Exploring the Dynamics of Well-Being and Depressive Symptoms
Among University Students: an Experience Sampling Study

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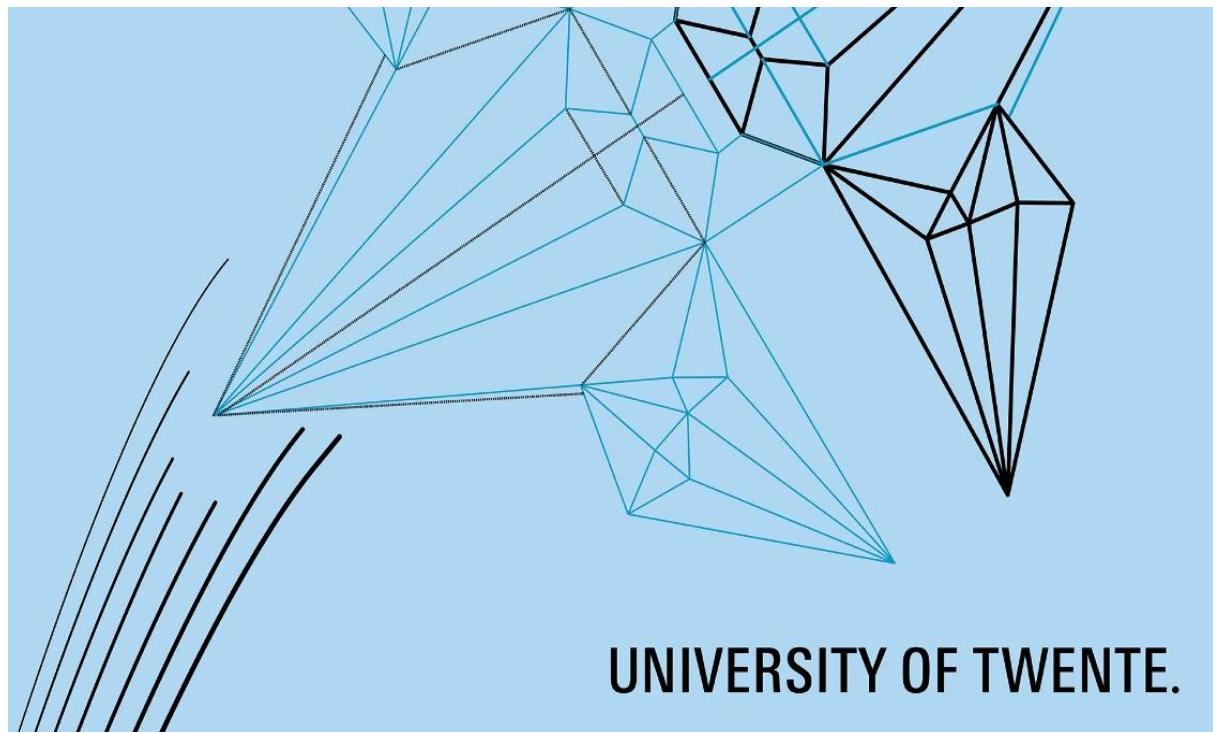
Abstract

To fully understand psychological constructs such as well-being and depression, it is essential to investigate the processes and dynamics that occur within individuals. This study explored the fluctuations of state well-being and depressive symptoms between and within university students. Since depression is relatively common among university students, the variation of depressive symptoms was examined as well as the association with well-being over the course of two weeks. For this, an experience sampling method (ESM) design was used. The daily questionnaires included the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS) and a visual-analogue scale (VAS) addressing depressive symptoms, and were triggered in the morning, afternoon, and evening on the Ethica App. Responses of a total of 25 participants were analysed through multiple linear mixed model (LMM) analyses. There was great variation of depressive symptoms between and within university students. No overall effect of time was found. Within-person level showed that individuals differed in fluctuations although their mean of depressive symptoms was similar. A strong negative association ($\beta = -.59$, $p < .001$) of well-being and depressive symptoms over time in the total sample was demonstrated. Follow-up analyses, however, revealed that although some individuals experienced a clear negative association, others demonstrated only a weak negative, a positive association or even a disconnection between well-being and depressive symptoms. Also, some individuals experienced substantial fluctuations from moment to moment, whereas others state feelings were mostly stable. Overall, this study confirmed previous cross-sectional findings of a strong association of well-being and depressive symptoms at the group level and further demonstrated individual differences in fluctuations and associations. The main strength of this study was the incorporation and combination of both between- and within-person level analyses which is essential when considering individual processes. An additional strong point was the high response rate (86%). In future studies, LMM analyses could focus more on statistically separating the between- and within level effects. Additionally, studies could explore the usability of ESM for real-time interventions (ESM-I) and thus, tailor the content more to individual's needs, creating a greater effectiveness of interventions.

Keywords: Experience sampling method (ESM), between-persons, within-persons, fluctuations, well-being, SWEMWBS, depressive symptoms, university students, linear mixed model (LMM)

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Introduction

"Well-being is not a beach you go and lie on. It's sort of dynamic dance and there's movement in that all the time and actually it's the functuality [*sic*] of that movement which actually is true levels of well-being", Nic Marks on BBC (Dodge, Daly, Huyton, & Sanders, 2012, p.230).

Defining well-being is a complex process (Dodge et al., 2012; Ryan & Deci, 2001). To gain a first understanding, well-being can be regarded from two different approaches: the hedonic and eudemonic approach (Ryan & Deci, 2001). The hedonic viewpoint considers happiness, the presence of pleasure, and absence of pain as important factors of well-being, whereas the eudemonic perspective focuses on the element of fully functioning (Ryan & Deci, 2001).

The latter is based on Roger's fully functioning person and carries the meaning of developing in terms of one's "optimal psychological adjustment, optimal psychological maturity, complete congruence, complete openness to experience, complete extensionality" (Rogers, 1959, p.235). Once these elements are reached, an individual experiences eudemonic well-being. However, it is essential to continue striving for the optimum (Rogers, 1959). Continuing to strive for the optimum is also reflected in the six-factor model of psychological well-being by Ryff. In that, she attributed six elements to well-being: "self-acceptance, positive relations with others, autonomy, environmental mastery, purpose in life, and personal growth" (Van Dierendonck, Díaz, Rodríguez-Carvajal, Blanco, & Moreno-Jiménez, 2008, p.474). Whereas most of these aspects are rather self-explanatory, environmental mastery refers to guiding one's life, while also considering one's environmental surroundings (Perron, 2006).

Overall, trying to formulate a definition of well-being, Dodge et al. (2012) suggest that well-being represents a so-called balance point between one's resources and encountered challenges. Because only if, and when, someone can balance certain challenges, the above-mentioned elements of well-being such as personal growth, and well-being overall, can be reached. This balance between resources and challenges may remind one of and is referring back to the quote of the beginning, being a dynamic dance.

An imbalance of such would not lead to well-being but rather to challenges in one's mental health, such as mental disorders. One of the most common mental disorders is depression (WHO, 2019). More precisely, depression is "a mood disorder involving emotional, motivational, behavioural, physical, and cognitive symptoms" (Davey, 2014, p. 196). These include negative experiences, disinterest in everyday activities, lack of energy, sleep disturbances, and pessimistic perspectives (Davey, 2014). Approximately 264 million people

worldwide are challenged with depression (WHO, 2019). Depression is also a generally known problem for university students. A study review by Ibrahim, Kelly, Adams, and Glazebrook (2013) suggests that approximately one third of students are affected by depression. With a point prevalence of 30.6%, this disorder is more prevalent within students than in the general population (Ibrahim et al., 2013), in which depression is present in around 4.4% of people (WHO, 2017).

However, most people do not experience such consistently high levels of depression to be qualified as a disorder in that sense. Nonetheless, most people are confronted with depressive moods throughout their daily life and, generally, everyone experiences fluctuations in mood (Watson, 2000). Often, depressive symptoms include for example feeling sad, being nervous, not seeing oneself worthy, or being hopeless (Mikolajczyk, Maxwell, Naydenova, Meier, & El Ansari, 2008). Although almost everyone recognizes those feelings, interestingly, students in higher education experience a higher prevalence rate in depressive symptoms. For instance, between 31% of western European and 43.5% of eastern European students have reported depressive symptoms (Mikolaijczyk et al., 2008). An Australian study noted 39.5% of university students with depressive symptoms (Schofield, O'Halloran, McLean, Forrester-Knauss, & Paxton, 2016). Such high prevalence rates are mainly due to study work or worries about their job future (Mikolajczyk et al., 2008). Schofield et al. (2016) added that stress, a great amount of anxiety, feeling lonely, and participating in little physical activity are associated with those symptoms. Additionally, depressive symptoms are related to motivation problems, procrastination, perfectionism, and concentration issues (Khawaja & Bryden, 2006). A study by Shadowen, Williamson, Guerra, Ammigan, and Drexler (2019) demonstrated that undergraduate and international students are faced with more depressive symptoms than graduate and national students. Moreover, it is often studied how depressive symptoms vary between countries (Castro-Costa et al.,2007) and between factors such as age, gender, or socioeconomic status (Turner & Lloyd, 1999). Overall, these studies seem to focus on the differences in depressive symptoms between individuals in order to generalize their findings which is informative in providing means and general information about a population.

