной квартан
Lada Labutena
Rahasia Hidup Baha
Galih_Studio
SAL Mustasharak
AppGeekH
Волшебные капел
Publishing House
3,39 €
©2016 Google
Nutzungsbedingungen der Website
Datenschutzerklärung
Entwickler
Interpreten
Impressum
Alle Preise inkl. MwSt.
https://play.google.com/store/apps/details?id=com.mag.RahasiaHidupBahagia
21:19
25.10.2016

3. Screenshots of app selection for analysis



4. Detailed description of each app

The first app, *Free Happiness* has three features: rating the current level of happiness, a gratitude log and a smile reminder. When rating the current level of happiness the user can choose between randomly ordered smileys with different facial expressions which are given numbers from 1 to 10. Further an overview of the average happiness level is presented by a smiley and an average score as well as 'the happiest day', 'your happy hour' and the 'best day of the week'. On four additional screens different progress charts can be viewed, presenting the weekly progress. The second feature on the main screen is a gratitude journal. It gives the user the possibility to log and review 1 to 30 things he or she is grateful about. Additionally, gratitude logs made in the past can be reviewed on a list. The third feature is the smile reminder. This option provides a service to record smiles either by taking a photo or assuring that the user has smiled. The smile reminder also offers a progress screen where the total percentage of smiles compared to days without recorded smiles can be viewed. Furthermore, the smile photos which have been taken can be reviewed on the same screen. Next to the main app features, Free Happiness provides an option to read frequently asked questions (FAQ's), to send feedback, or rate the app, as well as some settings to set reminders for the three different features. If not disabled, there are 3-10 reminders per day. The number and time of reminders can be customized. Every app feature can be used as many times per day as the user wants to.

The second app, *Happify* provides a variety of features. When opening the app for the first time, the user has to register and then receives an e-mail with a link to verify the new account. On basis of some questions in the beginning asking about demographics, social life, resilience and life satisfaction some 'tracks' are recommended to the user. The tracks have different topics like 'cope better with stress' or 'boost your happiness and spread positivity'. Each 'track' provides different features like games, meditation exercises or goal setting. Some features can only be carried out when upgrading to premium, which has to be payed for. Within five days, one track should be completed. It is only possible to follow one track at a time. Additionally the app provides an option for free play where different games can be played next to the currently followed track. Happify offers progress tracking by showing the development of five skills which are trained by following the tracks (savor, thank, aspire, give and empathize) which are trained by following the tracks. To have a look at more detailed statistics a premium account is required. Happify additionally offers a 'strengths assessment' to explore three signature strengths. For more than three, the upgrade to premium is needed.

Furthermore every user of Happify can participate in the Happify community which serves as a separate social media platform only for users of the app. Successes can be posted, commented on or liked. It is possible to 'follow' other users to discuss with them in a forum or to win prizes by developing the highest skills. Besides all these features happify provides settings to customize the user profile, to connect it with Facebook or twitter or to set notifications. It is possible to receive push notifications directly on the smartphone screen as well as via e-mail. There are different kinds of notifications (comments, likes/follows, track/activities, happiness assessment, coaching) which can be disabled or enabled at user's option. The number or time of notifications are not fixed, but occur randomly. The different app features can be used as many times as requested. Even the strengths assessment can be taken repeatedly.

The third app is *Happy Habits* which provides different features including a happiness assessment, a large amount of different audio guides focusing on happiness, emotion, relaxation or mindfulness, articles concerning happiness, a happiness journal and 50 suggestions about how to increase happiness as well as a progress tracker. Most audio guides provided by the app have a duration of about 20 minutes. Additionally to the audio tape some guides offer a transcript of what is said during the audio session. The user can choose freely between the different topics of the audios. For the happiness assessment 119 questions have to be answered by the user. After finishing the test, a score and a description of the test result can be viewed by the user. This score can be reviewed any time. The happiness journal is a service that allows the user to log self-created or standard affirmations like 'To be happy, I must share happiness". Furthermore a positive event can be logged as well as items for a to-do list. The 50 suggestions to increase happiness provided by the app can also be logged if they had been carried out by the user. A graph shows the development of the user's performance. Under the suggestions are requests to make use of the different app features or descriptions how to increase happiness in real-life, like "Pet an animal". Next to all its features, Happy Habits provides settings to customize the app design as well as privacy settings like the use of a password and the possibility to participate in a program that offers real cash rewards for collecting points in the app. Furthermore the apps provide the option to activate or disable a daily reminder. The reminder appears once per day. All app features can be used repeatedly without any limitation.

