Enhancing Post-Covid Well-being of University Students Through Intentional Extraversion

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28 June 2023

APA 7th edition

Word count: 7364

Abstract

Through the recent COVID-19 pandemic, the already concerningly low student well-being decreased further. Even now, at the pandemics' end, student well-being remains reduced and interventions are needed. A growing branch of literature suggests the use of state extraversion - a momentary level of extraversion, achieved through intentionally acting extraverted - as a well-being intervention. It was therefore studied in how far intentionally acting extraverted can enhance students' well-being in the recovery process of the pandemic and how far the intervention's duration influences its effectiveness.

This research applied a randomised controlled trial and manipulated the levels of state extraversion through daily behavioural challenges which were performed by a sample of social science students (n = 25). The sample consisted of 19 female, and six male participants with a mean age of 21.28 who mainly came from Germany (52%) and the Netherlands (28%). After performing an extraversion challenge a day, the experience sampling method (ESM) was used to assess the participants' well-being and state extraversion once a day. The experimental group engaged in this intervention for two weeks (14 days) and was compared to a control group that did not engage in any activities.

The analyses using linear mixed models revealed that although the manipulation through the behavioural challenges worked, the students' well-being was not enhanced over the timeframe of two weeks. Still, well-being increased for completing the challenges and behaving more extraverted for the experimental group on a daily level.

These results suggest that manipulating state extraversion through behavioural challenges works, but that well-being might be a too broad construct and rather has a small direct relationship with state extraversion. In addition, habituating to the challenge seems to influence the well-being increase and the participants' trait extraversion does not seem to moderate the effect of the intervention on well-being. More broadly, this study adds to a growing branch of literature investigating the potential of state extraversion as a well-being intervention.

Keywords: university students, COVID-19, well-being, intentional extraversion, experience sampling method (ESM)

Enhancing Post-Covid Well-being of University Students Through Intentional Extraversion

With more than 6.8 million deaths worldwide (WHOb, 2023), the COVID-19 pandemic is one of the biggest global crises, bringing along far-reaching and severe consequences for health, economy and society (WHOa, 2022). Especially students feel the consequences due to regulations or other COVID-related factors, affecting 90% of students in 2020 (Yim et al., 2022). The switch from on campus-education to online-education did not only disrupt the acquisition of new knowledge or led to study delays in almost half of the students (University of Maastricht, 2020), but also led to large numbers of students experiencing mental health issues (RIVM, 2021). Students scored low on life satisfaction and connectedness while scoring high on frustration, anxiety, loneliness, pressure to achieve, stress and sleep problems (RIVM, 2021; Zhai & Du, 2020). Their mental health was rated as low, while the risk for mental health issues was rated as high, with 77% of students experiencing mental health issues (Dayes, 2022; Kools et al., 2020; Choi et al., 2022).

Although since 2021 schools and universities partly reopened depending on their incident cases, the mental health of students is only slowly recovering (Yim et al., 2022; RIVM, 2022). From March to September 2022 the percentage of Dutch students with mental health issues decreased from 39% to 32%, the percentage of Dutch students with suicidal thoughts from 17% to 13% and the percentage of Dutch students who experienced loneliness from 52% to 46% (RIVM, 2022). Even though these statistics indicate a decrease in mental health issues and loneliness the numbers are still significantly worse than before the pandemic. In 2019 mental health issues were reported by 21% to 24% of students (Barham et al., 2019; Flink, 2020), while 26% experienced loneliness (Van Toorn, 2020), indicating that the COVID-19 pandemics impact on well-being cannot easily be reversed as the consequences are still experienced. Further research is needed as issues like energy levels, sleep quality and students' general well-being are still problematic (Yim et al., 2022). Herrera (2023) emphasises that although the pandemic is ending and mental health problems are slowly decreasing, there are still concerns and problems with student well-being as it is significantly lower than before the pandemic.

Especially the closing of universities due to the rising COVID-19 numbers in 2020 had a high impact on students' mental health and well-being (which also predicts mental health) (Schultze-Lutter et al., 2016). Social distancing, isolation and quarantines were part of students' lives, physically isolating them from peers, teachers, family or their community and disconnecting them from friends (Loades et al., 2020; Zhai & Du, 2020). As a result, over 50%

of 18- to 24-year-olds experienced an increase in loneliness. Loneliness is defined as the perception that a current relationship is not as expected or wished for; one is not able to have the desired amount of social contact (Heinrich & Gullone, 2006; Loades et al., 2020). As found by Loades et al. (2020) loneliness predicts well-being noticeably up to nine years later, showing its importance for student well-being. Furthermore, a systematic review of 63 studies and 51576 participants confirmed the association between loneliness and mental ill-health (Loades et al., 2020). While Shokrkon and Nicoladis (2021) explain that less social contact corresponds with more mental health problems, Yim et al. (2022) stress the importance of well-functioning psychological and social factors for good mental health. They also point out that the lockdown led students into social dysfunction, therefore heavily impacting their mental well-being (Choi et al., 2022; Saltzman et al., 2020; Grey et al., 2020).

The Role of Extraversion

One character trait that is of high importance for well-being and social interaction after the pandemic is extraversion (Choi et al., 2022; Saltzman et al., 2020; Grey et al., 2020). Nowadays extraversion belongs to the most important and investigated personality traits as it is also part of two major personality models, namely the five-factor model of personality (e.g. Costa & McCrae, 1988; Goldberg, 1990) and Eysenck's personality dimensions (e.g. Eysenck, 1991). The trait of extraversion is defined as generally experiencing positive emotions and can be related to traits like being active, sociable and lively (Martin & Ford, 2018) while also tending to socialize (Van Allen et al., 2021). Cherry (2022) further adds that extraverted individuals seek social stimulation and the opportunity to engage with others while they are also characterised as energetic, positive, talkative, assertive and excitable. Extraverts "gain energy from engaging in social interaction" (Cherry, 2022, p. 1). Next to the trait extraversion there also is state extraversion. State extraversion refers to the momentary behaviour of individuals that is seen as extraverted (McNiel et al., 2010). Opposite to trait extraversion, state extraversion naturally varies constantly and is therefore of better use in, for example, experimental manipulations. It enables observations of extraversion changes in contrast to the more or less fixed trait level of extraversion (McNiel et al., 2010). Furthermore, research by Fleeson et al. (2002) and McNiel and Fleeson (2006) showed that influencing state extraversion is not influenced by the individual's trait level of extraversion, as it focuses on the performed behaviour rather than character. This can be explained by state-trait isomorphism, which argues that traits and states are characterised by similar outcomes (Van Allen, 2021). As the trait extraversion is, for example, related to well-being, behaving extraverted (even for a short period

or by introverts) would therefore also increase well-being (Leikas and Ilmarinen, 2017; Fleeson & Jayawickreme, 2021).