The association between depression, or rather depressive symptoms, and well-being has been investigated in various studies. These studies indicated mainly the same results with a strong association found between the two constructs (Lagnado, Gilchrist, Smastuen, & Memon, 2017). More precisely, several studies found a negative relation between well-being and depression (e.g., De Coninck, 2019; Kaczmarek, 2015; Zheng, 2016). Zheng (2016) also specifically investigated the phenomena among students and indicated that students with a

higher well-being show a reduced level of depression. Additionally, it was pointed out that low levels in well-being can predict a higher level of depressive symptoms at a later time (Grant, Guille, & Sen, 2013). The studies investigated the association between individuals, so-called between-person analyses. The dual-continua model of mental health demonstrates that mental health and mental illness, or well-being and symptoms, are strongly related, yet also distinct constructs that are not opposites of one single spectrum (Iasiello, van Agteren, Muir-Cochrane, 2020). These findings are mainly based on cross-sectional studies and a few longitudinal researches.

Between-person analyses focus on finding differences between people, also referred to as interindividual variation (Hoffman, 2015). Hereby, the researchers are interested in finding one outcome per person to compare it to the outcomes of other people (Hoffman, 2015). Thereby, each person is examined only once within the study (Salkind, 2010; Sedgwick, 2014). Thus, this research is useful for traits that are rather stable and do not change over the course of (a short) time (Hamaker, 2012). It generalizes the findings to an entire population by averaging them. Thereby, however, these studies often tend to make potentially incorrect within-person conclusions based on their general findings. Between-person analyses refer to traditional study designs such as cross-sectional research (Hamaker, 2012; Hoffman, 2015). They are suitable for determining how prevalent a certain behaviour is within a population (Sedgwick, 2014), but do not provide information on the varying processes that lead to a certain outcome within a person (Hamaker, 2012). Generally, within-person studies about mental health are rare (Bunce, Handley, & Gaines, 2008).

However, it is crucial to consider that some features vary within people throughout time (Hoffman, 2015). This consideration takes place in within-person analyses, also referred to as intraindividual variation. Hereby, each person is assessed multiple times over the course of a study to understand their processes and fluctuations. Fluctuations can be defined in terms of random variation throughout the different measurement points within a person (Hoffman, 2015). Fluctuations have been detected in people, for example in mood or emotion (Nesselroade & Ram, 2004) and also in well-being (Boschman, Nieuwenhuijsen, & Sluiter, 2018; Ong, Horn, & Walsh, 2007) with the latter observation being particularly relevant for this study. Fluctuations in feelings can occur any time, "from moment to moment, day to day, week to week" (Nesselroade & Ram, 2004, p.10). Hence, it can be stated that individuals represent dynamic processes instead of stability (Nesselroade & Ram, 2004).

Comparing between-person and within-person analyses, it can be stated that their results may indicate different findings (Hamaker, 2012; Yearick, 2017). In other words, this means

that variables that are for example negatively related on the between-person level, can, but do not need to be, negatively related on the within-person level. Instead, they could also be positively related or show no relation at all (Yearick, 2017). Hamaker (2012) clarifies that on a within-person level, different individuals could experience different relations between the variables over time. Hence, the findings of between-person studies can not be generalised to each person (Hoffman, 2015). To establish how emotions can appear and fluctuate, it is crucial to also do a within-person analysis. Therefore, studies that focus on numerous measurement points of a construct of interest over time are necessary (Curran & Bauer, 2011).

For this, intensive longitudinal studies are beneficial (Hoffman, 2015). In particular, one possible longitudinal design that can be used for within-person analysis is the Experience Sampling Method (ESM), also referred to as Ecological Momentary Assessment (EMA) or diary method (Shiffman, Stone, & Hufford, 2008). Experience sampling can measure momentary states (Yearick, 2017) since it takes places in the daily life and asks participants to "report their thoughts, feelings, and symptoms, and also the context" at the moment they occur (Myin-Germeys, Oorschot, Collip, Lataster, Delespaul, & Van Os, 2009, p.1533). EMS can explore dynamic processes on within-person levels and can study short-term fluctuations (Yearick, 2017). Hereby, it considers that variance on a within-person level is not an error but is a relevant finding and shows that individuals differ to one another in their within-person level (Yearick, 2017). Another advantage of EMS and its multiple measurement points is that memory limitations can be reduced (Shiffman et al., 2008). The individuals are, thus, more likely to separate their emotions which leads to a greater possibility of understanding the different emotional states of the individual and the variability of such (Myin-Germeys et al., 2009). Overall, EMS can assess fluctuations in mental processes within a person in a natural daily life setting (Verhagen, Hasmi, Drukker, Van Os, & Delespaul, 2016).

It has been found that studying individuals on a within-person level instead of solely a between-person basis provides understanding of the processes and fluctuations that are occurring within individuals. Generally, within-person studies concerning mental health are limited and no studies to date have examined the association between well-being and depression using intensive longitudinal designs. The main constructs of interest in this study were therefore well-being and depressive symptoms. Since the latter is particularly common within university students, it was decided to focus on that population. This study was executed through the experience sampling method, a longitudinal design since it can focus on both between-person and within-person analyses. Considering all the above, the main objective of this study was to investigate well-being and depressive symptoms considering short-term fluctuation over time

among university students. In particular, this study aimed to address the following research questions:

RQ1: How do depressive symptoms vary between and within university students over the course of two weeks? This research question assesses the variation of depressive symptoms that occurs in the daily life of university students on the between-person and within-person level. A lot of literature was found regarding the between-person level of variation of depressive symptoms. However, in contrast to well-being, almost no studies could be found about the within-person fluctuations of depressive symptoms over time. Thus, it was decided to focus on the variation of depressive symptoms over two weeks in this study. It is hypothesized that a great variation of depressive symptoms between and within individuals occurs. It is assumed that depressive symptoms vary throughout the days, on some days with generally more depressive symptoms than on others. The idea is that the individuals are less depressed on the weekend than during the week. Further, it is expected that there is a great variation between and within the individual means of the depressive symptoms.

RQ2: How are mental well-being and depressive symptoms associated between and within university students over the course of two weeks? This research question focuses on the association of well-being and depressive symptoms that occur in the daily life of university students. It was hypothesized that well-being and depressive symptoms are clearly negatively associated which is also supported by literature. Closer to the within-person level, it was assumed that well-being and depressive symptoms may not always have a (clear) negative association and that the forms of association could vary among different individuals.

Methods

Participants

The sample for this study consisted of 35 university students from different countries. Sample sizes for ESM studies can be determined considering practical situations such as a limitation of the participant burden (Kirtley, Lafit, Achterhof, Hiekkaranta, & Myin-Germeys, 2019). As the availability of participants was seen as a crucial element for this study, a rather small sample size in comparison was attained. It was found that, on average, previous ESM studies contained 53 participants (Van Berkel, Ferreira, & Kostakos, 2017). However, since several outliers indicated great sample sizes, van Berkel et al. also indicated a median of 19 participants for ESM studies. Thus, considering both numbers, a sample size of 35 seemed fitting.

Since an experience sampling method study demands a lot of commitment from its

participants, including a higher timely effort (Verhagen et al., 2016; Yearick, 2017), the ability and motivation from the participants are essential (Connor & Lehman, 2012). Therefore, the participants were recruited through convenience sampling, a type of non-probability sampling, that provides the advantage of participants being easily accessible, timely available, and willing to participate (Etikan, Musa, & Alkassim, 2016). Thus, the researchers contacted the potential participants from their network informally through WhatsApp or in person. This is in line with a review of experience sampling methods that stated participants are mostly recruited through the contacts of the researchers (Yearick, 2017). Of all approached people, 83% participated in the study.

Materials

ESM studies are nowadays increasingly conducted using mobile phone applications since the technology enhanced and since these are easily accessible, affordable, and promote higher participation (Connor & Lehman, 2012). To collect the data for this study, the Ethica Data application (https://ethicadata.com/) was used. Ethica Data supports human-subject research and makes research easier for the participants as it uses their phone to collect data (Ethica, 2019). It ensures the privacy of the participants and supports the researcher with an easy enrolment process (Ethica, 2019). To participate in the study, the students needed to own or be able to use an email address and a phone. The app supported both Android and iOS and could also be used offline (Ethica, 2019).

The study consisted of two questionnaires: the baseline and the daily questionnaires. A combination of those questionnaires is typically used in ESM (Yearick, 2017). The baseline questionnaire included demographics and validated, multi-item statements about feelings and thoughts. Since the recall period for the baseline assessment focused on the participants' experiences during the last week and the last month, it assessed their traits. More precisely, the baseline consisted of several questionnaires: the Short Warwick-Edinburgh Mental Well-being Scale (SWEMWBS), the Hospital Anxiety and Depression Scale (HADS), the Perceived Stress Scale (PSS) and the General Self-Efficacy Scale (GSE) (see Appendix A).

The daily questionnaires consisted of two single-item visual-analogue scales (VAS), one concerned depressive mood and the other anxiety, the SWEMWBS, and questions about the context and possible stressful events (see Appendix B). The daily questionnaires asked about the participants' feelings at the moment. The VAS focused on the now, whereas the SWEMBS had a recall period of the past two hours. Thus, it assessed their momentary states instead of traits.

