The Influence of a Positive Psychology App on Depression and Anxiety amongst University Students

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Abstract

Positive psychology mobile applications can be used to decrease depression and anxiety amongst its users. However, evidence regarding the effectiveness of such apps in university student populations missing. This is crucial to examine during the increasing mental health problem rates in these populations. This present study investigated the effect of the positive psychology app Training in Positivity (TiP) on *depression* and *anxiety* and its user satisfaction. It was expected that usage of the app would cause a decrease in depression and anxiety. Moreover, it was expected that the effect would be larger for females. A pre-post design was used and 83 people participated. Depression and anxiety scores were measured before and after using the app for 18 days. Results revealed main effects of TiP in decreasing depression and anxiety from *mild* to *minimal* (6.04 to 4.27 and 6.48 to 4.53 respectively). The effect size of the app was largest for males compared to females in decreasing anxiety (β = -2.39 for males vs. β = -1.25 for females). No similar effects were found for depression, nor were there interaction effects found between *app usage* and *sex of the participant* on either *depression* or *anxiety.* Possible explanations for these findings are discussed. It can be concluded that TIP has small effects on decreasing depression and anxiety for university and university of applied science students. Integrating TIP in therapy may enhance the efficacy of therapy. Furthermore, use of TIP could act as a buffer against depressive and anxiety symptoms.

Keywords: positive psychology app, university students, depression, anxiety

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Mental health issues are a major problem amongst university students in Western countries. As a recent self-report questionnaire held in eight European countries reveals, approximately a third of all university students suffers from depression, anxiety, or substance abuse disorders (Auerbach et al., 2018). In the United States, an equal picture prevails, with a prevalence rate for mental health problems of 32% amongst 14 000 university students (Eisenberg, 2011). The consequences of these mental health problems are devastating for students, varying from university-related problems, such as lower academic achievements and higher dropout rates, to worse functioning later life in life or even ending it, with a suicide risk that is two times as high during studying (Eisenberg, 2009; Goldman-Mellor et. al, 2014; Lageborn, 2017). This is a problem that continues to adversely affect the lives of many young people and their relatives. What is even worse, is that many students feel unable in reaching out for help. They report on feeling stigma to discuss mental health problems, are afraid that others might judge them for seeking treatment, or feel that treatment is inaccessible to them (Eisenberg et al., 2011; Eisenberg, 2007; Gulliver et al., 2010). Only one-third of the students with mental health problems actually participates in treatment (Eisenberg et al., 2011).

A new approach for these students is needed; an approach that can reach many and in which students feel no longer barriers to participate. For this reason, the University of Twente, with a student population herself of which a third experiences moderate to severe forms of depression and anxiety (Kelders et al., 2019), developed an app named Training in Positivity (TiP). This app uses a positive psychological framework that aims towards increasing mental well-being and resilience.

Many advantages of app usage to reduce mental problems have been reported, such as anonymity in use, constant and low-threshold availability, large reach, and lower cost compared to traditional forms of treatment (Olff, 2015). Using TiP to do something about mental health problems within a university student population is a promising prospect, of which the effectiveness and acceptability are as yet unknown. This paper sets out to examine both by measuring the effects of the TiP app usage on depression and anxiety and its acceptability in a pilot study amongst university students.

Positive Psychology

Positive psychology is a specialization within psychology that continues to bear fruit. It has been defined as "a science of the factors that allow individuals, communities, and societies to flourish" (Seligman & Csikzentmihalyi, 2000, p. 1). The main objective is to develop a mindset in which pathological thoughts no longer hold ground and a sense of optimism towards life prevails, with interventions that emphasize positive attitudes towards a person's subjective experience, traits, and life events, as opposed to focussing on psychopathologies, common in the more traditional approaches of psychology (Peterson, 2008).

Positive Psychology Apps

Positive psychology has been proven to be effective for increasing well-being in a wide array of mobile applications already. For instance, taking part in a mindfulness application for ten minutes a day, on ten succeeding days, increases well-being and decreases depressive symptoms, with even greater increases in well-being for users who enjoyed participating in the intervention (Howells et al., 2020). Another positive psychology app that improves well-being is the app Snappy, which is about taking pictures of positive moments in one's daily life (Lee et al., 2021). In the study by Lee et al. (2021) participants took at least one picture a day, assigned it to either a positive activity they were experiencing in the

moment or a positive thought about the past, and wrote a description about how it made them feel. Participation led to a decrease in negative mood and an increase in positive mood after ten days already, but the more engaged a user was, the more positive mood and life satisfaction improved. In student populations, positive psychology apps are effective in decreasing depression and increasing well-being too (Yurayat & Seechaliao, 2021). In addition to these single app studies, a recent systematic review shows similar results. Eisenstadt et al. (2021) examined 39 studies on positive psychology apps for adults without a former mental health diagnosis and found that these apps had a positive effect on increasing well-being, while decreasing depression and anxiety at the same time.

Besides having effect in the general population, positive psychology app interventions are beneficial for clinical populations too. A meta-analysis of 30 studies on the effects of positive psychology interventions, representing roughly 1800 participants with clinical disorders, showed small effect sizes for increase in well-being and decreases in depression and anxiety (Chakssi et al., 2018). Single-app studies in varying clinical target groups demonstrate effects too. Birney et al. (2016) found effects of a positive psychology app in decreasing depressive symptoms amongst mild to depressive individuals, with effects lasting up to six weeks. In similar vein, positive psychology apps are effective in decreasing depression and anxiety amongst chronic pain patients (Peters et al., 2017). All in all, positive psychology apps are a promising prospect for clinical populations too.

Thus far positive psychology apps have been tested in both non-clinical and clinical populations amongst diverse groups of participants and showed decreases in depression and anxiety. A gap in literature prevails regarding the effects of such an approach in app format within a university student population in which mild to moderate depressive and anxiety symptoms occur frequently. Nonetheless, this is a major flaw in research, as the mental health status of university students is in critical condition and low-threshold positive psychology app

interventions have remained unexamined. Based on the results so far, it is expected that participation in the positive psychology app TiP will decrease both depressive and anxiety symptoms amongst university students.