Another app chosen for this study is *Happiness Tips* which offers hundreds of different happiness tips which can be saved or shared. It is possible read through all happiness tips which are never longer than one sentence. Users can choose between viewing all

happiness tips or only those which were marked as favorites. Sharing a happiness tip is possible on every social platform the device provides. Additional settings to customize the app are not provided.

The fifth app which has been analyzed is *Happiness Habits*. On the main screen of the app the user can find a list of 7 'Happiness Habits'. Each day one activity should be done according to the instructions. During this week the list of activities can be reviewed as many times as the user wants to. After one week a new list appears with 7 new habits. To remember doing such an activity a daily reminder can be set by the user.

Another app which has been studied is *Secret of Happiness.* The app calls itself a 30-day challenge within which the user should log 'three good things in life' and 'one thing that he or she wishes to accomplish that day' every morning and 'one thought, person or event he or she is happy about' in the evening. A reminder for morning and evening can be set by the user. Additionally it is possible to view back the content of what has been logged in the past. The app consistently displays either the morning exercise or the evening exercise depending on the time of day. It is not possible to catch up on the morning task in the evening or vice versa. When closing the app, the user is asked to rate the app if he or she likes it.

The app *Daily Happiness Tips* shows a new happiness tip each day. It is not possible to read all happiness tips once. Only the tips which have been shown in the last 4 days can be viewed back. Under every short tip the user can find a more detailed description of the tip. Furthermore the app provides a service to share a happiness tip via Facebook. It is also possible to read a letter of the developer directed to the users also including a picture of the developer. Another button offers access to 'Daily Success Tips' which is an additional paid service. There are no additional settings or features provided.

The following app *Jus'be happy* is an app with different features presented by smiley faces. The first feature, 'My Likes', lets the user rate different activities, standard or self-logged, on his level of happiness (low, medium, high). It is possible to add activities or to change ratings any time. Based on two reminders per day which ask the user which happiness activities selected in the 'My Likes' feature he has carried out called, a progress chart of the last seven days is presented. This rating service is a so called 'Happiness Journal'. Another feature 'Happy Moments' provides a service to capture happy moments in the user's life by recording a audio file, taking a photo or a video. Captured moments can be titled and viewed back on the same screen. The third feature, 'Happy Occasions' gives the user the possibility to set a reminder for happy occasions in the future like meeting a friend, Christmas or a birthday. Furthermore a feature called 'Happy Quotes' provides many different happiness quotes which

can be read, deleted or extended. Additionally a description of all app features can be read when clicking on a smiley with a question mark. Except for the 'Happiness Journal' which can only be used after being requested in form of a notification, every app feature can be used repeatedly and without limitations.

The *Happy App* shows a list of five different app features on its main screen and asks its user "How would you like to brighten your day?". Users can choose between 'an insightful quote', 'a funny video', 'a joke', 'a funny picture' or 'a stress eliminating tip'. The videos, pictures and joke buttons lead the user to external websites for presentation. Only the quotes and tips are presented directly in the app. All quotes and tips can be read through at one time. Furthermore it is possible to share a quote or a tip via Facebook, twitter or SMS. The app neither provides a notification service nor options for customization. Users have access to every app feature without limitations.

The tenth app analyzed in this study is the *Happiness Booster* which tells the user to shake the device to get to the 'four happinizer steps'. Funny pictures and quotes are displayed in four stages (changing perception, embedding smile, initializing happiness). The current status of the boosting process can be viewed on a bar presenting the percentage of progress. After shaking the device the first stage 'changing perception' begins with a random picture and a wise saying. The second stage 'boosting mood' presents a funny picture like a cat showing its tongue while a funny saying or joke is displayed above. The third stage shows a smiley picture and tells the user to smile and hold it for three seconds. Finally, in the last stage named 'Initializing happiness' the app logo, a smiley is shown as well as the words "You are happy and you know it". It is always possible to shake the device once again and to follow the boosting process another time with different pictures and sayings.

The last app, the *Activity Mood Tracker*, is a 'personalized random activity generator' which suggests different activities to increase happiness on a main screen. By clicking on an activity a new screen with a more detailed activity description is shown. Under the description, the mood before and after the activity can be rated from 0 for 'horrible' to 10 for 'ecstatic'. When rating the mood before engaging in a certain activity, a notification is created by the app. The user gets a reminder on his smartphone to rate the mood after he or she has finished the activity chosen before. It is further possible to add own activities and to view back the activity history and the particular ratings. The user can choose an activity or click op the random button which then picks an activity for the user. The Activity Mood Tracker can be used at any time without limitations.