The visual-analogue scale is a common scale that is used in ESM studies (e.g. Maes et al., 2015; Nisenbaum, Links, Eynan, & Heisel, 2010; Varese, Haddock, & Palmier-Claus, 2019). VASs are frequently used to make psychological assessments (Williams, Morlock, & Feltner, 2010). It is a valid tool to measure among others depression as it correlates significantly with the Beck Depression Inventory and with the depression subscale of the Symptom Checklist-90 (SCL-90) (McGuire, Kim, & Lang, 2004). With a unipolar VAS in this study, the researcher was able to consider the participants' level of depressive symptoms at any measurement point. To be concrete, this study asked the participant to indicate the following: To what extent do you feel down right now? ("Not down at all" [0] to "Extremely Down" [100]).

Momentary well-being was assessed using the Short Warwick-Edinburgh Mental Well-being Scale, which represents a reliable assessment for mental health and measurement for well-being (Haver, Akerjordet, Caputi, Furunes, & Magee, 2015). The SWEMWBS comprises seven positive formulated items and is a unidimensional scale (Stewart-Brown et al., 2009). The statements are characterized with a 5-point Likert scale, reaching from 'none of the time' to 'all of the time'. The SWEMWBS is highly correlated with its original 14-item version with a spearman correlation >.95 (Fat, Scholes, Boniface, Mindell, & Stewart-Brown, 2017) and has high internal consistency reliability with Cronbach's alpha = .89 (Vaingankar et al., 2017). The SWEMWBS assesses especially the eudemonic aspect (Fat et al., 2017), but also the hedonic perspective of well-being (Haver et al., 2015). The SWEMWBS has an advantage in its brevity and is seen as a more robust measurement (Stewart-Brown et al., 2009). Thus, it is an appropriate measurement for its purpose.

Procedure

Once the study was approved by the Ethics Committee BMS from the University of Twente (#191314), the researchers programmed it in Ethica and pilot tested it for correctness. Afterwards, each participant received a study invitation from Ethica via email. The students needed to register on that day. This was important because the study started the day after registration and all students were needed to begin on the same day for analysis purposes. Within the registration process, the participants were asked download the app on their smartphone. Before the start of the research, the participants provided active online consent in the app (see Appendix C).

On the first day of the study, the baseline questionnaire, a one-time assessment, was triggered at the same time as the first daily morning questionnaire. It was possible to complete

the baseline questionnaire in that moment or at any other time within the study; this was the choice of the participants to allow some flexibility. The baseline questionnaire was expected to take approximately ten minutes to be answered.

For the daily questionnaires, a fixed timing schedule, also referred to as interval-contingent sampling, was used since this allows to take multiple measurement points per day at standardized times (Connor & Lehman, 2012; Yearick, 2017). A fixed timing schedule was found to be the most prevalent sampling in ESM (Yearick, 2017). Thereby, three measurement points per day are most common, mostly representing the morning, late afternoon, and night (Yearick, 2017). Furthermore, Connor and Lehman (2012) pointed out that the measurements should take place during times the target group is awake and timely not too close to one another. Therefore, the daily questionnaires were triggered thrice a day; in the morning (at 10 am; valid until 1 pm), in the afternoon (at 3 pm; valid until 6 pm), and in the evening (at 8 pm; valid until 12 am) (see Figure 1). A fixed timing schedule is of least burden to the participants since they can consider the time of the daily questionnaires when planning their schedule, which may also increase the responses from the participants (Connor & Lehman, 2012; Yearick, 2017). Since reminders are often used within ESM (Yearick, 2017), supporting greater compliance to the study (Connor & Lehman, 2012), notifications in form of reminders were sent to the participants when the questionnaires were triggered. The daily questionnaires were each expected to take approximately three minutes to be filled out.

Figure 1. Release time and availability of daily questionnaires.

The study continued for a period of two weeks (April 06, 2020 – April 19, 2020). Connor and Lehman (2012), who pointed out that studies counting several measurement points per day should have a duration between three days and three weeks, supported the choice for this time duration. Additionally, considering the needed measurements for the researcher and the burden of involvement for the participants such a study duration was found to be a reasonable balance between both. After two weeks, the study ended.

Data analysis

The data from Ethica were imported to IBM SPSS Statistics 23 for statistical analysis. Unnecessary variables were removed, important variables renamed and recoded. Further, invalid cases with age=99, referring to test cases from researchers, and cases without the baseline assessment were removed. The days and measurement points of the daily measurements were calculated and the three files for morning, afternoon, and evening questionnaires were merged into one document.

      Some additional cases were excluded because the within participation rates were below the cut-off score of 50%. Hereby, missing data was dealt with through a complete case deletion, the most common approach (Kang, 2013). The cut-off score of 50% was created for several reasons. Firstly, Connor and Lehman (2012) stated that it is common to decide for at least a cut-off score of 50%. Additionally, a rather low cut-off score considered the likelihood for participants to miss some measurement points because of the duration and intensity of the study. Next, some participants were initially asked to participate in the study for solely one week. In order to decrease their burden and hold the participation rate, it was considered acceptable not to force a participation of two weeks. To be able to use the data of people that only participated for one week, the cut-off score was set to 50% and not higher. Overall, after the removal of additional cases due to missing data, a total of 25 cases were analysed (Mean age = 23.52 (SD = 23.82); 44% male, 56% female). They responded on average 36 out of 42 measurement points. On average, this represented a response rate within the participants of 86% (SD = 5.82, *Range* = 50% to 100%).

      Throughout the analyses, a series of linear mixed models (LMM) were used. It was decided for LMM, as they can deal with missing data and nested structure of the data (Magezi, 2015). First, repeated measurements of individuals (ID) over time were indicated to inform SPSS about the use of longitudinal data. This way, it was possible to receive Estimated Marginal (EM) means for the measurement points and participants. The Repeated Covariance Type of First-order autoregressive AR(1) was used for all LMMs. This covariance type was selected based on the fact that it assumes that measurements are correlated within person and that timely close measurements are stronger correlated.

      The first research question, concerning the variation of depressive symptoms over time, was measured with the visual analogue scale of depressive symptoms. Hereby, three steps were taken. First, the average daily depressive state was marked as the dependent variable (DV) with the fixed independent factor 'days'. This served the analysis of an EM mean in the depressive state per day of all participants. In this context, post-hoc Least Significant Difference (LSD)

tests were done to examine differences in depression between time-points. In a second model, the average daily depressive state was again set as the dependent variable and the fixed independent factor was represented as 'individuals'. This calculated the EM means in the depressive state per individual of the complete study period. The third step provided greater insight into the individual depressive states at all measurement points. In other words, it was examined how different individuals varied in their depressive symptoms over the course of all measurement points. This was done through including specifically chosen individuals as fixed independent factors, while the depressive state remained the dependent variable.

The second research question addressed the association between well-being and depressive symptoms over time. For this purpose, a total well-being score for each measurement point for each individual was created; the seven SWEMWBS items were summed and a new variable of state well-being was created. Next, the different scales of the depressive state (0-100) and the SWEMBS (7 – 35) were considered. To compare measurements from different scales and obtain standardized regression estimates, z-scores were calculated for both scales.

Afterwards, three main steps were taken. First, the dependent variable was defined as standardized depressive state, and then as standardized well-being, while the fixed independent factor was represented by the 'days'. The purpose was to create the EM mean of well-being and the depressive state per day of all individuals. Additionally, a model with standardized daily depressive scores as the dependent variable and standardized well-being as the fixed covariate was run. To indicate the strength of the association, Cohen's rule for standardized association was applied. This specifies the following associations: weak = $\beta < 0.3$; moderate = $\beta = 0.3 – 0.5$; strong = $\beta > 0.5$ (Cohen, 1988).

Second, each individual's EM mean of well-being and depressive state throughout the complete study period was analysed. Therefore, the standardized depressive state and well-being were set as the dependent variables whereas 'individuals' was the fixed independent factor.

The last step provided detailed insight into the different individual associations of well-being and depressive states across all measurement points. For this purpose, specific individuals were chosen. Those were indicated as fixed independent factors, while the depressive state and well-being represented the dependent variable.

To visualize most of these results, charts were created using the Microsoft Excel software. For most steps, graphs in terms of lines, and for one step a clustered column chart, were used. For this procedure, the EM means were copied from the SPSS output into Excel, in which they were highlighted and represented by a suitable chart.

Results

Visual Analyses: Variation of Depressive Symptoms

Mean of depressive state per day. EM mean depressive scores showed substantial fluctuations over two weeks (see Figure 2). When looking at the mean depressive scores per day and comparing them to each other, individuals appeared to report fewer depressive symptoms during the weekends and more during the week (see Figure 2). Depressive scores were at its peak on the very first day of the study, Monday. They clearly decreased on Thursday and again increased the next week on Tuesday. The lowest score of depressive symptoms was detected on Saturday of the first week. During the second week, depressive scores had its peak on Wednesday and started to decrease on Thursday. The lowest depressive score for the second week was found on Sunday. Overall, depressive symptoms seemed lower between Thursday and Monday and increased between Tuesday and Wednesday; it seemed that depressive symptoms fluctuated over the course of time with showing effects towards the end and beginning of the week (see Figure 2).