Sex Differences

In addition to TiP having a potential effect for all its users, sex differences of the users are expected to influence the app's effectiveness. In general, females are nearly twice as likely to suffer from depression than males (Kuehner, 2016). This gender-gap emerges during puberty, mainly due to activating effects of sex hormones in females, which interact with intrapersonal and interpersonal factors, and then lead to an increased number of stressors, resulting into a higher likelihood of developing depression which maintains throughout adulthood. Similarly, females are more prone towards developing anxiety, with prevalence rates 1.5 to two times higher (Christiansen, 2014). These patterns perpetuate to university student populations, where female students report experiencing mental health problems more often than males (Auerbach, 2018; Kelders et al., 2019).

However, female university students have a more optimistic attitude towards receiving treatment and belief to gain greater benefits from participation in mental health programs than male university students (Vidourek, 2014). According to the Health Belief Model, a model used to predict health related behaviours, both a *positive attitude* towards and *positive belief to gain benefits* from a treatment result in increased individual health-related behaviours, such as greater participation within a health programme and higher self-efficacy while doing so (Becker, 1974). This could mean that the model can be used to predict increased engagement of females and higher success rates due to their more beneficial health-related behaviours during the intervention.

In sum, pre-measurement differences of depression and anxiety are expected due to the higher occurrences in females. Furthermore, differences in success rates are expected

since females are more likely to show health beneficial behaviours than males. However, with the small sample size of the current study, caution must be applied, as the findings might not be generalizable. Nevertheless, sex differences remain important to examine because knowledge of for whom the app works best, helps to increase its impact. Furthermore, an indication of sex differences in the current sample could provide direction for future research.

Acceptability

Apart from examing the effectiveness of the app, it is important to study its acceptability, because acceptability helps to reduce barriers in usage, minimizes dropout, and maximizes an intervention's effect (Yardley et al., 2015). Acceptability is defined as "the extent to which an idea, program, or measure is judged as suitable, satisfying, or attractive to program recipients" (Bowen et al., 2009, p. 454).

Generally, use of positive psychology in interventions gains high acceptability rates because they center around a user's strengths as opposed to deficits, which might be more satisfying and appealing to its users (Priebe et al., 2018). For mildly to moderately depressed and anxious individuals, findings are less clear cut, as empirical validation is both in favour and against the suitability of positive psychology to reduce symptoms (Seligman & Parks, 2006; Deady et al., 2018). The aforementioned body of literature regarding the effectiveness of positive psychology apps on reducing depressive and anxious symptoms is in favour of the use of positive psychology to alleviate symptoms (Eisenstadt al., 2021; Chakssi et al., 2018). However, people with depression could find positive psychology exercises unsuitable to reduce their symptoms and unattractive in appeal, as depression is associated with reduced interest in enjoyable activities and motivation (Kazmarek et al., 2013). Yet, this finding might not be of predictive value to this current study, as the authors based their finding on an intervention with one exercise (gratitude), while TiP uses a multicomponent approach, which could have different results because there might be a better fit to the user. Another argument

against the suitability of positive psychology for individuals suffering from depressive and anxiety symptoms is that their psychopathologies might make them feel unable to identify their own positives, which could make them feel misunderstood by a positive approach (Walsh et al., 2018). Walsh et al. (2018) highlighted that an intervention was likely to be acceptable if it is easily accessible, its effectiveness is empirically validated, and does not require too much effort in usage; all three aims of TiP.

These inconsistencies in literature regarding the suitability of positive psychology apps for people suffering from depression or anxiety can be explained with the *positive activity model*. This model states that both the *characteristics of positive exercises*, such as their frequency and duration, and the *characteristics of the person* undergoing them, such as the person's mood and motivation, affect a positive intervention's acceptability (Lyubomirsky & Layous, 2013). This means that the literature could on the one hand yield against suitability of a positive psychology intervention because of the user's *personal characteristics*, but on the other hand be in favour if the *characteristics of the exercises* meet the user's needs. Whereas TiP uses a multicomponent approach, an approach in which not one type of exercise is used but several, there is a larger, more varying, number of exercise characteristics. This broad number of exercise characteristics could result into a finer fit to the user, which increases the overall user-exercise fit, and might give less weight to the unfavourable user characteristics, such as lowered motivation or mood, which could occur more frequently in a student population in which a large part suffers from mental health problems (Kelders et al., 2019). Therefore, it could be predicted that TiP gains favourable acceptability scores.

Current Study

This study set out to examine the effects of a positive psychology app on depression and anxiety scores within a population of university students. It is expected that the app is

effective in a decreasing in levels of depression and anxiety, and that this effect is larger for females than for males. Investigating the effectiveness and acceptability of the app helps to maximize its impact.

Methods

Design

A pre-post design with two independent variables was used in this study. The first independent variable was *time*, which contained two levels: *before* and *after*. In the *after* condition, participants had undergone the intervention, whereas in the *before* condition, they still had to start. The second independent variable was *sex of the participant*, which had two levels: *male* and *female.* There were two dependent variables, namely *depression* and *anxiety*, which were measured before and after the intervention. Levels in these variables varied from *minimal* to *severe*. Another variable, *acceptability,* targeted the evaluation and was measured after the intervention only.

Participants

Participants were recruited via SONA at University of Twente and as part of a minor course at Saxion University of Applied Sciences. Participants had to speak Dutch since all materials were in Dutch, be a student at either University of Twente or Saxion, and be aged 18 or above. 83 participants took part in the study. 14 cases were omitted because these participants either were underaged or did not complete the study. This left 69 participants (41 University of Twente; 28 Saxion) in the pre-sample with an average age of 21.16 years (SD = 2.38; min = 18; max = 30). This sample consisted of 24 males and 45 females. The post-sample contained 30 participants (18 University of Twente; 12 Saxion) with an average of 21.50 years (SD = 2.73; min = 18; max = 30), distributed over 10 males and 20 females.