Extraversion plays an important role in predicting and enhancing well-being after the pandemic. Extraversion is for example related to resilience toward mental health problems as a consequence of the pandemic (Saltzman et al., 2020). Although, as one would expect, extraverts showed a decline in well-being due to the pandemic's social restrictions, the well-being of extraverts stabilized quickly, leading to generally less decrease in well-being compared to less extraverted individuals (Choi et al., 2022). Extraverts can more easily cope with life changes, making them more resilient to the negative side of the pandemic (Choi et al., 2022; Shokrkon & Nicoladis, 2021). Furthermore, they tend to seek and provide more social support when confronted with problems, influencing their well-being (Swickert et al., 2002; Bowling & Swader, 2005; Sun et al., 2017). In addition, Choi et al. (2022) explain that extraverts remain happier compared to individuals with lower levels of extraversion as due to their character trait, they perceive themselves as happier, more satisfied with life and see more meaning in their existence. Furthermore, extraversion is related to self-acceptance, environmental mastery, positive relationships with others and predicts stress and mental health due to its social facets, showing its importance for well-being. (Costa & McCrae, 1980; Jacques-Hamilton et al., 2019; Van Allen et al., 2021; Choi et al., 2022; Swickert et al., 2002; Shokrkon & Nicoladis, 2021).

Intentionally acting extraverted can also increase well-being levels. All the aforementioned traits that predict well-being can be influenced and enhanced in individuals to increase their well-being (e.g. by more social contact or being more active) (Choi et al., 2022; Swickert et al., 2002; Shokrkon & Nicoladis, 2021). Therefore, not only extraverts can benefit from the relationship between extraversion and well-being. Margolis and Lyubomirsky (2020) felt that extraversion was neglected as a well-being intervention despite strong evidence of their association and potential use. Therefore, in 2020, they conducted a study with 131 undergraduate students. In this study, the students were instructed to behave like an extravert for one week and like an introvert for another week. The participants received a description of adjectives of either extraversion or introversion and decided on behaviour they could perform to act according to these adjectives. The study revealed that the intentional enactment of extraversion significantly increased the students' well-being over the timeframe of one week while performing introverted behaviour reduced well-being (Margolis & Lyubomirsky, 2020). The authors assumed that well-being interventions mainly target positive affect and connectedness, as these measures showed the highest influence through state extraversion changes. In addition, they found that the initial level of extraversion (trait extraversion) did not

moderate the effects of the intervention on well-being of the participants, meaning that acting extraverted showed the same effect on well-being for both more introverted and extraverted individuals.

A similar study was conducted by Van Allen et al. in 2021 with 546 student participants. In contrast to the study of Margolis and Lyubomirsky (2020), the participants got split into either an extraversion or introversion condition. The authors also found that acting extraverted increased the well-being of the participants and argued for a bidirectional relationship between acting extraverted and well-being (Van Allen et al., 2021). They also found no moderation effect of the participants' trait extraversion on the effect of the intervention on well-being.

Still, none of the two studies investigated the time till the effects of acting extraverted on well-being develop. Mathisen and Bronnick (2009) for example propose that interventions show similar significant effects after one day or five days, indicating that longer-lasting interventions are not necessarily needed to be effective. Still, they also propose that through more training higher effects can be achieved (Mathisen & Bronnick, 2009). Extraverted behaviour can, for example, be trained to experience more benefits (Cherry, 2023), as the individual gets habituated to the extraverted behaviour (Rankin et al., 2009).

The Present Study

Extraversion and especially social interaction are of high importance for recovering from the COVID-19 pandemic (Shokrkon & Nicoladis, 2021). It enhances the missing social contact which significantly impacted well-being and could help in recovering from the COVID-19 pandemics' consequences on student well-being (WHOa, 2022; Yim et al., 2022; Dayes, 2022).

Due to the high correlation between extraversion and well-being (e.g. Choi et al., 2022), the influence of extraversion on the social factors that were restricted through the pandemic (e.g. Shokrkon & Nicoladis, 2021) and the already conducted research on intentional extraversion (e.g. Van Allen et al., 2021; Margolis & Lyubomirsky, 2020), I hypothesise that (1) intentional extraversion significantly increases students' well-being in the recovery process from the pandemic. In addition, I hypothesise that (2) the participants' well-being is significantly increased after one day of the intervention, but (3) enhances further throughout the first and second week. As Mathisen and Bronnick (2009) suggest that interventions can show effect after one day, but still, the effect could increase due to habituation and training (Cherry, 2023; Rankin et al., 2009). Lastly, as indicated by past research on intentional extraversion (e.g. Van Allen et al., 2021; Margolis & Lyubomirsky, 2020), I want to replicate

the findings and therefore hypothesise that (4) the participants' baseline level of extraversion does not moderate the effect of the intervention on well-being.

Methods

Design

To investigate the research questions and hypotheses, a randomised controlled trial (RCT) with two conditions (experimental group and control group) was applied. The data collection was conducted online through a quantitative experience sampling method (ESM) approach with one measurement per day over two weeks. Including the separated pre-test, this equals to 15 measurement moments. The participants were randomly allocated to one of two groups, an experimental group that received extraverted behavioural challenges and a control group that did not receive any challenges. Furthermore, this study investigated between-group differences in well-being and within-group changes to account for differences in levels of state extraversion or completing the intervention's behavioural challenges.

Participants

The participants of this study were selected through convenience/voluntary sampling as well as snowball sampling. They were either recruited through the SONA system of the University of Twente, which offers a pool of social science students who need to participate in a certain amount of studies (convenience/voluntary sampling) or through asking friends to participate, who were encouraged to also ask their friends and peers (snowball sampling). In order to take part in this study, the participants needed to be older than 18 and had to study at a university that offers on-campus education. Furthermore, they needed access to a smartphone to install an application for the data collection.

Six participants either stopped filling in the questionnaires at some point during the study, paused participation in the study for multiple days, or filled in the questionnaires for multiple days on one occasion, so they had to be removed from the dataset. Therefore, a total of 25 participants took part in this study. Eleven in the experimental group and 14 in the control group. Of the participants, nine females and two males were part of the experimental group and ten females and four males were part of the control group, totalling up to 19 female (76%) and six male (24%) participants. The participants had a mean age of 21.28, reaching from 18 to 40. The most common nationalities were German with 13 participants (52%), of which five were part of the experimental group and eight were part of the control group and Dutch with seven participants (28%), of which two were part of the experimental and five part of the control group (five participants from other nationalities (20%), four in experimental group, one in the control group).