B: Description of theoretical elements incorporated within the apps

Name App	Description of application elements	Elemets AHT (positive emotion, engagement,meaning)	Use of positive psychological exercises
1. Free Happiness (Wowsery Inc.)	1. Rating happiness level 2. Gratitude log 3. Smile Reminder	**Positive Emotion** (Smile Reminder)	**Practicing gratitude** (gratitude log)
2. Happify (Happify, Inc.)	1. Home button (Overview of current track)2.Free Play (offers games apart from followed track)3. Explore tracks (different tracks can be viewed and filtered)4. Happify Daily (News Feed) 5. Community (Posts/Forums) 6. Win Prizes 7. Own profile (own strengths/statistics,posts,notifications, invites and settings)	**Positive Emotion** (e.g uplift game,look for positive and not for negative words on moving balloons)	**Meditation** ('serenity scene', guided meditation exercise) **Cultivate strengths** (Assesment: Discover Signature Strengths) **Being kind** ('kindness chain', sending someone a compliment card)
3. Happy Habits (Excel at Life)	1. Homescreen (happiness quotes) 2. Audios (Choose happiness, relaxation, emotion training, mindfulness training)3. Articles (Education: creating conditions for happiness,(negative)Thinking, Training: cope with stress)4. Test (Happiness Assessment)5.Journal (own affirmations, positive event, happiness to do list) 6. Suggestions (List of 50 suggestions to create conditions of happiness)	**Meaning** (Act as if what I do makes a difference. It does!"Suggestion: "Take responsibility") **Engagement** & **Positive Emotions**(Suggestions like "take a walk", "sit outside in the sun", "watch a comedy", "smile", "listen to happy playlist", "Don't dwell, do!"…)	**Meditation** (Audio relaxation and mindfullness training, emotion training, suggestions to meditate) **Practicing gratitude** (Writing about a positive event in the journal, Suggestion: "List the positives") **Being kind** (Suggestion: "Feel joy for someone else", "Give your time to help someone") **Writing down early life memories** (Suggestion: Think of an experience you've enjoyed"
4. Happiness Tips (Waikiki Sky)	1. Happiness Tips 2. Favorite Happiness Tips	**Positive Emotion** ("Try to make at least 3 people smile each day, beginning with yourself.", "Be able	**Being kind** ("Try to make at least 3 people smile each day, beginning with yourself." **Practicing gratitude**

		to laugh at yourself sometimes.", "Turn on happy music and dance.")	("Be content with where you are, who you are, and what you have." , Each night before you sleep, complete the following statement: "I am thankful for…" ,"Affirm all the good things about yourself each day.")
5. Happiness Habits (Arrowshark)	List of happiness habits	**Positive emotions** ("Look up a good joke and tell it to someone", "Think about a joyful experience. Visualize the details as if you where there, incorporating your senses; sights, smells, sounds, touch. Allow yourself to breathe deeply and feel the joy for a few minutes.")	**Being kind/Mindfullness**(" Close your eyes and imagine someone you love. Allow the feelings of love to wash over you for a few minutes. Extend those loving feelingsto someone else who needs them and then to yourself", "Do some little, nice thing for 2 different people…open a door, carry something for someone, tell someone they look nice **Mediation** (Watch a short meditation video on You-Tube or listen to calming music.")
6. Secret of Happiness (ShreeK)	1. Morning exercises: ("Enter 3 good things & one thing you wish to accomplish that day") 2. Evening exercise ("Enter one thought/person/event you are happy about.")	**Positive emotions & Engagement**("Enter one thing you wish to accomplish that day", "Enter one event you are happy about that happened in the last 24 hours.") directly in the app	**Practicing gratitude** ("Enter one person you are happy about.", "enter 3 good things.") directly in the app
7. Daily Happiness Tips(Chris Croft Training)	Daily happiness tips ordered by day	**Engagement** ("No TV today! What will you do instead? And afterwards, did you enjoy your evening more?"	**Practicing gratitude** ("Set up a screensaver on your computer to remind you that you have a good life") **Writing down early life memories** ("Photo