Procedure and Materials

Participants received a mail with general information about the study, such as the goals, duration, rights, and for whom participation was not suitable (see Appendix A for a copy of all information sent to participants prior to participation). Two days later, the participants received another mail with a link to the first questionnaire and download instructions for the app. This questionnaire had to be filled out before starting with the app, was hosted in Qualtrics, and took about 20 minutes to complete. The participants were first asked to complete an online consent form to confirm that the general information they had received was understood, the study is voluntary, and they wanted to participate (see Appendix B for a copy of the consent form). Then, they were asked to report their demographics, such as their age, sex, living situation, and nationality (see Appendix C for the complete demographic questionnaire) and to complete questions on their experiences with COVID-19, such as whether they or a loved one got infected (see Appendix D for the full list of questions about COVID-19). Afterwards, a total of 106 items were presented to the participants to assess their mental well-being and health, as the study was part of larger study (see below for a detailed description of the specific measures that were used for this study only). The questionnaire was divided into the categories well-being, anxiety symptoms, depressive symptoms, spiritual well-being, self-efficacy, positive re-evaluation, adaptability, self-compassion, savoring, and rumination and the participants answered items in these categories by marking an option on a Likert scale. Lastly, a debrief was provided, which contained an option to send questions or remarks to one of the researchers and a thank you message.

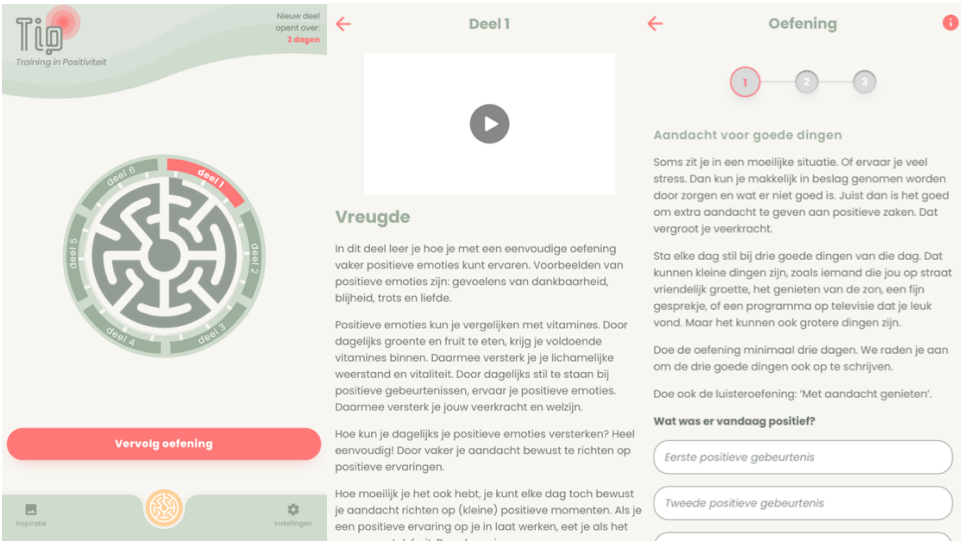
Next, participants downloaded the app via the download instructions received by mail. This could be done on either an iOS or Android device. An account had to be created which lend access to the app, so that the participants could immediately start using the app.

The app consisted of six parts (happiness, confidence in yourself, confidence in the future, friendliness, resilience, affiliation) that each contained an introductory video on the topic, explanatory note, and accompanying exercises, such as writing down positive events of the day (see Figure 1). After completion of one part, which took three consecutive days, participants could start with the succeeding part. The app was used for 15 minutes a day, six days a week, in a successive three-week period.

After 18 days since the start of the experiment, the participants received a final mail that lend access to the post questionnaire, hosted in the same environment as the first one, and took around 20 minutes to complete. Participants were asked to report their demographics, but this time only age and sex. Then, the same 106 items presented as in the first questionnaire on mental well-being and health followed. After these items, the app's acceptability was tested by 39 items on the participants' experiences with the app, with items such as "what do you think of the quality of TiP?". Lastly, the final debrief was provided, which contained an option to send final questions and a thank you note for participation.

Figure 1

Home screen, explanation, and exercise



Measures

Depression

The Patient Health Questionnaire-9 (PHQ-9; Kroenke et al., 2001) was used to measure the participants' severity of depression. The PHQ-9 assesses the nine DSM-IV criteria of depression over a two-week period, each scored on a 3-point Likert scale, on which zero represents "not at all" and four "nearly every day", resulting in a maximum score of 27. An example of an item is "how often in the past two weeks did you experience little interest in your activities?". The PHQ-9 displays the degree of depression in five categories: minimal (0-4), mild (5-9), moderate (10-14), moderately severe (15-19), severe (20-27). The questionnaire shows excellent internal reliability ($\alpha = .89$) and excellent test-retest reliability after 48 hours ($r = .84$) (Kroenke et al., 2001). Its predictive value is good too, with a sensitivity for detecting depression of 95% and specificity of 84% in the categories moderate to severely depressed (Kroenke et al., 2001). Its construct validity is satisfactory as well; it being a useful measure to detect depression in the general population (Martin et al., 2006).

Anxiety

The General Anxiety Disorder-7 Assessment (GAD-7; Spitzer et al., 2006) was used to measure levels of anxiety. The GAD-7 assesses the seven DSM-IV criteria of anxiety over a two-week period. The items, such as "how often did you feel nervous, anxious, or on edge over the past two weeks", were scored on a 3-point Likert scale, ranging from "not at all" (= 0) to "every day" (= 3). A maximum score of 21 can be reached, which is divided into four categories: minimal anxiety (0-4), mild anxiety (5-9), moderate anxiety (10-14), and severe anxiety (15-21). The GAD-7 has excellent internal consistency ($\alpha = .92$) and good test-retest reliability after a week ($r = .83$) (Spitzer et al., 2006). Furthermore, its construct validity was good, with consistent scores between the GAD-7 and other measures of anxiety, such as other questionnaires or judgement by clinicians (Spitzer et al., 2006).