Procedure

Before the data collection started, the study was approved by the BMS Ethics Committee (Department of Behavioural, Management and Social Sciences) of the University of Twente under application number 230118. The data was collected between 28.03.2023 and 24.04.2023. To start the study, the participants were randomly allocated to either the experimental group or the control group in order to receive tailored information on the intervention, fitting to their condition so that they did not know of the other group (Appendix A-B). They read the study information and filled in the informed consent form (Appendix C) to ensure their voluntary participation, stress the participants' rights and provide them with the purpose and other details on the study and its processes. Afterwards, they were instructed to install the University of Twente TIIM application, create an account and register for the current research (Appendix D-E). At 10 a.m. the next morning they received additional information on the procedure and tasks (Appendix F-G). They then started by filling out questionnaires on their demographic data and their initial level of well-being (experimental group and control group) and trait extraversion (only experimental group).

For the next 14 days, the experimental group received daily extraversion challenges which they had to perform till the evening. These challenges were made available at 8 a.m. in the morning. The control group did not receive any challenges. Both the experimental group and the control group filled in daily questionnaires on their well-being which were made available at 6 p.m. in the evening. The experimental group additionally received a daily question if they completed their challenge and a questionnaire on their level of state extraversion. Furthermore, all participants received daily push notifications on their smartphones phones to remind them of the challenges (experimental group) at 8 a.m. and 12 a.m.; and filling in the questionnaires (experimental group and control group) at 6 p.m. and 8 p.m. to make sure that they engage in all necessary activities. After the last measurements on day 14, the participants were thanked for their participation and finished their participation.

Intervention: Extraversion Challenges

Extraversion challenges were created for participants in the experimental group to engage in extraverted behaviour. Being social, talkative, active, assertive, positive and energetic were identified as key behavioural patterns. Out of these, seven challenges were created, like "Sit next to a stranger in class and try talking with them" (targeting talkativeness and social factors) or "Find the running track and either jog or quick walk one round" (targeting activeness, liveliness and the energetic side of extraversion) (See Appendix H for a list of all challenges and the targeted sides of extraversion). For every activity which needed the participants to be

on campus, a second challenge was created which could be performed at home, ensuring that the participants always had the possibility to engage in an activity even if they did not have on-campus classes on that day (e.g. "Call somebody you did not talk to for a while, but would like to keep in contact with"; targeting activeness, assertiveness, talkativeness and social factors). Still, challenges that could only be performed on campus were included as these offer the possibility of more direct and personal contact with peers. For the second week of the study, the challenges were repeated to give the participants the chance to get used to and adapt to the challenges instead of potentially stressing them through even more different challenges.

Materials

TIIM Application

The Twente Intervention and Interaction Machine (TIIM) is a mobile application for Android and IOS and was created by the BMS Lab (Department of Behavioural, Management and Social Sciences) of the University of Twente. It can be used to study participants long-term or repeatedly and is therefore often used for ESM or other longitudinal or cohort studies (BMS Lab, 2022). The application enables the researcher to send stimuli, questionnaires or other measurement tools to the participants at set time frames or when certain conditions are met. Furthermore, participants can be reminded through notifications to e.g. fill out questionnaires. In this study, the TIIM application was used to provide the participants with their daily challenges (experimental group) and daily questionnaires (experimental group and control group), while also using the push notifications of the application to improve adherence and engagement in all activities.

Single-Item Measurement for Completion of the Challenges

To check whether or not the participants from the experimental group adhered to the intervention and successfully completed their daily extraversion behavioural challenge, a single-item question was used. The participants were asked, "Did you successfully complete/acted out your challenge?" and were able to answer with either "yes" or "no".

Trait Measurements

Well-being. The mental health continuum short form (MHC-SF) (Keyes, 2002) is a 14-item scale that measures emotional, psychological and social well-being and is answered on a 6-point Likert scale (1 = *Never*, 6 = *Every day*) (e.g. "During the past month, how often did you feel interested in life?"). The MHC-SF showed high levels of test-retest reliability, discriminant validity, and internal consistency (Keyes, 2005; Keyes, 2006; Keyes et al., 2008; Lamers et al., 2011; Westerhof & Keyes, 2009). It is commonly used to assess the well-being of individuals or their mental health and was applied on two measurement moments once as a pre-test and

once as a post-test for this study. The MHC-SF showed excellent reliability (α = .92) and can be found in Appendix I.

Extraversion. The big five inventory (BFI) (John et al., 1991; Benet-Martínez & John, 1998; John et al., 2008) is a 44-item scale for measuring the personality dimensions extraversion, neuroticism, agreeableness, openness and conscientiousness. The extraversion scale consists of eight items that are answered on a 5-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*) (e.g. "I see myself as somebody who talks a lot."). According to Tkach and Lyubomirsky (2006), Shiota et al. (2006) and Rammstedt and John (2007), the BFI scores well on reliability, validity (Rammstedt and John, 2007; Srivastava et al., 2003) and internal consistency (Srivastava et al., 2003). In this study, it was used as a pre-test for the experimental group on one measurement moment. The extraversion scale of the BFI showed excellent reliability (α = .90) and can be found in Appendix J.

State Measurements

Daily Well-being. The short Warwick-Edinburgh mental well-being scale (SWEMWBS) is a 7-item scale that measures the well-being of individuals (Tennant et al., 2007). It is answered on a 5-point Likert scale (1 = *None of the time*, 5 = *All the time*) (e.g. "I've been feeling useful."). The SWEMWBS shows high internal consistency (Vaingankar et al., 2017), high validities, high reliabilities as well as high correlations to other mental health measurements (Koushede et al., 2019). In this study, the SWEMWBS was used for both the experimental as well as the control group once per day on 15 measurement moments. The SWEMWBS showed good overall reliability (α = .87) and can be found in Appendix K.

Daily Extraversion. The big five markers were developed by Goldberg in 1992 and later shortened by Saucier in 1994 to the mini markers. They are statements about a person's character that are answered using a 7-point Likert scale (1 = *Completely disagree*, 7 = *Completely agree*) (e.g. "Today, I was talkative."). "Talkative", "Assertive", "Energetic", "Sociable", "Active", "Positive", "Lively" and "Excitable" were selected as markers and also rated as reliable and valid for measuring extraversion (Fleeson, 2001; McNiel et al., 2010; Wit et al., 2012; Goldberg, 1992). In this study, the markers were used for the experimental group once per day on 14 measurement moments. The extraversion markers showed excellent overall reliability (α = .92) and can be found in Appendix L.

Data Analysis

For analysing the collected data, Rstudio version 2023.03.0+386 was used. Before analyses, the packages "tidyverse", "ggplot2", "rstatix", "psych", "lme4" and "lmerTest" were loaded. Following the descriptives were calculated.

To check whether manipulating the participants' level of extraversion through the assigned challenges worked, a linear mixed model was used with completing the challenges as the independent variable, the participants' ID as the random effect and state extraversion as the dependent variable. Generally, it is important to acknowledge the possible differences in power for the different analyses, as the data used for the between-groups analysis had 25 measurement moments (25 participants) total, while the within-subjects data used had a total of 350 measurement moments (14 days x 25 participants). This resulted from the difference in measurement, either one time for the between-groups (pre-test/post-test) or daily for the within-subjects (state well-being).