		Positive emotions (“Photo show- Leaf through some old photo albums today. Laugh at your old hair styles, and remember fun times you had. How great it is o have these memories and these photos”)	show- Leaf through some old photo albums today. Laugh at your old hair styles, and remember fun times you had. How great it is o have these memories and these photos”)
8. Jus’ be happy (Ashok Kumar V)	1. My likes- what makes you happy? 2. Happy Moments 3. Happy Occasions 4. Happy quotes 5.Happiness Meter	**Engagement** (. My likes- what makes you happy) directly in the app **Positive emotions** (“Happy Moments , Happy Occasions”) directly in the app	**Writing down early life memories** (Happy Moments) directly in the app **Practicing gratitude** (My likes – What makes you happy?) directly in the app
9. Happy App (Jrim software)	1. Insightful quotes 2. Funny videos 3. Jokes 4. Funny pictures 5. Stress eliminating tips	**Positive emotions** (app tries to make user laugh by showing funny pictures,videos or jokes)	
10. Happiness Booster (Meewolti Studio)	4 happinizer steps: 1. Changing perception 2. Boosting mood 3. Embedding smile (Hold smile 3 seconds) 4. Initializing happiness	**Positive emotions** (“Smile for 3 seconds”, funny pictures)	
11. Activity Mood Tracker (MoodTools)	List of Activities to promote happiness	**Positive emotions** (“Watch a comedy”) **Engagement** (app claims to engage in different activities e.g read a book, get sunlight, hobby)	**Meditation** (“Mindfulness Meditation”, “Relax”) **Being kind** (“Help others”) **Practicing gratitude** (“Practice gratitude”)

C: Description and coding scheme of Persuasive System Design Elements

1. Overview with descriptions

Persuasive System Design Elements (Oinas-Kukkonen & Harjumaa, 2009)

Primary Task Support	
Reduction	Effort to perform the target behavior should be reduced
Tunneling	System should guide the user through the process by providing means for action that brings them closer to the target behavior
Tailoring	System should provide tailored information for its user groups
Personalization	System should offer personalized content and services for its users.
Self-Monitoring	System should provide means for users to track their performance or status
Simulation	System should provide means for observing the link between the cause and effect with regard to users' behavior.
Rehearsal	System should provide means for rehearsing a target behavior.
Dialogue Support	
Praise	System should use praise via words, images, symbols, or sounds as a way to provide user feedback information based on his/her behaviors
Rewards	System should provide virtual rewards for users in order to give credit for performing the target behavior
Reminders	System should remind users of their target behavior during the use of the system
Suggestions	System should suggest that users carry out behaviors during the system use process
Similarity	System should imitate its users in some specific way

Liking	System should have a look and feel that appeals to its users
Social Role	System should adopt a social role
System Credibility Support	
Trustworthiness	System should provide information that is truthful, fair and unbiased
Expertise	System should provide information showing knowledge, experience, and competence
Surface Credibility	System should have competent look and feel
Real-world feel	System should provide information of the organization and/or actual people behind its content and services
Authority	System should refer to people in the role of authority
Third-party endorsements	System should provide endorsements from respected sources
Verifiability	System should provide means to verify the accuracy of site content via outside sources
Social Support	
Social learning	System should provide means to observe other users who are performing their target behaviors and to see the outcomes of their behavior
Social comparison	System should provide means for comparing performance with the performance of other users
Normative influence	System should provide means for gathering together people who have the same goal and make them feel norms
Social facilitation	System should provide means for discerning other users who are performing the behavior
Cooperation	System should provide means for co-operation
Competition	System should provide means for competing with other users
Recognition	System should provide public recognition for users who perform their target behavior

2. Coding scheme for the use of PSD elements

Table1. Primary Task Support								
App	Reduction	Tunnelling	Tailoring	Personalization	Self-monitoring	Simulation	Rehearsal	Score & (N: used principles)
1. Free Happiness (Wowsery Inc.)	Fully included (++)	Not included (--)	Not included (--)	Partly included (+-)	Fully included (++)	Not included (--)	Partly included (+-)	6 (4)
	Simple overview of 3 elements, happiness ratings, gratitude logs and smile reminder			Possibilty to **change the number of items** which can be logged in the gratitude journal and to **change the time of reminders or to disable** them	**Happiness development** viewable (averages, progress), **overview of gratitude logs**, **review smile progress** and fotos of smiles		**Recording smiles** with reminders to **smile more often**	
2. Happify (Happify, Inc.)	(++)	(++)	(--)	(++)	(+-)	(+-)	(++)	10 (6)
	Easy to choose one track on the track screen (“explore tracks”) , **clearly arranged task bar** presenting all options, System **povides activities directly in the app**	A **new track** can only be followed **when completing the first**		System asks **personal questions** before starting the intervention (demographics or personality traits “Would you consider yourself as social?”), user has an own **profile** with their user name, possible to **choose between community**	User can see how much time is left to complete all his activities **and how his/her skills** (Savor/Thank, Aspire,Give,Empathize) **have developed** (for more statistics happify pro has to be bought)	**Statistics of cause and effect** are reported: “86% of regular users saw happiness improvements in 2 month”	Different **games are rehearsing the target behavior** e.g. “Paying attention to details” can be practiced by playing a game in which little hidden objects have to be found in a landscape picture	