Acceptability

The Client Satisfaction Questionnaire-8 (CSQ-8; Attkisson & Zwick, 1982) was used to measure levels of acceptability. The CSQ-8 measures satisfaction by 8 items, such as "how would you rate the quality of service you received", on a 4-point Likert scale, where "1" indicates the lowest degree of satisfaction and "4" the highest, leading to a maximum score of 32. The items were slightly tailored to include the app's name. Internal consistency ($\alpha = .93$) is excellent, as well as its construct validity, tested with consistency of scores to three other service utilization questionnaires (Attkisson & Zwick, 1982).

Data Analysis

The data analysis program SPSS version 26 was used. The data from pre- and postquestionnaires was merged into one file, and the dependent variables *depression* and *anxiety* were distinguished between *before* and *after* app usage by transforming the dataset into long-format with the added variable *time* (1 = before, 2 = after). Per dependent variable, a linear mixed model with repeated measures was run to investigate the main effect of *time* on the respective dependent variables *depression* and *anxiety*. After, the model was run again with the added interaction effect between *time* and *sex of the participant*. Effect sizes were assessed with Cohen's *d*. Sex differences in regard to effect of the app were examined by splitting the datafile into *males* and *females* and running a linear mixed model with *time* as independent variable and *depression* or *anxiety* as dependent variable. Sex differences between *before* and *after* scores of *depression* and *anxiety* were assessed by splitting the file into *before* and *after* and running a linear mixed model with *sex of the participant* as independent variable. Pairwise comparisons between males and females before and after app usage were computed to examine the difference. Acceptability was analysed by computing means for each of the evaluative items. Descriptives were discussed. A total acceptability

item was created by summing the scores of each item, of which a histogram with normal curve showed the response distribution.

Results

Depression

It was predicted that participants would have lower *depression* after app usage. More specifically, it was predicted that depression for females would be higher a priori compared to males, and that the decrease in depression after app usage would be higher too, indicated by a larger effect size. For the mean scores across conditions and sexes, see Table 1.

A linear mixed model with repeated measures with *depression* as the independent variable and added fixed effect of *time* revealed a significant effect of *time* on *depression* (β = -1.48, t = 2.29, p = .028). A linear mixed model with repeated measures with *depression* as the independent variable and added fixed effects of *time*, as well as the interaction effect between *time* and *sex of the participant* revealed a significant main effect of *time* on *depression* (β = -1.31, t = 1.63, p = .033), reflecting that app usage decreased depression from *mild* to *minimal*. Respective Cohen's d testing revealed a medium effect size of *time* (d = 0.46) on *depression*, indicating that depression scores were almost half a standard deviation lower *after* app usage as compared to *before*. No interaction effect between *time* and *sex of the participant* was found (β = -0.34, t = 0.26, p = .800), meaning that the participant's sex combined with app usage did not influence depression scores.

Table 1

Means of Depression before and after App Usage for Females, Males, and Total

	Before			After		
	N	*M*	*SD*	*N*	*M*	*SD*
Males	24	5.50	4.75	10	3.80	2.66
Females	45	6.33	4.20	20	4.5	3.43
Total	69	6.04	4.38	30	4.27	3.16

Differences Males and Females

A linear mixed model with repeated measures with *depression* as the independent variable and the added fixed effect of *time* revealed no significant effect of *time* on depression for *males* (β = -1.65, t = 1.55, p = .140), nor did it reveal a significant effect for *females* (β = -1.31, t = 1.63, p = .117), reflecting that app usage did not decrease depression amongst *males* or *females* independently. *Females* had a higher level of depression *before* using the app as compared to *males* (M = 6.33, SE = 0.63 vs. M = 5.50, SE = 0.97; MD = -0.83, 95% CI [-3.16, 1.50]). However, a pairwise comparison revealed that this difference was non-significant (t(69) = 0.52, p = .474). *Males* had a lower level of depression *after* app usage compared to *females* (M = 3.80, SE = 0.84 vs. M = 4.50, SE = *0.76; MD* = 0.70, 95% CI [-1.65, 3.05]), but this difference was non-significant (t(30)= 0.38, p = .544).

Anxiety

It was predicted that participants would have lower *anxiety* after the app was used. More specifically, it was predicted that *anxiety* for *females* would be higher a priori compared to *males*, and that the decrease in anxiety after app usage would be higher too. For the mean scores across conditions and sexes, see Table 2.

A linear mixed model with repeated measures with *anxiety* as the independent variable and added fixed effect of *time* revealed a significant effect of *time* (β = -1.65, t = 3.15, p = .003). A linear mixed model with repeated measures with *anxiety* as the independent variable and added fixed effect of *time* and interaction effect between *time* and *sex of the participant* revealed a significant main effect of *time* (β = -1.25, t = 2.09, p = .001) but no significant interaction effect between *time* and *sex of the participant* (β = -1.15, t = 1.11, p = .277). This indicates that while there was an effect of *time* on *anxiety*, decreasing *anxiety* from *mild* to *minimal*, *anxiety* did not differ as a function of the combination between *time* and *sex of the participant,* meaning that the effect of *time* is independent of the *sex of the participant*. Respective Cohen's *d* testing revealed a medium-sized effect of *time* (d = 0.61) on *anxiety*, indicating that *anxiety* was more than half a standard deviation lower *after* app usage compared to *before*.