To answer the first hypothesis of whether acting extraverted significantly enhances well-being, a linear mixed model was used with the measurement moment (pre-/post-test), the condition (experimental or control group) and their interaction effect as fixed effects and the participants' ID as a random effect, on the score that entails either the pre- or post-test well-being value of the participant (between-groups analysis). Furthermore, Hedges' *g* was calculated to determine the effect size of the difference in post-test well-being between the experimental and control group. To add up, an analysis using a linear mixed model was conducted to check whether the level of extraversion experienced impacts the state well-being of participants in the experimental group. For that, the state levels of extraversion of the participants, completing the challenges and their interaction were used as fixed effects, the participants' ID as a random effect and the participants' state well-being as the dependent variable (within-subjects analysis).

Another linear mixed model was used to answer the second hypothesis of whether there is an increase in well-being after one day. The measurement moment (day 0 or day 1), the condition and the interaction between the two were used as fixed effects and the participants' ID as the random effect. The dependent variable was the participants' well-being at the measurement moments (between-groups analysis). Again, Hedges' *g* was calculated to determine the effect size of the difference in day 1 well-being between the experimental and control group. To check in how far performing the challenge impacted the well-being on the first day, a linear model was applied with the independent variable completion on the state well-being of the first day (within-subjects analysis).

To answer the third hypothesis whether state well-being increases throughout the first and second week, a linear trend analysis was conducted. A linear mixed model was used where the days (one up to 14), the participants' group and their interaction effect were used as fixed effects, the participants' ID as the random effect and the state well-being as the dependent

variable (within-subjects analysis). In addition, separate linear models for the experimental and control group were created with the days as the independent and state well-being as the dependent variable. They were analysed for a linear trend and the slopes of the trends were extracted.

A linear mixed model was applied to answer the fourth and last hypothesis of whether the baseline level of extraversion moderates the effect of the intervention on well-being. The test performed (pre-test or post-test), the baseline level of extraversion and the interaction effect between these variables were the fixed effects, the participants' ID the random effect, and the pre-test or post-test score on the well-being of the participants was the dependent variable (between-groups analysis).

Results

The manipulation check revealed a significant main effect for completing the challenges on the participants' state extraversion ($t(147) = 2.18$, $p = .031$). This showed that the manipulation, so performing the extraverted challenges, worked and influenced the participants' state extraversion. In addition, from the 154 daily challenges, 125 were performed, resulting in adherence of 81.17%. See Table 1 for an overview of the adherence to the different challenges.

Table 1

Overview of the adherence to the different challenges

Adherence	Challenge						
	1	2	3	4	5	6	7
Performed	20	17	17	18	20	13	20
Not performed	2	5	5	4	2	9	2

Note. Every challenge was performed twice over the course of 14 days; there were 11 participants that received the challenges. See Appendix A for the challenge descriptions.

See Table 2 for the means and standard deviations of the pre-test and post-test of the two conditions and Table 3 for the means and standard deviations of well-being (experimental and control group) and extraversion (experimental group) between the conditions on each measurement moment. For the first hypothesis, the analyses revealed a non-significant main effect for the within-subjects factor measurement moment (pre/post-test) ($F(1, 28) = 1.15$, $p =$

.292) and a non-significant main effect for the between-subjects factor condition ($F(1, 28) = 0.03$, $p = .855$) on the pre-test or post-test well-being score. There was also a non-significant interaction effect between the measurement moment and condition ($F(1, 31) = 0.22$, $p = .644$). Post-hoc tests on the analysis were not performed due to the lack of significant effects. In addition, calculating Hedges' *g* showed an effect size of $g = 0.41$ for the difference in post-test well-being between the experimental and control group. See Figure 1 for a comparison between the conditions on the pre-test and post-test.

Table 2

Mean and Standard Deviation of the Pre- and Post-Measures

Scale	Experimental Group	Control Group
	M (*SD*)	*M* (*SD*)
Pre-Well-being	3.86 (0.74)	3.73 (0.93)
Post-Well-being	4.23 (0.75)	3.87 (0.93)
Pre-Extraversion	2.73 (0.83)	

Table 3

State Well-being and Extraversion per Day for the Experimental Group and State Well-being per Day for the Control Group

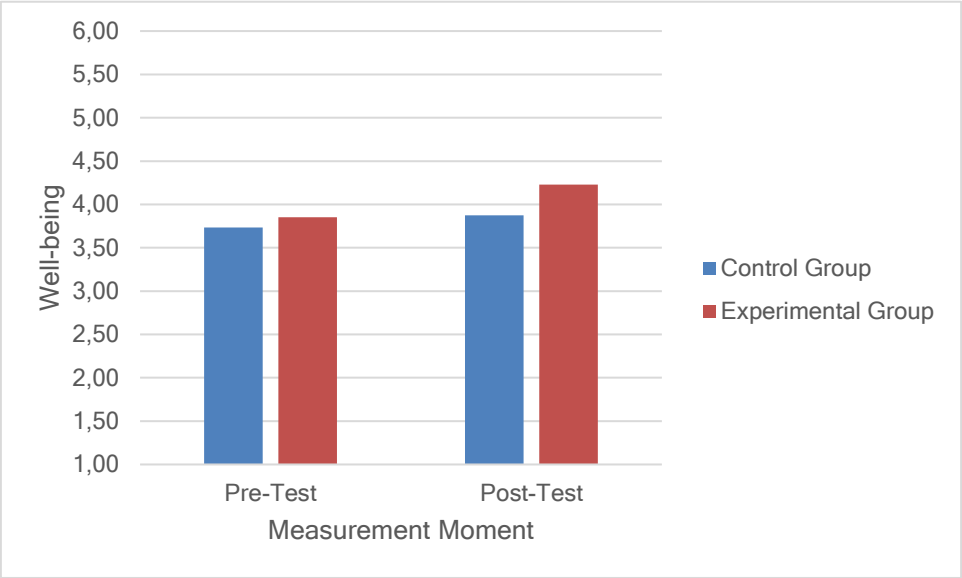
Day	Experimental Group		Control Group
	State Extraversion	State Well-being	
0		3.69 (0.56)	3.39 (0.81)
1	4 (1.34)	3.52 (0.66)	3.43 (0.71)
2	4.65 (1.24)	3.68 (0.54)	3.41 (0.9)
3	4.44	3.45	3.51

	(1.31)	(0.48)	(0.67)
4	4.5	3.52	3.54
	(1.17)	(0.64)	(0.84)
5	4.64	3.44	3.43
	(1.34)	(0.5)	(0.57)
6	4.36	3.39	3.58
	(1.19)	(0.79)	(0.86)
7	4.8	3.47	3.12
	(1.27)	(0.41)	(0.72)
8	3.99	3.53	3.6
	(1.56)	(0.67)	(0.69)
9	5.07	3.87	3.58
	(1.1)	(0.56)	(0.68)
10	4.48	3.49	3.68
	(1.27)	(0.93)	(0.76)
11	5.15	3.7	3.5
	(1.15)	(0.46)	(0.78)
12	5.45	3.83	3.38
	(1.44)	(0.55)	(1.01)
13	4.3	3.7	3.59
	(1.31)	(0.68)	(1)
14	5	3.96	3.64
	(1.23)	(0.59)	(0.72)

Note. State extraversion was not measured on day one. The extraversion scale ranged from one to seven. The well-being scale ranged from one to five.