Taking the scores of the peak (first Monday) and the bottom (first Saturday) into account, a pairwise LSD test showed that the mean difference of 8.33 was significant ($p = .048$; $p < .05$). Other pairwise comparisons between measurement days were not significant. Although certain tendencies were seen towards the end and beginning of the week, the overall effect of time was not significant ($p = 0.82$).
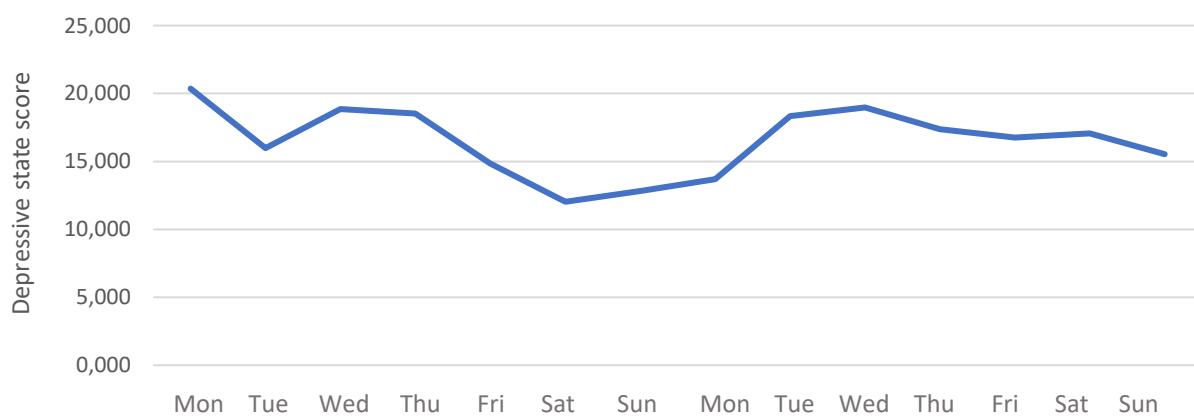
Figure 2. EM means of depressive state per day of all participants; days + 1.

Mean of depressive state per individual. Considering the EM mean depressive scores per individual, figure 3 demonstrates a great variation of average scores across individuals, which was not detectable in figure 2. Four individuals scored on average five or below on the

depressive scale. On the other hand, seven participants scored higher than 20 on average, reflecting the highest depressive EM mean scores of the data set, and 14 individuals scored in between (see Figure 3). The individuals with the lowest EM mean depression scores reported an average depressive state of one, whereas the individual with the highest mean scored 41 on the scale.

The seven individuals with the highest EM mean were analysed in more detail to gain a greater understanding of their processes and fluctuations, and to examine whether those were rather stable or variable.
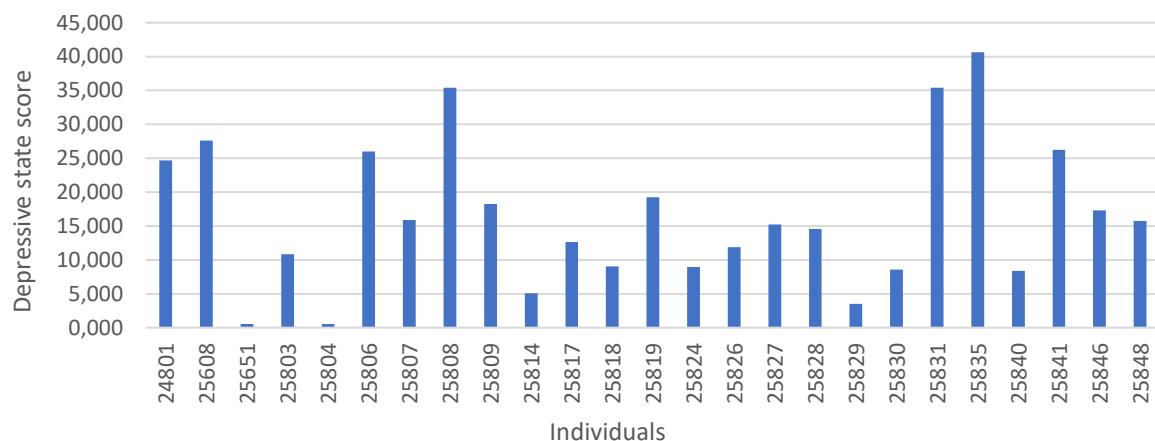
Figure 3. EM means of depressive state per individual of the complete study period.

Depressive states of individuals. For clarity, the depressive states for those seven individuals are visualized in two graphs; the first considers the three individuals with the highest EM means, the second those who had similar EM means in their depressive state level.

Generally, the interruptions of the indicated lines represent missing measurement points due to questionnaires that were not filled out (see Figure 4). Figure 4 demonstrates that depressive symptoms varied mostly between the scores 10 and 80. Participant 25831 had large variations in his depressive state, but in the second week of the study (after measurement point 21), he demonstrated more balance between the scores of 20 and 40, indicating a more stable state. Participant 25808 had no missing measurement points and indicated substantial variation between the different measurement points throughout the two weeks. Participant 25835 showed the most missing measurement points and the greatest variations in his depressive score over the measurement points, with depression scores varying from one up to 100.
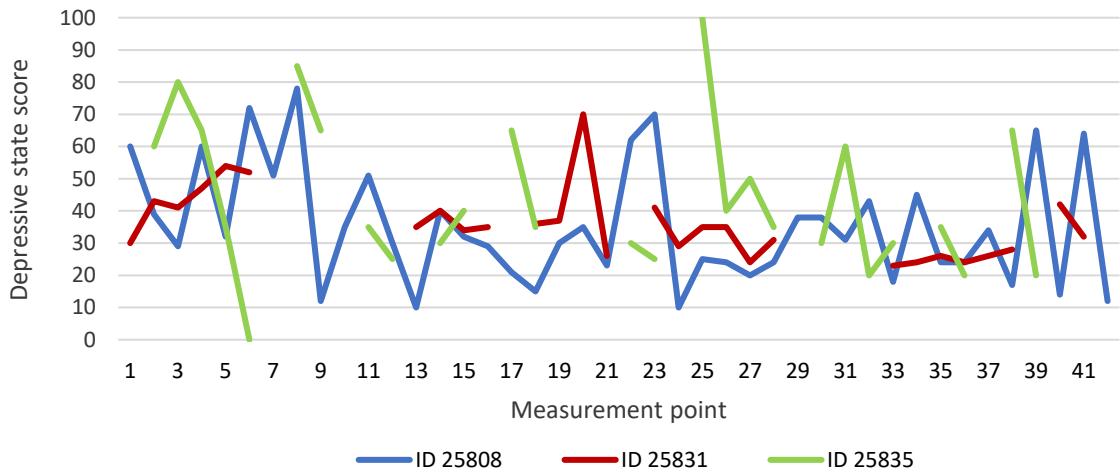
Figure 4. Individual depressive state per measurement point of the three participants with the highest EM means.

Figure 5 visualizes the four individuals with more similar depressive EM means, belonging to the seven individuals who scored on average above 20. Participant 25806 (M= 26.01) and participant 25841 (M=26.26) had almost the same EM mean, but a great difference in terms of their variation over time (see Figure 5). Participant 25806 represented the greatest variation possible – varying from no depressive mood to total depressive mood (0-100), with barely scores in between. Participant 25841 demonstrated less variation and more in between scores. Figure 5 shows that participants 25608 and 24801 had similar trends of fluctuations although they had a greater difference in their EM mean; participant 25608 (M=27.6), participant 24801 (M= 24.67). They indicated the same direction of feeling more or less depressed and had less variation.
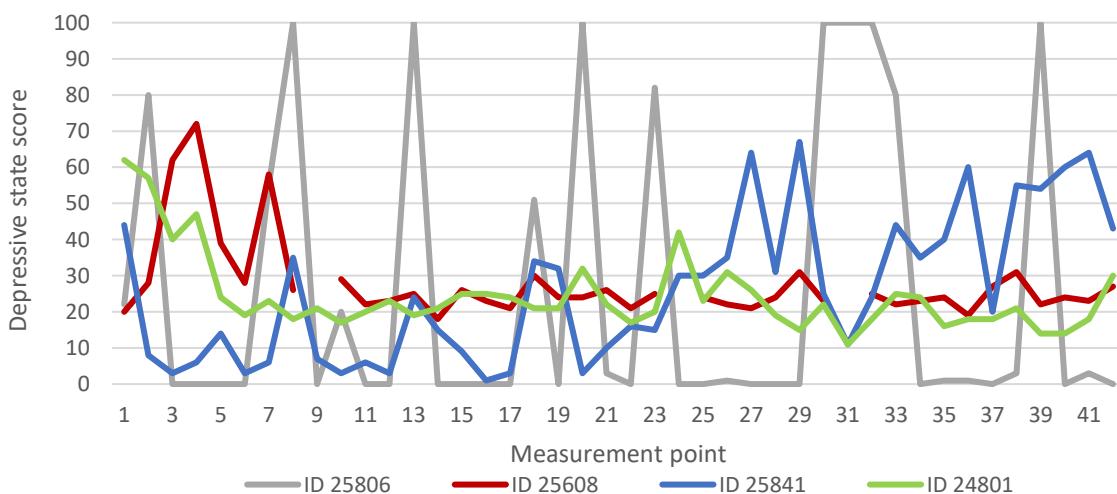
Figure 5. Individual depressive state per measurement point of the four participants with similar high EM means.