Table 2

Means of Anxiety Before and After App Usage for Males, Females, and Total

	Before			After		
	N	*M*	*SD*	*N*	*M*	*SD*
Males	24	5.63	3.89	10	3.30	2.16
Females	45	6.93	3.86	20	5.15	2.47
Total	69	6.48	3.89	30	4.53	2.30

Differences Males and Females

A linear mixed model with repeated measures with *anxiety* as the independent variable and the added fixed effect of *time* revealed a significant effect of *time* on anxiety for both *males* (β = -2.39, t = 2.83, p = .012) and *females* (β = -1.25, t = 2.09, p = .049), indicating that app usage influenced anxiety amongst males and females independently, from

mild to *minimal*, and that the effect of the app was largest amongst *males*. *Females* had a higher level of anxiety *before* using the app compared to *males* (M = 6.93, SE = 0.58 vs. M = 5.63, SE = 0.79; MD = 1.30, 95% CI [-0.66, 3.28]), but a pairwise comparison revealed that this difference was non-significant ($t(69) = 1.78$, $p = .189$). *Males* had a lower level of anxiety *after* app usage compared to *females* (M = 3.30, SE = 0.68 vs. M = 5.15, SE = *0.48; MD* = 1.85, 95% CI [0.09, 3.61]). This difference was significant ($t(30) = 4.88$, $p = .040$), reflecting that the app had a different effect for the different *sexes* regarding their level of *anxiety*. Cohen's d showed a large size of the effect (d = 0.85), meaning a difference of more than three fourth of a standard deviation between *males* and *females after* app usage.

Acceptability

Participants were satisfied with TiP (see Table 3), as was predicted. Participants were especially satisfied with the *amount of help* they received (M = 2.90; SD = 0.64) and the *overall impression* they got while using the app (M = 2.82; SD = 0.72). They were least satisfied regarding *using TiP again for similar problems* (M = 2.31; SD = 0.77) and TiP *meeting their needs* (M = 2.51; SD = 0.64). Satisfaction ratings for each of the items were close to each other, with no outliers. The total satisfaction rating was 21.13 (SD = 4.71; min = 12.00; max = 30.00). A histogram revealed non-normally distributed responses, indicating varying total satisfaction scores (see Figure 2). Four participants were not satisfied at all, indicated by a total satisfaction score of 12.00, whereas two participants were extremely satisfied with the app, with total satisfaction scores of 28.00 and 30.00 respectively. Overall, responses were skewed towards the left, meaning most participants that filled out the satisfaction questionnaire and did not drop out were satisfied in using TiP.

Table 3

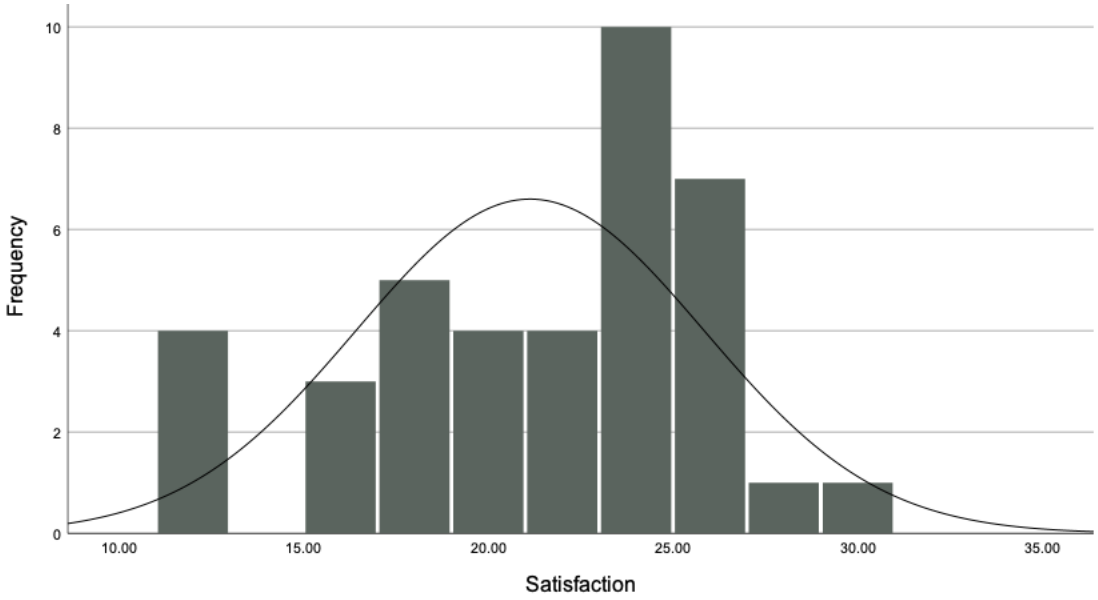
Means of Satisfaction

Item	Content	*M*	*SD*
1	Quality	2.72	0.69
2	Expectations met	2.67	0.77
3	Needs met	2.51	0.64
4	Recommend to others	2.54	0.79
5	Amount of help received	2.90	0.64
6	Improvement life situation	2.67	0.62
7	Overall impression	2.82	0.72
8	Use again	2.31	0.77

Note. $N = 39$. Range from 1 (= not satisfied) to 4 (= satisfied).

Figure 2

Histogram Total Satisfaction Score



Note. $N = 39$. Range from 0 – 32. Line represents normal curve.

Discussion

This study demonstrated that usage of the positive psychology app TiP for 18 days decreased both *depression* and *anxiety* amongst its university and university of applied science student users. This was tested with two questionnaires that measured participants' level of depression and anxiety *before* and *after* using the app. Results showed that as participants had used the app, both anxiety and depression decreased from *mild* to *minimal*. Moreover, sex differences with regards to the app's effectiveness in decreasing *anxiety* were found, with the app being most effective for *males*, while no similar effect was found for *depression*. Additional testing revealed no interaction effect between app usage and sex of the participant for depression and anxiety, nor did it reveal significant differences in mean scores between the sexes. Evaluation of the app revealed that most users enjoyed participating in the intervention.