Figure 1

Pre-Tests and Post-Tests Compared by Group



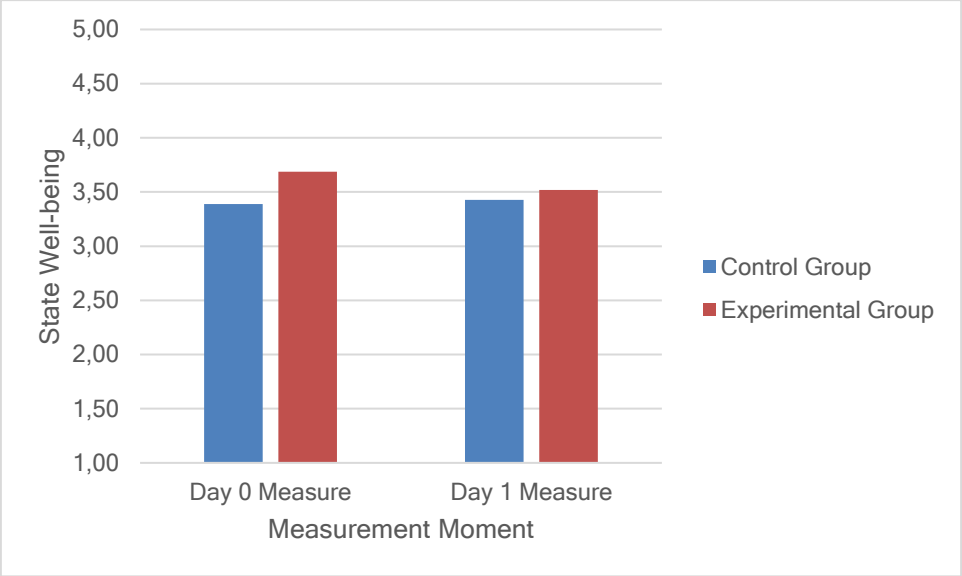
Still, for the experimental condition, completing the challenges ($t(146) = 2.61$, $p = .010$), the level of state extraversion ($t(151) = 7.14$, $p < .001$) and the interaction between them ($t(146) = -2.73$, $p = .007$) were found to have a statistically significant effect on the participants level of state well-being. This means that the positive effects of state extraversion on the participants' state well-being are higher, if the participants completed the extraversion challenge, compared to when they did not complete the challenge.

Therefore, the hypothesis that intentional extraversion significantly enhances well-being cannot fully be rejected. Although there is no general effect between groups on well-being over the two weeks, there is a within-subjects effect on a daily level in which state extraversion and completing the challenge significantly impact well-being.

For the second hypothesis, the analyses revealed a non-significant main effect for the within-subjects factor measurement moment (day 0/1) ($F(1, 31) = 2.35$, $p = .135$) and a non-significant main effect for the between-subjects factor condition ($F(1, 32) = 0.34$, $p = .566$) on the day 0 or day 1 well-being score. There was also a non-significant interaction effect between the measurement moments and condition ($F(1, 37) = 2.56$, $p = .118$). Post-hoc tests on the analysis were not performed due to the lack of significant effects. In addition, calculating Hedges' g showed an effect size $g = 0.13$ for the difference in day 1 well-being between the experimental and control group. See Figure 2 for a comparison between the conditions on day 0 and day 1 well-being.

Figure 2

Well-being on Days 0 and 1 Compared by Group

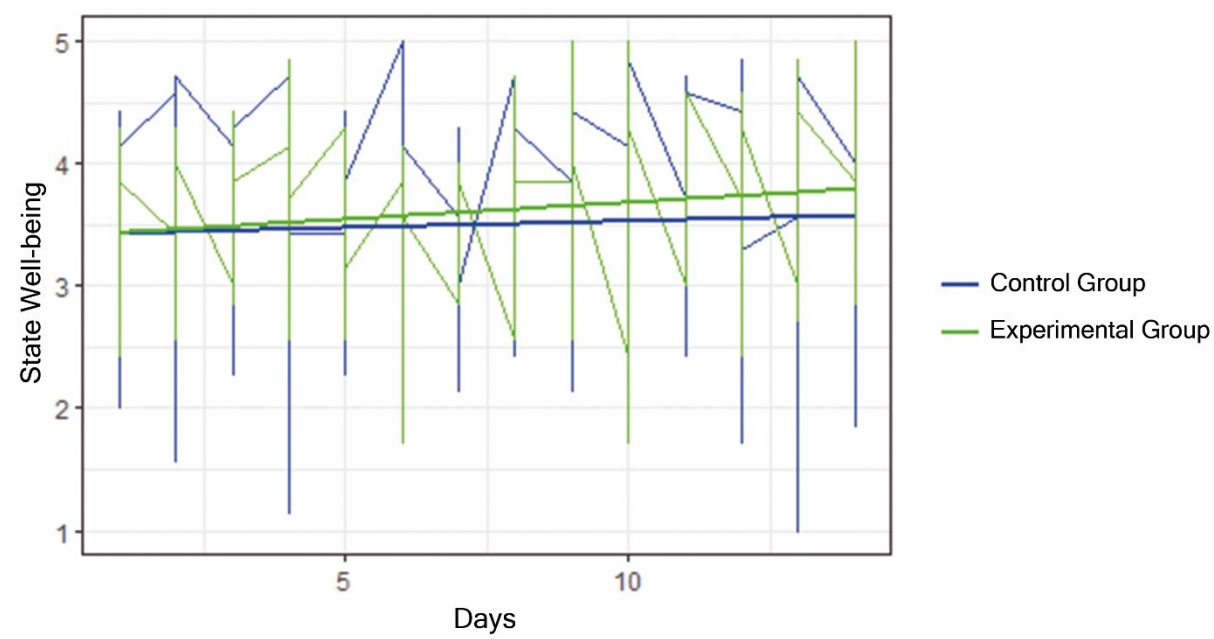


In addition, no significant main effect of completing the challenges ($t(23) = 0.967$, $p = .344$) on the participants' state well-being on day 1 was found. Therefore, the second hypothesis that well-being is enhanced after one day can be rejected.