				mode and private mode				
3. Happy Habits (Excel at Life)	(++)	(--)	(--)	(+-)	(++)	(--)	(--)	5 (3)
	Different audio guides (Choose Happiness, Relaxation, Emotion Training, Mindfulness Training) are **subdivided into different steps** which may be followed, **clearly arranged task bar** presenting all options			User can **disable daily reminders**, **enlarge the app design** and text size/style for visually impaired people, and **several privacy settings** (e.g. creating a password)	User can view **test results** from the "Happiness Assessment Test", viewable **"Journal "- History** (self logged affirmations, good events, happiness to do list),**own happiness suggestions can be saved**, **overview** of already **completed tasks**			
4. Happines	(++)			(+-)				3 (2)

s Tips (Waikiki Sky)	**All options** the app provides can be carried out **on the first screen** (See happiness tips, go further, go back, add to favorites, share happiness tips, show favorites)			Possibility to **add** several **happiness tips** to **favorites**				
5. Happines s Habits (Arrowsh ark)	(++)			(+-)				3 (2)
	One main screen providing **overview of all happines s habits** and 3 buttons (contact us, instructio ns, set reminder)			User can **set** the preferred time and day(s) for the **reminder**				
6. Secret of	(++)	(+-)	(--)	(+-)	(--)	(--)	(++)	6 (4)

Happiness (ShreeK)	System provides **simple tasks** to do in the morning (enter 3 things you are grateful for, goal for the day) and in the evening (person or event you are happy about), **clearly arranged**	System offers **different morning and evening activities**		Possible to **set time of reminder** for morning and evening			**Rehearses all its tasks** (information can be entered into the app)	
7. Daily Happiness Tips(Chris Croft Training)	(++)	(--)	(--)	(--)	(--)	(--)	(--)	2 (1)
	Easy to go forward and back to already received happiness tips							
8. Jus' be happy (Ashok Kumar V)	(++)	(--)	(--)	(++)	(++)	(--)	(++)	8 (4)
	Simple tasks represented by smiley buttons on the first screen, **easy to follow**			Possible to **add new own happiness** activities and quotes, **capture happy moments** with foto/audio/video, **group them into categories** and to **set time for notifications** to rate happiness, **set own happiness goal**	Possible to view the **"Happiness Meter"** which shows level of happiness, **view back happy moments** and to **have a look at happy activities**		**Capturing happy moments** is rehearsed everyday as well as **rating level of happiness** and **log happy activities**	

9. Happy App (Jrim software)	(++)	(--)	(--)	(--)	(--)	(--)	(--)	2 (1)
	5 different options presented on one screen							
10. Happiness Booster (Meewolti Studio)	(++)	(--)	(--)	(--)	(--)	(--)	(+-)	3 (2)
	Through easily **shaking** the mobile device **4 steps to boost happiness** are **presented**						App encourages to **hold a smile for 3 seconds**	
11. Activity Mood Tracker (MoodTools)	(++)	(--)	(--)	(+-)	(++)	(--)	(+-)	6 (4)
	Activities are presented **on one main screen**, **easy to follow different steps** by clicking on activity			Possible to **add own activities** or **delete some**	Possible to **view history** of activities and mood before and after it		App encourages to **rate mood before and after an activity**	
Score	22 (11)	3 (2)	0 (0)	10 (8)	9 (5)	1 (1)	9 (6)	54 (33)