These findings are part in line with previous works on the effectiveness of positive psychology apps in decreasing depression and anxiety, while contradicting previous studies with regards to respective sex differences in effectiveness. Based on similar interventions with different target groups, it was hypothesized that positive psychology in app format would decrease depressive symptoms amongst its users, as it would for anxiety (Chakssi et al., 2018; Eisenstadt et al., 2021). Next to this, it was hypothesized that the effect of app usage would be larger for females due to their more optimistic attitude towards receiving treatment and greater belief to gain benefits from participation in mental health programs than males, which could lead to increased engagement in the intervention (Becker, 1974; Vidourek, 2014).

A potential account for the disagreement between literature and this study in relation to sex differences is that the number of male and female participants were vastly different in size. The female group was nearly two times as large as the male group, while both being

relatively small in total sample size. This effect can be noted in large confidence intervals of mean differences between the groups, which were different compared to the descriptive means. Additionally, these small and unequal groups can lead to a probable loss in statistical power and increased risk of type I error (Rusticus & Lovato, 2014). The larger effect of the app for males to decrease anxiety could be a *false positive*, which means that there is in fact no larger effect for this group outside this study but within the study only. However, it must be noted that small sample sizes are common in pilot testing and therefore not necessarily that harmful. Additionally, the fact that nearly two times as much female student participants took part in this study is informative in its own right, possibly indicating a trend to developers to take into account a largely female target group amongst student populations. Yet, to rule a possible false positive out in future studies, it is advisable to operate with a larger sample size that contains more male participants.

Another account for the study's contradicting findings lies within the high dropout rates. Between the first and second examination, response rates were more than half lower, leading, again, to unequally distributed groups between the *pre* and *post* measurements. Statistical implications of this can be found in the paragraph above. Additionally, the high dropout could give skewed results of the app's effectiveness, with the possibility that participants that felt like the app was working continued their participation, whereas participants who felt like the app was ineffective quit the study. This then, could also have influenced the app's satisfaction ratings, simply because the unsatisfied users were no longer part of the cohort. For instance, if these possibly unsatisfied users, who now could have dropped out due to dissatisfaction, were part of the total group, the app's satisfaction ratings are likely to be lower. This study tried to minimize dropout by sending the post-questionnaire and reminders several times, yet it remained in vain. To downplay effects of dropout in future studies, it is advisable to target participants who dropped out with an optional question on the

reason for their dropout, giving them room to voice their opinion, while keeping in mind that participants have the right to withdraw without giving a reason.

Limitations

Although this study demonstrated the effectiveness of a new positive psychology app on decreasing symptoms of depression and anxiety, a potential confounding variable must be taken into account that could have influenced the results, namely *user satisfaction*. This study showed that most of the participants enjoyed using the app, as was indicated by high levels of satisfaction. However, this points to a potential limitation, as a two-way stream between user satisfaction and the effectiveness of a system might exist, where user satisfaction influences effectiveness and vice versa (Al-Maskari & Sanderson, 2010). Another study showed that when users enjoyed participating in a positive psychology app, apart from solely participating in it, not only did their depressive symptoms decrease, but their well-being also increased (Howells et al., 2020). The confounding effect of satisfaction was not ruled out by this current study's design, which is advisable to do in future studies by taking this effect into inferential analyses. This could lead to a more steadfast pinpointing of the effectiveness of the different components of the app, revealing better where to improve, and in doing so, expanding its potential impact. Nevertheless, it is important to note that not any psychological intervention is suitable for all participants, nor will a positive psychology app be. Different techniques are more suited for some people than for others, and therefore it is not expected that more research on TiP will lead to satisfied users only. It is a way of better identifying which app components work best for users already enjoying these parts and seeing where to improve.

Moreover, despite the study's largely non-significant and contradicting findings to support its hypotheses regarding sex differences, it might have given rise to the importance to conduct more research on the matter, possibly with larger sample sizes and a more equal

sex-ratio, which could give more insight into the potential interaction hypothesized effect between app usage and sex of the participant too. In case such an effect does not exist, it can be said with more certainty that this indeed does not hold. However, all this was not possible due to the study being a pilot one in nature and resources constraints.

Implications

TIP was effective in decreasing depression and anxiety amongst university and university students from mild to minimal. The app can be implied in two ways. University counsellors could integrate TIP next to traditional interventions. Integration of mobile apps in therapy can lead to higher therapy engagement, increased access to therapeutic strategies between therapy sessions, and reduction of stigma with regards to externalising therapy (Gindidis et al., 2019). These factors are all beneficial to the client and could possibly facilitate the therapy process. Another implication is to make TIP available for all students so it could act as a buffer against depression and anxiety. The app's training in positive thinking could work preventative that keep depressive and anxiety thoughts from arising, which could be especially needed for first-year students who are in a critical phase of transition to university (McLean et al., 2022). Both implications help reduce depression and anxiety amongst students.

Conclusion

This study suggested that usage of the positive psychology app TiP decreases depression and anxiety amongst university and university of applied science students. Furthermore, the sex of the participant was expected to influence this decrease, with a larger effect in both conditions for females. Results showed indeed a decrease in depression and anxiety, which confirmed the app's effectiveness, but for sexes differences results pointed the other way in case of anxiety and were non-significant for depression. It remains unsure whether this is due to methodological inadequacies or potentially a new direction for

literature, and that is why this should be further investigated with this study's limitations addressed. Knowledge in this field of research helps to further tailor positive psychology interventions by intervention makers to their target groups, increasing its reach and impact, and in doing so, decreasing mental health problems.

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Appendix A

Participant Information

Kun je wel wat positiviteit en veerkracht gebruiken? Ben je gemotiveerd om zelfstandig jouw mentaal welbevinden te vergroten en ben je minimaal 18 jaar? Doe dan mee aan dit onderzoek van de Universiteit Twente!

Meedoen is vrijwillig. Voordat je de beslissing neemt, is het belangrijk om meer te weten over het onderzoek. Lees deze informatiebrief rustig door. Bespreek de inhoud met je vrienden, partner of familie. Heb je na het lezen van de informatie nog vragen? Dan kun je terecht bij de onderzoeker Kim Tönis. Onderaan deze brief vind je haar contactgegevens.