Visual Analyses: Association of Well-being and Depressive Symptoms

Mean of well-being and depressive state per day. When analysing respondents' EM mean scores over time (figure 6), a clear pattern between depressive symptoms and well-being was seen. The depressive scores decreased when the total score of well-being increased which indicated a negative association between depressive symptoms and well-being. Only day 11, 12 and 13 gave a different impression when both increased and decreased similarly.
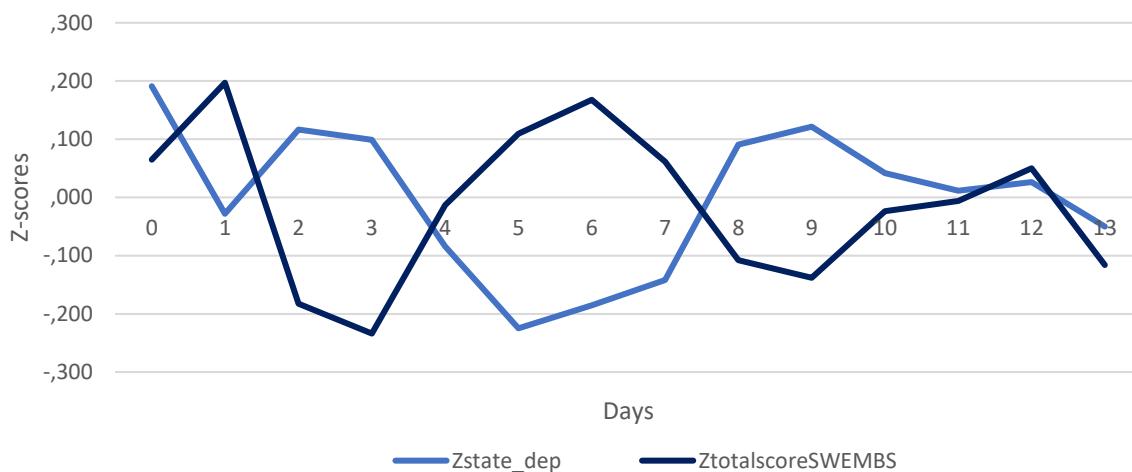
Figure 6. EM means of well-being and depressive state per day of all participants; days + 1.

To test whether the negative association seen visually was also present with a significance test, estimates of fixed effects were calculated (see Table 1). The results show that the total scores of well-being were clearly associated with depressive symptoms since the standardized association was strong and significant (β = -.59, p < .001) (see Table 1).

Table 1. Estimates of fixed effects standardized well-being on standardized depressive scores as dependent variable

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	-.01	.04	195.03	-.20	.84	-.08	.07
Z-score well-being	-.59	.03	900.15	-22.48	<.001	-.64	-.54

Mean of well-being and depressive state per individual. When comparing the EM mean scores of well-being and depressive symptoms of the individuals through the complete study period, three types of patterns are visible (see Figure 7).

A. In situation A (52% of the sample), individuals scored with depressive symptoms above and with well-being below the EM mean (and vice versa) to nearly the same extent (see Figure 7). This situation is in accordance with the overall analysis and sample average scores in figure 6; if one of the states increased, the other one decreased to approximately the same extent, indicating a clear negative association. This association was seen specifically among 13 individuals.

B. Situation B (16% of the sample) refers to individuals who clearly scored below average on one state but solely slightly above average on the other one. It shows one individual who scored slightly above the group EM mean for depressive symptoms and clearly below average on well-being. The opposite effect was visible in another individual who scored well-being slightly below the EM mean and depressive symptoms clearly above. Two other individuals scored slightly below the EM mean with depressive symptoms, but clearly above with well-being. This pattern suggested still a negative association, but with a less clear agreement between well-being and depressive symptoms.

C. Situation C (32% of the sample) demonstrates individuals whose well-being scores and depressive symptoms, both, were above average for three individuals or below average for five individuals. This indicated a positive relationship between well-being and depressive symptoms.

Overall, figure 7 shows that there were greater variations between the individuals than visible before. Some individuals showed a clear negative association, some only a weak negative association and others demonstrated a positive association between well-being and depressive symptoms.
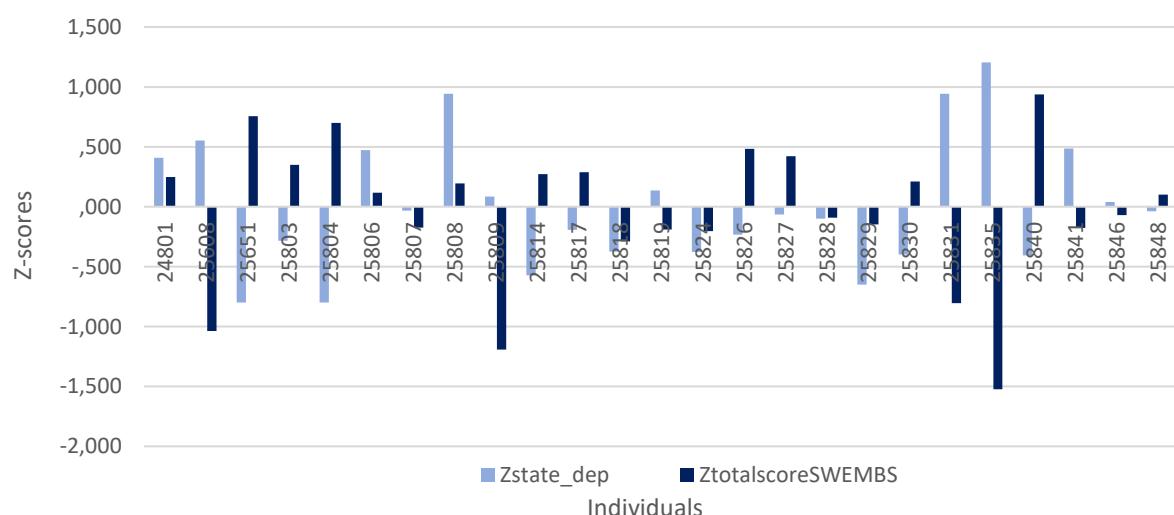

Figure 7. EM means of well-being and depressive state per individual of the complete study period.

Well-being and depressive states of individuals. Based on these situations, it was interesting to study the individual processes and fluctuations on follow-up analyses that considered the within-person level closer, trying to separate it from the overall between- and within-level analysis. Thereby, one individual was chosen for each situation. For situation A, individual 25835 (clear negative association), for situation B, individual 25841(less perfect negative association) and for situation C, individual 24801 (positive association) were examined in more detail.

A. Analysing figure 8, it is visible that individual 25835 supported a clear negative association, as the well-being and depressive symptoms were almost exactly mirrored over time; the individual showed increased depressive symptoms and to the same extent a decreased well-being. Figure 8 indicates that this individual had similar depressive and well-being scores as the mean at some moments (e.g. measurement point 6). At other times, the individual was deviating from the mean greatly (e.g. measurement points 3 and 25). Thus, this individual varied greatly in his emotions. Considering timely close measurement points, it became clear that the variation occurred from moment to moment. An example of this was detected on measurement point 23, an afternoon measurement, (24 missing) and 25, a morning measurement.
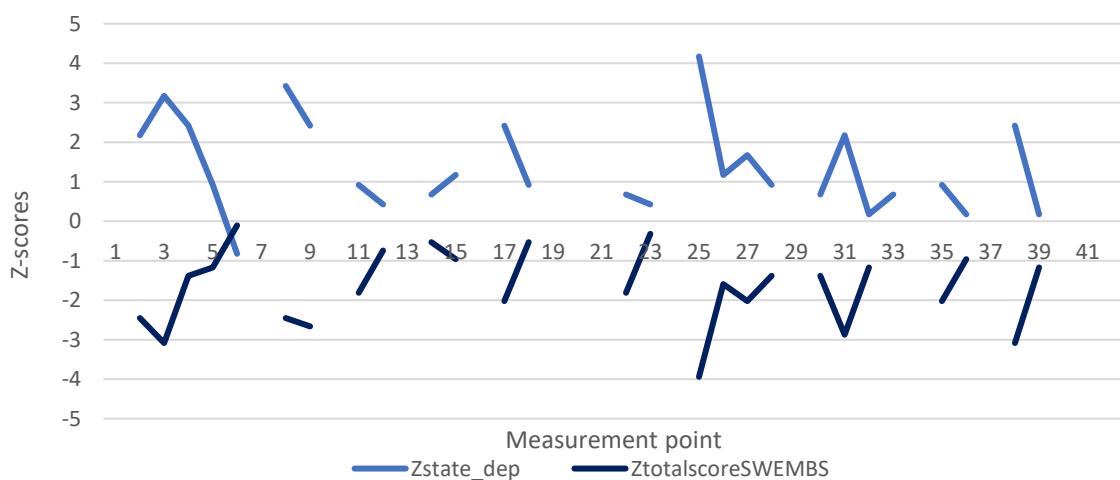

Figure 8. Well-being and depressive state per measurement point of individual 25835.