For the third hypothesis, the analyses revealed a non-significant linear time trend ($F(1, 325) = 1.25$, $p = .211$) and a non-significant main effect of the participants' group ($F(1, 38) = -0.05$, $p = .965$) on state well-being. There was also a non-significant interaction effect between the days and the group ($F(1, 325) = 1.21$, $p = .228$) on the state well-being. Still, separate analyses on the two conditions showed a significant positive linear trend of the days on mean well-being for the experimental group ($t(152) = 2.50$, $p = .026$) with a slope of 0.03 and a non-significant positive linear trend for the control group ($t(194) = 0.81$, $p = .417$) with a slope of 0.01. See Figure 3 for a comparison of state well-being over time between the two conditions.

Figure 3

State Well-being over Time



Note. The vertical lines indicate the different state well-being measures of the different participants. The horizontal lines show the linear time trends of the two groups.

Nonetheless, the third hypothesis that well-being increases over the first and second week can be rejected as there is no significant difference between the groups.

Lastly, for the fourth hypothesis, the analyses revealed non-significant main effects of the pre- or post-test ($t(9) = -0.001$, $p = .999$) and a non-significant main effect of the participants' baseline level of extraversion ($t(13) = 1.5$, $p = .158$) on the pre-test or post-test scores. There was also a non-significant interaction effect between the test and the baseline level of extraversion ($F(9) = -0.55$, $p = .595$). Therefore, there is no evidence found that the participants' trait extraversion moderates the effect of the intervention on well-being, but the hypothesis cannot fully be accepted, as the statistical power of the test is too low to interpret the results as evidence for the absence of the moderation effect.

Discussion

The purpose of this research is to investigate in how far intentional extraversion enhances university students' well-being in the recovery process from the COVID-19 pandemic. Furthermore, this study looks into the duration of the intervention and in how far it influences its effectiveness.

The results of the analyses show that performing the challenges, so following the intervention, has a positive impact on the participants' level of state extraversion. This confirms that the manipulation of this study works and the behavioural instructions lead to an increased level of state extraversion. Although there is no clear and accepted agreement on a definition or frame on when to speak of adherence or non-adherence, the proposed percentages of e.g. Gordis et al., (1969) (75%) and Black et al. (1987) (80%) would describe the 81.17 % of the current research as an example of adherence to an intervention.

Still, although the manipulation works as intended and the participants adhere to the intervention, the between-group analysis reveals that well-being is not enhanced over the two weeks; intentionally acting extraverted does not change the participants' well-being over the intervention's duration. Nonetheless, the within-subjects analysis shows that in the experimental condition, the well-being is enhanced when participants experience higher levels of state extraversion and is even more increased when the behavioural challenges are completed, showing that there is an effect on a daily basis.

Due to the small sample of this research, and the low effect size for the post-tests between the two groups ($g < 0.5$; Cohen, 2013), the results have to be interpreted carefully (Bhandari, 2022). The within-subject effects on a daily basis have more measurement moments and can therefore be considered as more reliable, therefore pointing toward an effect of state extraversion on well-being. Still, the small effect size of the between-groups analysis indicates a rather small effect of state extraversion on well-being.

One explanation for these findings could lie in the measured construct of well-being. Both Van Allen et al. (2021) and Margolis and Lyubomirsky (2020) focused their research not on overall well-being, but on positive affect. Positive affect is defined as "the extent to which an individual subjectively experiences positive moods such as joy, interest, and alertness" (Miller, 2011, p. 1) and is higher in more extraverted individuals. Compared to the more comprehensive and broader overall concept of well-being that consists of various parts of an individual's life quality, positive affect is more specific, influences well-being and is about positive experiences and emotions. At the end of their research, Margolis and Lyubomirsky (2020) hypothesised that extraversion interventions might mainly target positive affect, for which they found strong positive effects, and might influence more general and stable constructs like life satisfaction or happiness less. Therefore, similar to the only weaker effects of happiness and life satisfaction, the construct of well-being of the current research might also have a smaller direct connection to state extraversion compared to positive affect.

The results also revealed that the participants' well-being is not enhanced or changed after one day of the intervention. Performing the behavioural challenges does also not influence well-being on the first day. Again, the calculated effect size for the day 1 well-being between the two groups is considered small ($g < 0.5$; Cohen, 2013) and the result should therefore be interpreted carefully (Bhandari, 2022).

One explanation would be some sort of discomfort the experimental group could have experienced when starting with the intervention and the challenges. The participants had to leave their comfort zone and engage in extraverted behaviour, explaining the decrease in well-being seen in Figure 2 although it is not significant. After some time, they might have habituated to the intervention and their actions (Cherry, 2023; Rankin et al., 2009), explaining the found significant positive effect of completing the challenges and behaving extraverted on the participants' well-being on a daily level. The effects show after more than one day of the intervention possibly due to habituation and training.

In addition, although the well-being of the experimental group shows a positive linear trend (a general increase in well-being) comparing it to the control group again reveals that even though there might be a positive trend toward an increase in well-being, the effect is too small. This is possibly caused by the measured construct of overall well-being. Truijens et al. (2021) furthermore remind that the administration of self-report questionnaires might on its own be similar to an intervention and influences the interpretation of symptoms and feelings. The participants might have therefore already reported a small increase in well-being, influencing the later comparison between the experimental and control group.

Lastly, no evidence was found that the participants' baseline level, so trait level of extraversion moderates the effect of the intervention on well-being, as expected. Due to the statistical power of the moderation analysis, this cannot be seen as evidence for the general absence of the effect (Quertemont, 2011), but still is in line with the previous findings of both Margolis and Lyubomirsky (2020) and Van Allen et al. (2021) and therefore supports the suggested absence of a moderational effect of trait extraversion. In addition, compared to the studies conducted by Margolis and Lyubomirsky (2020) and Van Allen et al. (2021), the provided challenges are not adapted to individual differences. During the other studies, the participants were only instructed to behave as extraverted as possible, so for individuals low in extraversion, the behaviour might have been less extraverted than for individuals generally high in extraversion. Therefore, no moderating effect of trait extraversion could be found as the performed behavioural change was tailored to individual differences. In the current study, this is not the case, as the challenges were not adjustable, but already chosen. Resulting, certain

challenges like the challenge "Call somebody you did not talk to for a while but would like to keep in contact with" (see Appendix H) on days 6 and 13 are not performed on nine occasions (also see Table 1), indicating that the challenge does not seem to be suitable for all participants. This would theoretically open the possibility of trait extraversion based differences in well-being, but the results still show no evidence for a moderation. This, therefore, backs up and rules out an alternative explanation to the previous studies by Margolis and Lyubomirsky (2020) and Van Allen et al. (2021).