Doel van het onderzoek
De Universiteit Twente wil op basis van nieuwe wetenschappelijke inzichten de effectiviteit van een app met enkele positiviteitsoefeningen uittesten onder studenten. De app die in dit onderzoek onderzocht wordt is bedoeld om hen te ondersteunen in hun mentale weerbaarheid en positiviteit. Het doel van dit onderzoek is om vast te stellen of het gebruik van deze app kan helpen bij het vergroten van mentaal welbevinden en veerkracht.

Wie kunnen deelnemen aan het onderzoek?
Je kunt meedoen aan het onderzoek als je 18 jaar of ouder bent, in het bezit bent van een smartphone of tablet met een goede internetverbinding en beschikt over een e-mailadres. Het onderzoek is bedoeld voor mensen die (enigszins) last hebben van stressklachten of verminderd welzijn, mogelijk mede door de gevolgen van de coronacrisis. Je hebt behoefte aan ondersteuning bij het vergroten jouw mentale weerbaarheid en positiviteit. Je mag milde psychische klachten ervaren, zoals somberheid, angst of slaapproblemen. Je mag geen ernstige psychische klachten hebben.

De app
Het is de bedoeling dat je een app downloadt op je smartphone of tablet. Met deze app doe je gedurende 3 weken 6 dagen per week een positieve psychologie-oefening gericht op het vergroten van jouw mentaal welbevinden. Ter ondersteuning ontvang je elke dag een herinnering van deze app.

Hoe werkt het onderzoek?
Aanmelding en toestemmingsverklaring
Wanneer je deze brief hebt gelezen en akkoord bent, dan onderteken je de toestemmingsverklaring online bij het invullen van de (eerste) vragenlijst.

Vragenlijstonderzoek en loting
In totaal duurt het onderzoek 1 maand. Voor het onderzoek vul je 2 keer een vragenlijst in. Als je mee kunt doen aan het onderzoek ontvang je de eerste vragenlijst bij de start van het onderzoek op een door jou opgegeven e-mailadres. De andere vragenlijsten ontvang je 3 á 4 weken na de start van het onderzoek na het afronden van de app. Deze vragenlijsten vul je online in, bijvoorbeeld thuis op jouw computer. Het invullen van de vragenlijst duurt per keer gemiddeld 20 minuten. Zodra je met de app aan de slag mag gaan, ontvangt je informatie over hoe je de app kunt downloaden en inloggen.

Vrijwilligheid deelname
Als je besluit niet mee te doen, hoef je verder niets te doen. Je hoeft ook niet te zeggen waarom je niet wilt meedoen. Als je wel meedoet, kun je je altijd bedenken en toch stoppen, ook als je daarvoor geen reden wilt opgeven. Dit kan ook tijdens het onderzoek.

Wat wordt er van jou verwacht?
Voor het onderzoek vragen wij je twee keer een vragenlijst in te vullen. Verder is het van belang dat je gemotiveerd bent om de app gedurende 3 weken te gebruiken en dat je in deze periode ongeveer 75 minuten per week met de oefening aan de slag gaat.

Voor- en nadelen van deelname aan dit onderzoek
Als je deelneemt aan het onderzoek levert je een belangrijke bijdrage aan de kennis over het effect van de app met positiviteitsoefeningen voor het welzijn en veerkracht van studenten in het hoger onderwijs. Voor de toekomst kan het onderzoek nuttige gegevens opleveren. Meedoen aan het onderzoek kan leiden tot een beter mentaal welzijn en veerkracht. Deelname aan het onderzoek heeft voor jou geen nadelen. Wel kost het je de tijd die nodig is voor het gebruik van de app en om de vragenlijsten in te vullen. De oefeningen van de app duren ongeveer 15 minuten per dag, 6 dagen per week (gedurende 3 weken). Het invullen van de vragenlijsten kost gemiddeld 20 minuten per keer (in totaal twee keer).

Privacy
Jouw persoonlijke gegevens, jouw antwoorden op de vragenlijsten zullen vertrouwelijk worden behandeld en gecodeerd worden opgeslagen. Dit betekent dat er een code wordt gegeven aan jouw gegevens, die niet naar jou herleidbaar is. Alle ingevulde vragenlijsten zullen los van jouw persoonlijke gegevens bewaard worden. Wij zijn verplicht jouw onderzoeksgegevens en persoonsgegevens 10 jaar te bewaren (dus los van elkaar). Daarvoor geeft je toestemming als je meedoet aan dit onderzoek. Gedurende de looptijd van het onderzoek kunt je altijd contact opnemen met de onderzoeker wanneer je inzage in jouw gegevens wilt hebben.

Goedkeuring onderzoek
De Ethische Commissie van de faculteit BMS van de Universiteit Twente heeft haar goedkeuring verleend voor dit onderzoek. Dit betekent dat het onderzoek voldoet aan internationaal vastgestelde richtlijnen die nauwkeurig in acht worden genomen.

Verdere informatie
Mocht je nog vragen hebben dan kunt je altijd contact opnemen met [researcher], de uitvoerder van het onderzoek (zie hieronder voor haar contactgegevens). Wil je graag een onafhankelijk advise over meedoen aan dit onderzoek? Dan kunt je terecht bij een onafhankelijk deskundige. Hij is niet direct bij het onderzoek betrokken, maar wel voldoende op de hoogte om jouw vragen te kunnen beantwoorden. Zijn gegevens zijn: [researcher], e-mail: [contact information],
telefoon: [contact information].