Table 2. Dialogue support								
App	Praise	Rewards	Reminders	Suggestions	Similarity	Liking	Social Role	Score
1. Free Happiness (Wowsery Inc.)	(+-)	(--)	(++)	(--)	(--)	(+-)	(--)	4 (3)
	When completing gratitude log, or smile reminder for the first time **"Awesome", "Beautiful!"**		**Daily reminder for each element** (happiness rating, gratitude log, smiling)			Medium attractive design through smiley faces		
2. Happify (Happify, Inc.)	(++)	(++)	(++)	(++)	(--)	(++)	(--)	10 (5)
	After completed activity **"congratulations!", "Well done!", "Great** Job"	Earning a **medal (silver-gold)** and more **points** in developing different skills, possibility to win gift cards	Daily reminder that **activities are waiting** (push notoficatios) **and e-mail reminders**	Many **suggestions in the description** of every activity e.g. "reduce negative thinking"		**Remarkably attractive design**		
3. Happy	(++)	(++)	(+-)	(++)	(--)	(+-)	(--)	8 (5)

Habits (Excel at Life)	Graph of collected points **praises the user when collecting points for completed tasks** ("Good Job!, Great!, WOW!,Terrific!, Amazing")	**Points** can be collected **for completed tasks** (suggestions for happiness), possible to participate in an external program (Achieve Mint) where real cash can be winned by collecting points	**One daily reminder to open the app** "Don't forget Happy Habits today!"	A **list of 50 suggestions** to create conditions for happiness, **test results also give suggestions** to improve happiness"focusing on positive outcomes"		**Medium attractive design**		
4. Happiness Tips (Waikiki Sky)	(--)	(--)	(--)	(+-)	(--)	(--)	(--)	1 (1)
				Suggestions in the form of **happiness tips**				
5. Happiness Habits (Arrowshark)	(--)	(--)	(+-)	(+-)	(--)	(--)	(--)	2 (2)
			Possible to **set one reminder** per day	Suggestions in form of the listed **"happiness habits"**				
6. Secret	(--)	(--)	(++)	(--)	(--)	(--)	(--)	2 (1)

of Happiness (ShreeK)			**Reminders** to do **recommended tasks** two times per day (morning and evening)					
7. Daily Happiness Tips(Chris Croft Training)	(--)	(--)	(--)	(+-)	(--)	(--)	(--)	1 (1)
				Suggestions in form of **daily happiness tips**				
8. Jus' be happy (Ashok Kumar V)	(--)	(--)	(++)	(++)	(--)	(+-)	(--)	5 (3)
			Reminder for **happy occasions** which have been logged earlier, reminder to **rate happiness**	Suggests different **activities** that increase happiness		Medium attractive design		
9. Happy App (Jrim software)	(--)	(--)	(--)	(--)	(--)	(+-)	(--)	1 (1)
						Medium attractive design		
10. Happiness Booster (Meewolti Studio)	(--)	(--)	(--)	(+-)	(--)	(++)	(--)	3 (2)
				Suggests to **hold a smile for 3 seconds**		Attractive design		

11. Activity Mood Tracker (MoodTools)	(--)	(--)	(+-)	(++)	(--)	(--)	(--)	3 (2)
			Reminder to rate mood after an earlier chosen activity	Suggests a great number of **activities to increase happiness**				
Score	5 (3)	4 (2)	11 (6)	12 (8)	0 (0)	8 (6)	0 (0)	40 (25)

Table3. System Credibility Support

App	Trustworthiness	Expertise	Surface credibility	Real-world feel	Authority	Third-party endorsements	Verifiability	Score
1. Free Happiness (Wowsery Inc.)	(++)	(++)	(+-)	(++)	(+-)	(--)	(+-)	9 (6)
	System provides information that is **truthful, fair and unbiased**. **No advertising** or **marketing information**	Referring to **studies about the effectiveness of smiling and being grateful**. Referring to **research in positive psychology** and scientific articles	System **looks and feels relatively competent**, no advertisement at all	Possibility to **contact developer** and ask questions or send feedback**, direct link** to developer's homepage	Gives **one reference** from a study by **Harvard**		Claims in the application are partly **supported by articles from other sources** (gratitude journal, smiling)	
2. Happify (Happify, Inc.)	(+-)	(++)	(++)	(++)	(++)	(--)	(++)	11 (6)
	System provides **informati**	Referring to a great number	System **looks and**	Possibility to **send an email to developers**	Each "Track" is created by a **"Positive**		Referring to **own homepage**	