Limitations and Strengths

Some limitations apply to this study. The current research only contains a small sample size (n = 25) and the analyses have small effect sizes, rather low power and depending on the analyses only few measurement moments. Furthermore, the participants are drawn from a pool of social science students which might have influenced the reliability of the research, as the results cannot be generalized due to the small sample size and the sample might be biased due to social science students' more socially invested character traits and interests. In addition, extraversion is not measured in the control group which would have been beneficial for comparisons between the two groups and analysing the intervention's success, but still through the variable "completion" it is possible to obtain this data in another way.

Nonetheless, there are multiple strong points that are outstanding and beneficial in this research. As already partly studied by Van Allen et al. (2021), this research uses an RCT and does not focus on introversion, but only on extraversion and its positive effects; placing a higher focus on extraversion. The control group is not negative, but neutral and is also not influenced by any compensating task. It is therefore unbiased, compared to e.g. Van Allen et al. (2021) who let the participants in the control group write for example diary entries or the introversion group of Margolis and Lyubomirsky (2020). In addition, this study looks into the overarching construct of well-being instead of focusing on positive affect. According to Cantor and Sanderson (1999), focusing on (future-oriented) well-being instead of momentary positive affect is important for individuals who try to increase well-being through life activities of any form, such as the extraversion challenges. Furthermore, this research focuses more detailed on the duration of the intervention and the corresponding effects by observing well-being over two weeks and collecting daily measures of it, bringing more detailed insights into well-being changes. Lastly, a different approach through the extraversion challenges is applied with specific tasks instead of general instructions to behave extraverted. The extraversion challenges the participants perform are not tailored towards individual differences in the participants other than e.g. the general instruction to behave as extraverted as possible given by e.g. Margolis and

Lyubomirsky (2020) or Van Allen et al. (2021) in which the participants could choose the most fitting behaviour themselves. This provides further evidence against a moderation of trait extraversion while controlling for a possible methodological mistake of the previous research.

Future Directions

For future research, it would be interesting to replicate this current research or improve it with for example a larger sample size to get a clearer picture of the results with larger effect sizes. Next to that, future research in this area should work with longer behavioural interventions as well as interventions that aim for stronger behavioural change. This could entail e.g. daily or weekly extraversion training of longer duration like one hour. The intervention run time could also be increased to observe the participants' well-being over e.g. one month or include follow-up tests one or a few months after the intervention to observe how long the effects of the intervention last. In addition, future research could also study which constructs intentional extraversion interventions actually target and why. This would for example bring more insights if only positive affect is positively influenced or also life satisfaction, loneliness, happiness, motivation or other constructs are increased through intentional extraversion or if they are not influenced. It should also be researched how it is possible to target more future-oriented well-being instead of momentary positive affect. Furthermore, similar to the behavioural challenges in this study, more and different ways to influence the participants' level of state extraversion should be explored and tested. Lastly, it could be interesting for future studies to control for positive, negative or other special life events like e.g. exam results or death of family members to ensure more reliable results and investigate connections to well-being and state extraversion.

Conclusion

The results of this research suggest that intentionally acting extraverted does not enhance well-being in the recovery process of the COVID-19 pandemic over the timeframe of two weeks; when compared to the control group. Still, the results show that following the intervention and behaving more extraverted relate to improved well-being of the experimental group on a daily basis. These contradictions are probably caused by the measured overall construct of well-being. Furthermore, the well-being does not increase after one day of the intervention, suggesting that habituating to the challenges or training plays a role in the benefits of this extraversion intervention. Still, the well-being increases further depending on performing the extraversion challenges and the level of state extraversion. Manipulating state extraversion is therefore possible through specific behavioural instructions in the form of challenges. Future research should look further into the duration of the intervention, long-term

effects and the constructs impacted by state extraversion while controlling for life events of any form. This study could be replicated with a larger sample size to support or reject the proposed interpretations of the results.

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Appendix A

Study Information Experimental Group

Dear Research Participant,

thank you very much for participating in this study as part of my bachelor's thesis! Please read the following information carefully:

Background Knowledge:

Due to the recent COVID-19 pandemic, the well-being of students drastically decreased, resulting from social isolation, online education and other pandemic-related restrictions. Therefore, more attention has to be directed towards the students' recovery process. One possible way of enhancing the post-covid well-being of students is through the trait of extraversion (being active, sociable, talkative, etc.).

This Study:

With this study, I want to investigate this further. The University of Twente´s "TIIM" application will be needed to be installed, as you will be instructed to complete one extraverted challenge per day (Challenges could for example be "Sit next to a stranger during a lecture") and fill out a short well-being and extraversion questionnaire in the evening. This procedure will be repeated every day over the timeframe of two weeks.

Please use these challenges, behave extraverted and try to complete all challenges and questionnaires.

Detailed information on the exact procedure and the installation of the needed application will follow in a bit.

Contact Information:

If you have any questions or concerns about the study or the procedure you can contact:

The researcher: Simon Schön | s.schon@student.utwente.nl

The supervisor: Dr. M. Radstaak | m.radstaak@utwente.nl

Appendix B

Study Information Control Group

Dear Research Participant,

thank you very much for participating in this study as part of my bachelor's thesis! Please read

the following information carefully:

Background Knowledge:
Due to the recent COVID-19 pandemic, the well-being of students drastically decreased, resulting from social isolation, online education and other pandemic-related restrictions. Therefore, more attention has to be directed towards the students' recovery process.

This Study:
With this study, I want to investigate the post-covid well-being of university students. The University of Twentes "TIIM" application will be needed to be installed, as you will be instructed to fill out a short well-being questionnaire every evening for two weeks.

Detailed information on the exact procedure and the installation of the needed application will follow in a bit.

Contact Information:
If you have any questions or concerns about the study or the procedure you can contact:
The researcher: Simon Schön | s.schon@student.utwente.nl
The Supervisor: Dr. M. Radstaak | m.radstaak@utwente.nl

Appendix C
Informed Consent Form

I have read and understood the study information and know that I can contact the researcher for questions at any time (yes/no).

I consent voluntarily to be a participant in this study and understand that I can refuse to answer questions and I can withdraw from the study at any time, without having to give a reason (yes/no).

I understand that taking part in this study involves installing the University of Twente TIIM application and engaging in daily activities (e.g. daily questionnaires) over the timeframe of two weeks (yes/no).

I understand that information I provide will be used for analyses in the context of a bachelor thesis (yes/no).

I understand that all personal data will be anonymised or removed (yes/no).

Contact Information for Questions about Your Rights as a Research Participant:
If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher, please contact the Secretary of the Ethics Committee/domain Humanities & Social Sciences of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-hss@utwente.nl.