B. Individual 25841 mostly experienced a negative association, yet not as clear (see Figure 9). Although figure 7 indicates that this participant scored above the EM mean on depressive symptoms and slightly below on well-being, it can be seen that this participant also scored above the EM mean on well-being at several measurement points (e.g. 20) and below of depressive symptoms (e.g. 16). The graph indicates a great fluctuation since the individual varied sometimes from clearly above the EM mean to clearly below (e.g. measurement point 20 versus 29 or 16 versus 29). Some measurement points indicated a positive relation (e.g.

between measurement points 5 and 6).
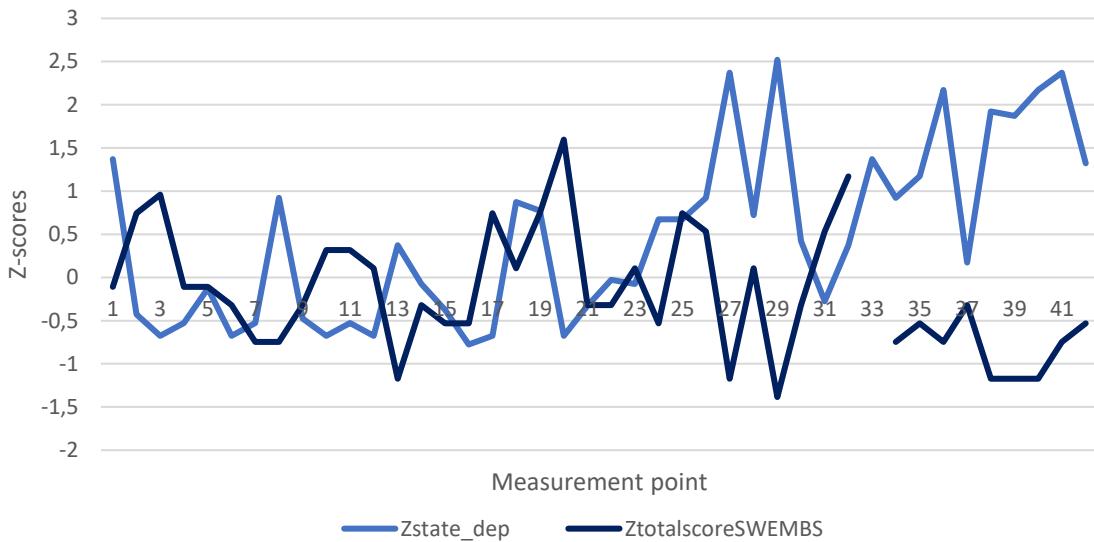
Figure 9. Well-being and depressive state per measurement point of individual 25841.

C. Lastly, individual 24801 indicated a disconnection of well-being and depressive symptoms. Figure 10 provides more insight. With exception of the first four measurement points, 15 until 17, and 42, this individual scored their well-being and depressive state in the same areas over time. Considering, this individual seemed to be quite stable with only a few fluctuations. The indicated EM mean of this person (see Figure 7) seemed to be representative of its actual emotional state. The few fluctuations represented different forms of association; a negative association (e.g. 1 – 5), a positive association (e.g. 25 – 27) and no association (e.g. 34 – 39).
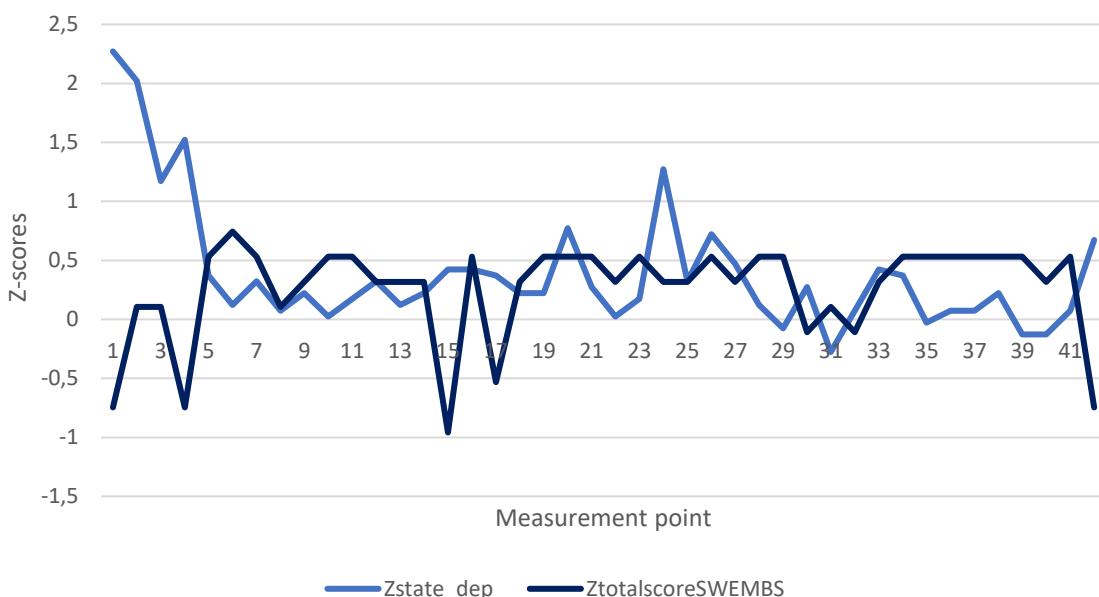
Figure 10. Well-being and depressive state per measurement point of individual 24801.

Discussion

The present study aimed to determine how depressive symptoms vary and how well-being and depressive symptoms are associated among university students over the course of two weeks. This is a timely topic since approximately one-third of university students experience depression (Ibrahim et al., 2013). One of the most relevant findings was the great variation in depressive symptoms between and within the studied university students. Additionally, a strong negative association between well-being and depressive symptoms was found at the group level. Further analyses demonstrated, however, that the majority of the people showed a clear negative association, but others only a weak negative, positive or disconnected association. Generally, the findings regarding both research questions confirmed that variations in depression and the association with well-being at the within-person level may vary considerably, supporting the use of ESM type studies to examine well-being and depressive symptoms in students in more detail.

Taking a closer look at the variation of depressive symptoms among university students over the course of two weeks, several notable findings were detected. The variation of depressive symptoms varied greatly over time. Depressive symptoms seemed to be lower between Thursday and Monday and higher between Tuesday and Wednesday. This could be due to higher work load during the weekdays. One significant difference existed in the first week between Monday and Saturday. However, the overall effect of time was not significant at the group level. Thus, the hypothesis that depressive symptoms are significantly higher on certain days than on others and that individuals are less depressed on weekends was only partly supported.

When analysing the individual means of depressive states, a significant variation of average scores was detected. This suggested that the overall group means may not necessarily provide an accurate picture of each individual although the within levels were already incorporated. Further analysis confirmed this realisation considering more closely the within-individual processes and showed that individuals had their very own patterns of variations between different measurement points. Some individuals experienced substantial variations from very low depressive symptoms to very high depressive symptoms, whereas other individuals indicated more stability in depressive symptoms, and that yet both could be described with a very similar mean. This finding is in line with Hoffman (2015) who suggested that two individuals may have the same mean in mental health although one has great fluctuations whereas the other indicates barely any fluctuations. The current study also

demonstrated that different individuals showed deviating means but presented a similar trend in the variation of depressive symptoms – these individuals had differences in their depressive scores, but the way these increased or decreased was similar. This may suggest that, although their depressive level generally differed, their way of increasing or decreasing in the variation of depressive symptoms was similar.

The outcomes of the analysis concerning the association of well-being and depressive symptoms differed. The study found a clear negative association of well-being and depressive symptoms at the group level: depressive scores decreased when well-being increased and vice versa. This is in line with previous research that suggested a negative relation between these constructs (e.g. De Coninck, 2019; Kaczmarek, 2015; Lagnado et al., 2017; Zheng, 2016). The findings of the current study are also consistent with those of Zheng (2016) who indicated that well-being and depression in university students are negatively correlated. The dual-continua model of mental health suggests that individuals can experience high mental health while being diagnosed with a mental illness (Iasiello, van Agteren, & Muir-Cochrane, 2020). It further suggested that positive and negative affects are independent from one another (Iasiello et al., 2020). The clear negative association of well-being and depressive symptoms at the group level in this study, first seemed to disagree with those findings, indicating that they are not independent from one another. However, the follow-up analyses support the dual-continua model of mental health in the end. Importantly, the dual-continua model suggests that ''more complex interactions may be occurring at the individual level'' (Iasiello et al., 2020, p.11). For example, the dual-continua model would suggest that a high level in well-being does not indicate an absence of depressive symptoms. This is in line with the results of this study.

Follow-up analyses suggested that the clear negative association between well-being and depressive symptoms is mostly apparent at the between level. More in-depth analyses showed that approximately half of the people demonstrated a clear negative, some a weaker negative and others a positive association or even a disconnection between well-being and depressive symptoms. This seems to encourage the hypothesis that the between-level associations do not necessarily translate to within-level associations between well-being and depressive symptoms for all people. This finding is also supported by literature that indicated that the results of the two levels may differ (Hamaker, 2012; Yearick, 2017). Additionally, Hamaker (2012) indicated that within-levels can show different patterns for different individuals, which seems to support the findings of this study.

To understand those different patterns, the associations between well-being and depressive symptoms among specifically chosen individuals over the course of all measurement

points were examined in more detail. Hereby, similar findings to the follow-up analyses of depressive symptoms were demonstrated. It was found that a mean may, but more likely may not, truly represent individual depressive symptoms and its association with well-being. Some individuals had mostly stable depressive symptoms and well-being, thus showed less variation around their mean, whereas others experienced great fluctuations from moment to moment.