	on that is truthful, fair and unbiased. Only marketing informati on for app upgrade	of studies. For **each activity a reference** can be retrieved	**feels very competen**t, no external advertis ements, only recomm ending upgrade	**of the app**, **direct link** to e-mail app on the device	**Psychology Coach"** who is presented with a picture, an Expert **Biography can be read**		which gives a **long list of references** for every activity in the app	
3. Happy Habits (Excel at Life)	(+-)	(++)	(--)	(++)	(++)	(+-)	(++)	10 (6)
	Provides informati on that is **truthful, fair and unbiased,** but **extern advertise ment** (Amazon)	Referring to **different happines s articles** and **Cognitive Behavior al Therapy**		Possible to **contact the developer via e-mail to give suggestions or feedback**, **direct link** to e-mail app on the device	Refers to a **clinical psychologist** (Monica A. Frank. Ph.D) as founder of app company	Happiness Assessment Test includes 119 **items from the "Internatio nal Personality Item Pool** (IPIP)"	Claims in the application are **supported by articles from other sources** (references can be found on company website)	
4. Happines s Tips (Waikiki Sky)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
5.	(++)	(++)	(++)	(+-)	(++)	(--)	(--)	9 (5)

Happines s Habits (Arrowsh ark)	System provides informati on that is **truthful, fair and unbiased**. **No advertisin g** or marketing informati on	Informati on showing backgrou nd of "happines s habits" , **positive psycholog ical activities**	**Looks and feels competent, no advertis ment**	Possible to **contact developers via e-mail** adress shown in the app, **no direct link**	Refers to **researchers in Positive Psychology** (Fredrickson, Lyubormirsk y,Biswas-Diener)			
6. Secret of Happines s (ShreeK)	(--)	(--)	(--)	(+-)	(--)	(--)	(--)	1 (1)
				Possible to **contact developers via e-mail, no direct link**				
7. Daily Happines s Tips(Chris Croft Training)	(--)	(--)	(--)	(+-)	(--)	(--)	(--)	1 (1)
				Developer is presented with a foto, **no contact details** within the app				
8. Jus' be happy (Ashok Kumar V)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
				No contact details within the app				
9. Happy App (Jrim software)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
				No contact details within the app				

10. Happiness Booster (Meewolti Studio)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
				No contact details within the app				
11. Activity Mood Tracker (MoodTools)	(++)	(--)	(+-)	(--)	(--)	(--)	(--)	3 (2)
	System provides **information that is truthful, fair and unbiased**. **No advertising or marketing information**		Looks and feels relatively competent	No contact details within the app				
	8 (5)	8 (4)	6 (4)	9 (6)	7 (4)	1 (1)	5 (3)	44 (27)

Table 4. Social Support

App	Social learning	Social Comparison	Normative influence	Social facilitation	Cooperation	Competition	Recognition	Score
1. Free Happiness (Wowsery Inc.)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
2. Happify	(++)	(++)	(--)	(++)	(--)	(++)	(+-)	9 (5)

(Happify, Inc.)	People in the community can **post their successes** and other people can **comment on it**	Users can see how **others have developed their skills** and compare themselves to others		Possible to see the posts of others in the **community** or to discuss with them in the forum, further they can connect with **facebook or twitter** to share their happiness experience		Possible to **win prizes** monthly by completing happiness activities, the more activities the user completes, the higher the chance to win	People, who win a prize are presented in the app with their first name and the first letter of their last name,as well as the plac they live in	
3. Happy Habits (Excel at Life)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
4. Happiness Tips (Waikiki Sky)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
5. Happiness Habits (Arrowshark)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
7. Secret of Happiness (ShreeK)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
8. Daily Happiness Tips(Chris Croft Training)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
9. Jus' be	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)

happy (Ashok Kumar V)								
10. Happy App (Jrim software)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
11. Happiness Booster (Meewolti Studio)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
12. Activity Mood Tracker (MoodTools)	(--)	(--)	(--)	(--)	(--)	(--)	(--)	0 (0)
	2 (1)	2 (1)		2 (1)		2 (1)	1 (1)	9 (5)

++: to a great extent (2 points

+-: available to some extent (1 point)

--: not available or badly applied (0 points)

E: Overview of all results summarized

App Name	Theoretical background:	PSD elements Total score & No. of principles	Subjective quality	App Store rating (No. of raters)	No. of downloads
1. Free Happiness	One element of AHT included: **Positive emotion** One positive psychological exercise included: **Practicing gratitude**	Score: 19 (13) Primary Task Support: **Reduction, personalization,self-monitoring,rehearsal** Dialogue Support: **Praise, reminders, liking** System Credibility Support: **Trustworthiness, expertise, suface credibility, real-world-feel,authority, verifiability** Social Support: ***No principles found***	App quality mean: 3,94 Subjective quality mean: 2,0	3,8 (34)	1.000
2. Happify	One element of AHT included: **Positive emotion** Three positive psychological exercises included: **Being kind, cultivating strengths, meditation/mindfulness**	Score: 40 (22) Primary Task Support: **Reduction, tunneling,personalization, self-monitoring,simulation,rehearsal** Dialogue Support: **Praise, rewards, reminders, suggestions,linking** System Credibility Support: **Trustworthiness, expertise, suface**	App quality mean: 4,58 Subjective quality mean: 4,0	4,7 (11)	1.000