Appendix D
Instructions to Install the App for the Experimental Group

Beginning the Study
To start with the study follow these steps:

1. Installing the TIIM application Go to the GooglePlay or Apple store and install the "TIIM" application from the BMSLab/Utwente (Android: https://play.google.com/store/apps/details?id=nl.bmslab.utwente.tiimapp | IOS: https://apps.apple.com/us/app/tiim/id1229896853 or just type in "TIIM Utwente")

2. Registering in TIIM Open the App and create an account with your student email and a password of your choice

3. Enrol for the study Click the QR-code Icon in the top right corner and either scan the QR-Code shown below or type in the following Code: z3i2E

4. Starting the study Subscribe to the research. You can start with the study the day after you subscribed at 10:00. You will also receive a push notification, but please also check the app at 10:00.

5. Make sure to enable push notifications Click on the three lines in the top left corner. Under "Profile" click on settings. There, enable push notifications and click on save at the bottom of the page

That's it you are ready to start with this study! Please keep in mind that it is important to really try completing all challenges and questionnaires!

From now, please follow the instruction in the TIIM application. Have fun and challenge yourself!

Appendix E
Instructions to Install the App for the Experimental Group

Beginning the Study
To start with the study follow these steps:

1. Installing the TIIM application Go to the GooglePlay or Apple store and install the "TIIM" application from the BMSLab/Utwente (Android:https://play.google.com/store/apps/details?id=nl.bmslab.utwente.tiimapp | IOS:https://apps.apple.com/us/app/tiim/id1229896853 or just type in "TIIM Utwente")

2. Registering in TIIM Open the App and create an account with your student email and a password of your choice

3. Enrol for the study Click the QR-code Icon in the top right corner and either scan the QR-Code shown below or type in the following Code: OoEgq

4. Starting the study Subscribe to the research. You can start with the study the day after you subscribed at 10:00. You will also receive a push notification, but please also check the app at 10:00.

5. Make sure to enable push notifications Click on the three lines on the top left corner. Under "Profile" click on settings. There, enable pushnotifications and click on save at the bottom of the page

That's it you are ready to start with this study! Please keep in mind that it is important to really try completing all questionnaires!
From now, please follow the instruction in the TIIM application. Thank you!

Appendix F

Additional Information in the App Experimental Group

Hey [user-firstname]!

Thank you for installing the app and welcome to this study. From now on you will work with this app on a daily basis for the next two weeks.

Let's get started with today's initial questions and a small introduction!
#####################

That's already it for today!

From tomorrow on you will receive daily challenges. These challenges are available at 8:00, but make sure to read them in the morning so that you have enough time to perform/act them out! Additionally, you will receive notifications at 8:00 and 13:00 to remind you of your challenges.

At 18:00 the daily well-being and extraversion questionnaires will be made available for you, with reminder notifications at 18:00 and 20:00.

Please try your best to perform all challenges and fill out all questionnaires!

See you tomorrow for your first challenge!

Appendix G

Additional Information in the App Control Group

Hey [user-firstname]!

Thank you for installing the app and welcome to this study. From now on you will work with this app on a daily basis for the next two weeks.

Let´s get started with today´s initial questions and a small introduction!
##########################

That´s already it for today!

From tomorrow on you will receive daily well-being measures. They will be made available for you at 18:00 with reminder notifications at 18:00 and 20:00.

Please try your best to fill out all questionnaires!

See you tomorrow for your first set of questions!

Appendix H

Extraversion Challenges & Targeted Behaviour

1. Try greeting and smiling at at least 3 strangers while walking over the campus (Focus on behaving social, assertive, positive)
   Alternative: Write down 5 things you liked about the day (Focus on behaving positive, lively)
2. Sit next to a stranger in class and try talking with them (Focus on behaving talkative, social)
   Alternative: Make plans for meeting a friend or somebody you would like to be friends with (Focus on behaving active, social, energetic, talkative)
3. Find the running track and either jog or quick walk one round (Focus on behaving active, lively, energetic)
   Alternative: Set a timer and go for a walk for 15 minutes (without listening to music or looking at the phone). Try to smile at least at 3 strangers (Focus on behaving active, lively, energetic, positive)
4. Ask for or offer help to peers (Focus on behaving assertive, social, active, talkative)
5. Compliment a stranger on something you notice about them (Focus on behaving social, assertive, positive)
   Alternative: Explain to your roommate what you achieved this week. If you live alone, call a friend and explain to them what you achieved over the week (Focus on behaving positive, Social, talkative, active, assertive)

6. Call somebody you did not talk to for a while but would like to keep in contact with (Focus on behaving social, talkative, active, assertive
7. Write down 5 traits that you like about yourself (Focus on behaving positive)

Appendix I

MHC-SF

During the past month, how often did you feel …	NEVER	ONCE OR TWICE	ABOUT ONCE A WEEK	ABOUT 2 OR 3 TIMES A WEEK	ALMOST EVERY DAY	EVERY DAY
1. happy						
2. interested in life						
3. satisfied with life						
4. that you had something important to contribute to society						
5. that you belonged to a community (like a social group, or your neighborhood)						
SEE BELOW 6. that our society is a good place, or is becoming a better place, for all people						
7. that people are basically good						
8. that the way our society works makes sense to you						
9. that you liked most parts of your personality						
10. good at managing the responsibilities of your daily life						
11. that you had warm and trusting relationships with others						
12. that you had experiences that challenged you to grow and become a better person						
13. confident to think or express your own ideas and opinions						
14. that your life has a sense of direction or meaning to it						

Appendix J

BFI Extraversion Items

I see myself as somebody who…

		Strongly Disagree				Strongly Agree
1.	Talks a lot	1	2	3	4	5
2.	Keeps their thoughts to themselves (-)	1	2	3	4	5
3.	Has a lot of energy	1	2	3	4	5
4.	Makes things exciting	1	2	3	4	5
5.	Tends to be quiet (-)	1	2	3	4	5
6.	Has a good, strong personality	1	2	3	4	5
7.	Is kind of shy (-)	1	2	3	4	5
8.	Is outgoing; likes to be with people	1	2	3	4	5

Appendix K

SWEMWBS

Below are some statements about feelings and thoughts. Please select the answer that best describes your experience of today.

	None of the Time	Rarely	Some of the Time	Often	All of the Time
I've been feeling optimistic about the future	**1**	**2**	**3**	**4**	**5**
I've been feeling useful	1	2	3	4	5
I've been feeling relaxed	1	2	3	4	5
I've been dealing with problems well	1	2	3	4	5
I've been thinking clearly	1	2	3	4	5
I've been feeling close to other people	1	2	3	4	5
I've been able to make up my own mind about things	1	2	3	4	5

Appendix L

Extraversion Markers

Today, I was… (1 Completely Disagree – 7 Completely Agree)

1. Energetic 1 2 3 4 5 6 7
2. Talkative 1 2 3 4 5 6 7
3. Assertive 1 2 3 4 5 6 7
4. Active 1 2 3 4 5 6 7
5. Positive 1 2 3 4 5 6 7
6. Sociable 1 2 3 4 5 6 7
7. Lively 1 2 3 4 5 6 7
8. Excitable 1 2 3 4 5 6 7