The latter finding supports previous literature, which acknowledges that it is normal to encounter fluctuations in one's mood (Watson, 2000). The current study demonstrated that individuals fluctuate in terms of well-being and depressive symptoms, that some individuals fluctuate more and some less than others, and that it is important to realize that an individual who is higher in well-being than another person also experiences depressive moods. This is in line with Kuppens, Stouten, and Mesquita (2009) who pointed out that to understand a person, it is necessary to consider their emotions and the fluctuations within such. With understanding a person, it is referred to learning the processes that are on-going within that person; the processes within people can differ even if their mean on well-being for example was similar. Therefore, to reach awareness of individual differences, it is crucial to learn about within-personal processes (Curran & Bauer, 2011).

This element refers to one of the strengths of this study. The intensive longitudinal design and the use of the experience sampling method enabled research that could in fact consider the within-personal level besides the between-personal level, thus guaranteed a more in-depth analysis, considering the fluctuations and variations within the individuals. This contrasts with cross-sectional studies that consider only between-person associations. It is remarkably common to misinterpret the results in those studies and make incorrect conclusions from one level to another (Kievit, Frankenhuis, Waldrop, & Borsboom, 2013). In other words, cross-sectional studies are only able to draw conclusions on the between-person level. Nonetheless, the outcomes of a study are often translated to the within-person level. Hereby, it is wrongly assumed that the associations are compatible. The directions of the associations may be opposite to one another on different levels. In fact, an association may be positive on the between-person level, e.g. of a population, but negative on the within-person level, e.g. individuals belonging to that population (Kievit et al., 2013; Yearick, 2017). This interpretation is known as Simpson's paradox (SP) (Kievit, et al., 2013). Thus, to avoid the pitfall of Simpson's paradox, it was a strength of this study to analyse the data on within-person levels.

However, it is crucial to be aware that the LMM analyses within this study did not conduct two separate analyses of between- and within-person levels in that sense but already considered and mixed the effects of those associations. Mixing both levels is an advantage of

LMM analyses since conclusions can be drawn to within levels and was the reason why it was chosen for this study in the first place. Therefore, the follow-up analyses in this study gave an impression and got close to separating the two levels and strengthened once more that within level differ from between levels, but did not follow a statistical procedure for specifically separating between- and with-person level effects.

Since differences between those levels became however apparent, it could be interesting to use statistical approaches that actually do separate between and within person effects in LMM for future researches. Such could be reached through using a person-mean centring strategy, which is seen as a valid and best method for this purpose (Curran & Bauer, 2011). On one hand the person-mean score (mean of all measurement points of each person) needs to be calculated for the between-person effect. On the other hand, the person-mean centred score (deviation from the person-mean at each measurement point) is assessed for within-person effects (Curran & Bauer, 2011). This strategy could report differences and relations of between-person and within-person levels. In other words, those analyses allow a statistical disaggregation between the two levels (Curran & Bauer, 2011). This is an advantage in deepening understanding and awareness of how exactly those levels differ.

Another strong point of this study refers to the high response rate of the participants. A review of experience sampling method studies revealed that, on average, the response rate of all invited participants is approximately 63% and the response rate within people during the study is approximately 80% (Yearick, 2017). This current study, however, demonstrated a response rate of all invited participants of 83%, and a response rate during the study within people of 86%. Thus, in comparison to other EMS studies, this study was determined by a high response rate. A factor that may have influenced the high attendance could be the good functionality of the Ethica app. The questionnaires were released for each measurement point, thus no technical difficulties appeared and the reminders that were sent to the phone seemed to have worked throughout the entire study period. Besides, the fixed timing schedules may have contributed to such a high response rate since the participants could plan it actively in their daily schedule. Additionally, the researchers knew the participants personally which may have contributed to the high response rates. The participants may have felt more motivated to participate in the study.

However, this strong point also approaches one limitation of the study, referring to the convenience sampling through which the participants were recruited. The main limitation of this sampling method is the great likelihood of biases, such as the selection bias (Etikan, et al., 2016). The current sample could for example be biased in terms of the cultural background

since a great majority was of German nationality due to the connections of the researchers. People from different cultures may interpret depressive symptoms or the presence of such in another way. Additionally, the sample could be biased in terms of the mental health of the participants; the researchers may have carefully picked the participants in terms of their mental conditions to guarantee that acquaintances with a known general lower level of depressive symptoms do not get triggered by this study. Yet, this idea needs to be considered carefully, as the researchers can in no way be aware of the actual mental health of each participant. Considering the possible biases, this recruitment method is not the best representation of a population (Etikan et al., 2016).

Thus, it is important to note that the findings of this study should not be extrapolated to the general population. This is necessary to address since the findings refer to a highly educated population representing a rather homogeneous sample with the same age range in university students. Different age ranges may demonstrate different outcomes in variations and fluctuations of well-being and depressive symptoms within and between individuals. However, the general population was not of interest for this study, since the focus was solely meant to be set on university students.

Further, it is essential to bear in mind that the data for this study were collected in the first weeks of the Corona Virus crisis (COVID-19) and its countermeasures. Those measures meant being severely socially restricted in one's social life. It was required to keep a physical distance to others, travel restrictions were given, and most facilities were closed. People were advised to stay at home as much as possible. Considering that this study took place in the first few weeks of those measurements, it not only meant for participants to deal with those circumstances, but also to adapt to them in the first place. Adapting to the situation required additionally to change one's awareness and understanding of a certain situation and adapt one's actions. Possible biases in the responses to the study may have existed. One could assume that depressive symptoms may have been higher due to those circumstances and well-being lower than usual. However, as this study was not interested in absolute levels of well-being and depressive symptoms, but in associations, the question arises whether this situation affected the form or strengths of the associations. The association could be negative regardless, but could also differ under different circumstances; for instance instead of a negative association between well-being and depressive symptoms, research could find an absent or positive one. This can not be calculated. Nonetheless, it is important to be aware of the general situation.

For further research, it might be interesting to examine the role of individuals' coping mechanisms and the links between experiencing well-being and depressive symptoms more

closely, such as how individuals regulate their emotional state. For instance, a study by Kraiss, ten Klooster, Moskowitz, and Bohlmeijer (2020) focused on examining the link between well-being and emotion regulation. It has been indicated by literature that well-being serves as a 'balance point' between experienced confrontations and one's capabilities of handling those (Dodge et al., 2012). Thus, a greater focus on coping mechanisms could produce interesting findings on that balance point, add new insights on the within-individual processes and strengthen the focus of such, apart from their variations and associations of well-being and depressive symptoms. This could be studied by asking the participants to indicate how they have coped with their emotions since the previous daily questionnaire.

Such questions could not only help in understanding the processes utilizing ESM as an observational tool, but also as an interventional tool. In fact, it could support the participants in becoming consciously more aware of their emotions, behaviour, and coping mechanisms. ESM as an intervention tool could support individuals to seek a balance point (Verhagen, Simons, Van Zelst, & Delespaul, 2017). Participants may get motivated to be attentive towards their behaviour after a questionnaire and consider whether they experienced for example an increase in well-being. This could help to improve their overall well-being since they may be motivated to adjust certain behaviour once a pattern is realized. ESM interventions (ESM-I) gain detailed insight into a target group (Kramer et al., 2014). They consider hereby personal patterns and the context and are thus tailored to the individuals. Several ESM-I have been created, also concerning depression or depressive symptoms (e.g. Kramer et al., 2014; Simons et al., 2017). Kramer et al. (2014) pointed out that some experienced an association between ESM-I and less depressive symptoms. Studies demonstrated that participants benefitted from feedback through the intervention. As a result, this led to possible changes in behaviour (Kramer et al., 2014).

Hence, future research should focus more on interventions based on within-person analyses, such as ESM-I. Since different processes occur within individuals, people have different needs. To make interventions most effective, it is essential that they meet the needs of the individual people and not of the population as a whole. And in order to recognize the different processes, and thus needs, it is important to conduct within-person analyses. The interventions would be more detailed and thus, reach greater effectiveness in tackling the problem.

Concluding, one of the most significant findings to emerge from this study is that through examining well-being and depressive symptoms using a combination of between- and within-person levels, conclusions can be drawn to the general population as well as to the more individual level. Although the general analysis indicated a negative association of well-being

and depressive symptoms, already considered and combined both levels, more detailed within-person analyses established that some people experienced also a positive association or disconnection between well-being and depressive symptoms. Additionally, this study demonstrated that even when considering both levels, group means might not be representative to the individuals' actual processes. Overall, this study demonstrated that considering also within-person levels is beneficial in several ways. As a take-home message from this study and previous research, it can be referred back to the quote of the beginning, supporting the importance of considering fluctuations within individuals to study the people instead of simply the population: "Well-being is not a beach you go and lie on. It's sort of dynamic dance and there's movement in that all the time and actually it's the functuality [*sic*] of that movement which actually is true levels of well-being" (Dodge et al., 2012, p.230).

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Appendices

Appendix A: Baseline Questionnaire.

SWEMWBS: Q#6-Q#12, HADS: Q#13-Q#26, PSS: Q#27-Q#36, GSE: Q#37-Q#46)

(Q#1): How old are you?