		credibility, real-world-feel,authority, verifiability Social Support: **Social learning, social comparison, social facilitation, competition, recognition**			
3. Happy Habits	All elements of AHT included: **Positive emotion, engagement, meaning** Three positive psychological exercises included: **Practicing gratitude, being kind, meditation, early life memories**	Score: 23 (14) Primary Task Support: **Reduction, personalization** Dialogue Support: **Praise, rewards, reminders, suggestions,linking** Surface Credibility Support: **Trustworthiness, expertise,real-world-feel, authority, third-party endorsements, verifiability** Social Support: ***No principles found***	App quality mean: 2,89 Subjective quality mean: 2,25	4,7 (19)	100
4.Happiness Tips	One element of AHT included: **Positive emotion** Three positive psychological exercises included: **Practicing gratitude, being kind**	Score: 4 (3) Primary Task Support: **Reduction, personalization** Dialogue Support: **Suggestions** System Credibility Support: ***No principles found*** Social Support:	App quality mean: 3,24 Subjective quality mean: 1,25	3,5 (1251)	100.000

5. Happiness Habits	One element of AHT included: **Positive emotion** Two positive psychological exercises included: **Being kind, meditation/mindfulness**	Score: 14 (9) Primary Task Support: **Reduction, personalization** Dialogue Support: **Suggestions, similarity** System Credibility Support: **Trustworthiness, expertise, suface credibility, real-world-feel,authority** Social Support: ***No principles found***	App quality mean: 3,29 Subjective quality mean: 1,75	3,7 (124)	5.000
6. Secret of Happiness	Two elements of AHT included: **Positive emotion, engagement** One positive psychological exercise included: **Practicing gratitude**	Score: 9 (6) Primary Task Support: **Reduction, tunneling, personalization, rehearsal** Dialogue Support: **Reminders** System Credibility Support: **Real-world-feel** Social Support: ***No principles found***	App quality mean: 3,56 Subjective quality mean: 2,5	3,4 (71)	10.000
7. Daily Happiness Tips	One element of AHT included: **Positive emotion** Two positive psychological exercises included:	Score: 4 (3) Primary Task Support: **Reduction** Dialogue Support: **Suggestions** System Credibility	App quality mean: 3,06 Subjective quality mean: 1,75	3,9 (26)	1.000

	Practicing gratitude, early life memories	Support: **Real-world-feel** Social Support: ***No principles found***			
8. Jus' be happy	Two elements of AHT included: **Positive emotion, engagement** Two positive psychological exercises included: **Practicing gratitude, early life memories**	13 (7) Primary Task Support: **Reduction, personalization, self-monitoring, rehearsal** Dialogue Support: **Reminders, suggestions, liking** System Credibility Support: **No principles found** Social Support: ***No principles found***	App quality mean: 3,83 Subjective quality mean: 2,75	4,3 (3)	500
9. Happy App	One element of AHT included: **Positive emotion** No positive psychological exercises included	Score: 3 (2) Primary Task Support: **Reduction** Dialogue Support: **Liking** System Credibility Support: **No principles found** Social Support: ***No principles found***	App quality mean: 2,76 Subjective quality mean: 1,0	4,1 (763)	100.000
10. Happiness Booster	One element of AHT included: **Positive emotion** No positive	Score: 6 (4) Primary Task Support: **Reduction, rehearsal** Dialogue Support:	App quality mean: 3,56 Subjective	4,9 (29)	100

	psychological exercises included	Suggestions, liking Credibility Support: **No principles found** Social Support: ***No principles found***	quality mean: 1,0 ,		
11. Activity Mood Tracker	Two elements of AHT included: **Positive emotion, engagement** Three positive psychological exercises included: **Practicing gratitude, being kind, meditation/mindfulness**	Score: 12 (18) Primary Task Support: **Reduction, personalization, self-monitorin, rehearsal** Dialogue Support: **Reminders, suggestions** System Credibility Support: **Trustworthiness, surface credibility** Social Support: ***No principles found***	App quality mean: 3,82 Subjective quality mean: 2,5	4,3 (6545)	100.000