[researcher]
[contact information]

Appendix B

Informed Consent

Door een vinkje te zetten voor elk van de volgende voorwaarden ga je akkoord met de voorwaarden voor deelname aan het onderzoek:

- Ik bevestig dat ik de informatiebrief voor deelnemers aan het onderzoek naar gebruik van de app met positiviteitsoefeningen heb gelezen en ik begrijp de informatie.
- Ik heb voldoende tijd gehad om over mijn deelname na te denken. Ik ben in de gelegenheid geweest om vragen te stellen. Deze vragen zijn naar tevredenheid beantwoord.
- Ik geef toestemming voor deelname aan dit onderzoek naar gebruik van de app met positiviteitsoefeningen.
- Ik weet dat mijn deelname geheel vrijwillig is en dat ik mijn toestemming op ieder moment kan intrekken zonder dat ik daarvoor een reden hoef op te geven.
- Ik stem in met het gebruik van mijn onderzoeksgegevens op de wijze zoals in de informatiebrief staat omschreven, onder het kopje “privacy”.

Appendix C

Demographic Questionnaire

Wat is je leeftijd? (in jaren)

Wat is je woonsituatie?
- Man
- Vrouw
- Anders
- Wil ik niet aangeven

Wat is je woonsituatie?
- Alleenwonend
- Samenwonend met partner en kind(eren)
- Samenwonend met partner zonder kind(eren)
- Alleen met kind(eren)
- Bij ouders
- Met ander(en)
- Anders, namelijk

Wat is je burgelijke staat?
- Getrouwd of geregistreerd partnerschap
- Gescheiden
- Weduve/weduwnaar
- Nooit getrouwd geweest/nooit geregisteerd partnetschap gehad

In welk land woon je?
- Nederland
- België
- Anders, namelijk

In welk land ben je geboren?
- Nederland
- België
- Marokko
- Turkije
- Suriname
- Nederlandse Antillen, Aruba
- Indonesië
- Anders, namelijk

In welk land is je moeder geboren?
- Nederland
- België
- Marokko
- Turkije
- Suriname
- Nederlandse Antillen, Aruba

Indonesië
Anders, namelijk

In welk land is je vader geboren?
Nederland
België
Marokko
Turkije
Suriname
Nederlandse Antillen, Aruba
Indonesië
Anders, namelijk

Wat doe je in het dagelijks leven?
Betaald werk (in loondienst)
Zelfstandig ondernemer
Onbetaald werk, vrijwillgers werk
Op zoek naar werk, of werkloos
(gedeeltelijk) Arbeidsongeschikt
Gepensioneerd (AOW/VUT)
Huisman/huisvrouw
Student, scholier
Anders, namelijk

Wat is de hoogste opleiding die je hebt afgerond?
Geen opleiding afgerond
Basisonderwijs, lagere school of een gedeelte daarvan
Lager beroepsonderwijs (LBO), huishoudschool
VMBO, MAVO, (M)ULO, 3 jaar HAVO of VWO
Middelmaar beroepsonderwijs (MBO), MTS, MEAO
Hoger voortgezet onderwijs: HAVO, VWO, Athneum, Gymnasium, Lyceum, MMS
Hoger beroepsonderwijs (HBO, HTS, HEAO
Wetenschappelijk onderwijs (Universiteit)
Anders, namelijk

Appendix D

Corona Questionnaire

Heb je zelf één of meer van onderstaande dingen meegemaakt als gevolg van COVID-19? (meerdere antwoorden mogelijk)

- Dat wil ik niet zeggen
- Geen van de onderstaande opties zijn op mij van toepassing
- Ik ben getest op mogelijke besmetting met het nieuwe coronavirus
- Ik ben/was besmet met het nieuwe coronavirus
- Ik ben/was in thuisisolatie omdat ik of iemand in mijn omgeving (mogelijk) besmet was met het nieuwe corona virus
- Ik ben opgenomen geweest in het ziekenhuis omdat ik besmet was met het niewue corna virus
- Ik ben opgenomen geweest op de intensive care (IC) omdat ik besmet was met het corona virus
- Anders, namelijk

Heeft een dierbare van je één of onderstaande dingen meegemaakt als gevolg van COVID-19? (meerdere antwoorden mogelijk)

- Dat wil ik niet zeggen
- Geen van de onderstaande opties zijn van toepassing
- Een dierbare van mij is getest op mogelijke besmetting met het nieuwe coronavirus
- Een dierbare van mij is besmet (geweest) met het nieuwe coronavirus
- Een dierbare van mij is in thuis isolatie (geweest) omdat diegene of iemand in de omgeving (mogelijk) besmet was met het nieuwe corona virus
- Een dierbare van mij is opgenomen (geweest) op de intensive care (IC) omdat diegene mesmet was met het nieuwe coronavirus
- Een dierbare van mij is overladen als gevolg van het nieuwe corona virus
- Anders, namelijk

Volgens het RIVM zijn er verschillende risicogroepen bij het nieuwe coronavirus. Zou je willen aangeven of je tot één can deze groepen rekent?

- Ja, ik reken mij tot één of meer van deze risicogroepen
- Nee, ik reken mij tot geen van deze risicogroepen
- Dat wil ik niet zeggen
- Anders, namelijk

In welke mate heeft de coronacrisis op dit moment een negatieve invloed op jouw welzijn?

- Helemaal niet
- Enigzins
- Redelijk
- Veel
- Heel veel

Van welke mogelijke gevolgen van de coronacrisis ervaar je op dit moment een negatieve invloed op jouw welzijn? (meerdere antwoorden mogelijk)

- Minder/geen uitgaansmogelijkheden
- Minder/geen mogelijkheden om mijn hobby uit te voeren

Afgelaste uitjes (bijvoorbeeld concert, feest, theaterbezoek, festival)
Afgelaste vakantie
Minder/geen sociale contacten
Relatieproblemen
Spannignen thuis
Onzekerheid over de toekomst
Onzekerheid over mijn baan
Onzekerheid over de baan van mijn partner
(te) Hoge werkdruk
Verlies van mijn eigen baan
Verlies van de baan van mijn partner
Angst voor besmetting
Angst dat een dierbare besmet raakt
Gedachten aan de dood
Slaapproblemen
Lichamelijke klachten na besmetting
GEEN negatieve gevolgen
Anders, namelijk