(Q#2): Please indicate your gender
○ Male ○ Female ○ Other

(Q#3): What is your nationality?
○ Dutch ○ Australian
○ German ○ Other

(Q#4): What is the highest degree or level of school you have completed? *If currently enrolled, mark the highest degree already received.*
○ High school graduate ○ Bachelor's degree
○ Master's degree ○ Doctorate degree or higher
○ Other

(Q#5): If you are currently enrolled as student, what is your field of study?
○ Social sciences ○ Natural sciences
(e.g. psychology, sociology, economics (e.g. biology, physics
social work or political sciences) or chemistry)
○ Medical sciences ○ Computer science
○ Mathematics or statistics ○ Arts
○ Law ○ Philosophy
○ Theology ○ Other
○ Not applicable, I am currently not enrolled as student

Below are some statements about feelings and thoughts. Please tick the box that best describes your experience of each **over the last week.**

(Q#6): I've been feeling optimistic about the future
○ None of the time ○ Rarely
○ Some of the time ○ Often
○ All of the time

(Q#7): I've been feeling useful
○ None of the time ○ Rarely
○ Some of the time ○ Often
○ All of the time

(Q#8): I've been feeling relaxed
○ None of the time ○ Rarely
○ Some of the time ○ Often

    ○   All of the time

(Q#9): I've been dealing with problems well
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#10): I've been thinking clearly
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#11): I've been feeling close to other people
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#12): I've been able to make up my own mind about things
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

Tick the box beside the reply that is closest to how you have been feeling **in the past week.** Don't overthink - your immediate is best

(Q#13): I feel tens or 'wound up'
- ○ Most of the time   ○ A lot of the time
- ○ From time to time, occasionally   ○ Not at all

(Q#14): I still enjoy the things I used to enjoy
- ○ Definitely as much   ○ Not quite as much
- ○ Only a little   ○ Hardly at all

(Q#15): I get a sort of frightened feeling as if something awful is about to happen
- ○ Very definitely and quite badly   ○ Yes, but not too badly
- ○ A little, but it doesn't worry me   ○ Not at all

(Q#16): I can laugh and see the funny side of things
- ○ As much as I always could   ○ Not quite so much now
- ○ Definitely not so much now   ○ Not at all

(Q#17): Worrying thoughts go through my mind
- ○ A great deal of the time   ○ A lot of the time
- ○ From time to time, but not too often   ○ Only occasionally

(Q#18): I feel cheerful
- ○ Not at all   ○ Not often
- ○ Sometimes   ○ Most of the time

(Q#19): I can sit at ease and feel relaxed
- ○ Definitely
- ○ Usually
- ○ Not often
- ○ Not at all

Tick the box beside the reply that is closest to how you have been feeling **in the past week.** Don't overthink - your immediate is best

(Q#20): I feel as if I am slowed down
- ○ Nearly all the time
- ○ Very often
- ○ Sometimes
- ○ Not at all

(Q#21): I get a sort of frightened feeling like 'butterflies' in the stomach
- ○ Not at all
- ○ Occasionally
- ○ Quite often
- ○ Very often

(Q#22): I have lost interest in my appearance
- ○ Definitely
- ○ I don't take as much care as I should
- ○ I may not take quite as much care
- ○ I take just as much care as ever

(Q#23): I feel restless as if I have to be on the move
- ○ Very much indeed
- ○ Quite a lot
- ○ Not very much
- ○ Not at all

(Q#24): I look forward with enjoyment to things
- ○ As much as I ever did
- ○ Rather less then I used to
- ○ Definitely less than I used to
- ○ Hardly at all

(Q#25): I get sudden feelings of panic
- ○ Very often indeed
- ○ Quite often
- ○ Not very often
- ○ Not at all

(Q#26): I can enjoy a good book or radio or TV program
- ○ Often
- ○ Sometimes
- ○ Not often
- ○ Very seldom

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, please indicate how often you felt or thought a certain way.

(Q#27): In the last month, how often have you been upset because of something that happened unexpectedly?
- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often

(Q#28): In the last month, how often have you felt that you were unable to control the important things in your life?
- ○ Never
- ○ Almost never
- ○ Sometimes
- ○ Fairly often
- ○ Very often

(Q#29): In the last month, how often have you felt nervous and "stressed"?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

(Q#30): In the last month, how often have you felt confident about your ability to handle your personal problems?

- Never
- Almost never
- Sometime
- Fairly often
- Very often

(Q#31): In the last month, how often have you felt that things were going your way?

- Never
- Almost never
- Sometime
- Fairly often
- Very often

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate by circling how often you felt or thought a certain way.

(Q#32): In the last month, how often have you found that you could not cope with all the things that you had to do?

- Never
- Almost never
- Sometime
- Fairly often
- Very often

(Q#33): In the last month, how often have you been able to control irritations in your life?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

(Q#34): In the last month, how often have you felt that you were on top of things?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

(Q#35): In the last month, how often have you been angered because of things that were outside of your control?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

(Q#36): In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

- Never
- Almost never
- Sometimes
- Fairly often
- Very often

The following statements describe people's feelings and reactions to various situations. Please read each statement carefully and indicate the extent to which you agree with each statement.

(Q#37): I can always manage to solve difficult problems if I try hard enough

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#38): If someone opposes me, I can find the means and ways to get what I want

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#39): It is easy for me to stick to my aims and accomplish my goals

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#40): I am confident that I could deal efficiently with unexpected events

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#41): Thanks to my resourcefulness, I know how to handle unforeseen situations

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

The following statements describe people's feelings and reactions to various situations. Please read each statement carefully and indicate the extent to which you agree with each statement.

(Q#42): I can solve most problems if I invest the necessary effort

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#43): I can remain calm when facing difficulties because I can rely on my coping abilities

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#44): When I am confronted with a problem, I can usually find several solutions

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#45): If I am in trouble, I can usually think of a solution

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

(Q#46): I can usually handle whatever comes my way

- ○ Not at all true
- ○ Hardly true
- ○ Moderately true
- ○ Exactly true

Appendix B: Daily Questionnaires (Morning, Afternoon, Evening).

(Q#1):   How   anxious   do   you   feel   right   now?

0: Not anxious at all   100: Extremely anxious

(Q#2):   To   what   extent   do   you   feel   down   right   now?

0: Not down at all   100: Extremely down

Below are some statements about feelings and thoughts. Please tick the box that best describes your experience of each **over the past 2 hours**

(Q#3): I've been feeling optimistic about the future
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#4): I've been feeling useful
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#5): I've been feeling relaxed
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#6): I've been dealing with problems well
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#7): I've been thinking clearly
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#8): I've been feeling close to other people
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#9): I've been able to make up my own mind about things
- ○ None of the time   ○ Rarely
- ○ Some of the time   ○ Often
- ○ All of the time

(Q#10): Who did you spend time with **within the last 2 hours**? *(select the one category of people that you personally feel most connected to if you spent time with multiple people)*
- ○ Partner   ○ Close friend(s)
- ○ Family member(s)   ○ Acquaintances (e.g., colleagues / fellow students)
- ○ This does not apply, I was by myself

(Q#11): How did this contact take place?
- ○ Outside home, in person   ○ At home, in person
- ○ Online (electronic devices)   ○ This does not apply, because I was by myself

(Q#12): Since the last time you answered a questionnaire for this study, has there been any event that caused you stress?
- ○ No   ○ Yes

(Q#13): How stressful was this event for you?
(if there were several events that caused you stress, please think of the event that caused the most stress)
- ○ A little bit stressful   ○ Moderately stressful
- ○ Stressful   ○ Very stressful

(Q#14): How much control did you have over the situation?
- ○ None at all
- ○ A little bit
- ○ Some
- ○ A lot

(Q#15): What was the stressful event about? Please choose the category which you think is fitting best.
- ○ Argument or disagreement with anyone (e.g., arguing with someone)
- ○ Work or study related event (e.g., working on assignment, finding out about exam results)
- ○ Home related event (e.g., expensive utility bill)
- ○ Health related event (e.g., finding out about health issue)
- ○ Event related to COVID-19 (e.g., self-isolation)
- ○ Other event not listed

(Q#16): Please specify, if you answered '*Other event not listed*' on the previous question. Otherwise, you can leave this box empty.

Appendix C: Informed Consent.

Dear participant,

Thank you for your participation in this study. Before you participate, it is important that you understand the goal of this research and what the study will ask from you. The purpose of this study is to find out how different components of mental health are related to each other. To explore this relationship, we want to measure fluctuations in mental health in daily life to gather a more detailed picture of the dynamics of mental health.

For this study, we will ask you to fill in several questionnaires on your mobile phone. All questionnaires will be completed in the Ethica app. The study will start with a questionnaire concerning your demographics and general mental health. This initial questionnaire will take about 10 minutes to complete. After that, you will receive three daily (short) questionnaires each day for a period of two weeks. Notifications will remind you about the next questionnaire. The questionnaires will be provided in the morning, afternoon and evening. One daily questionnaire takes approximately 2 minutes to complete.

For the purpose of this study, it is important that you answer the questionnaires as soon as possible after the notification. Make sure that you have switched on your notifications for the Ethica app on your mobile device, as you will receive a notification on your mobile device when to fill in the questions. We would also like to ask you to regularly check the Ethica application to see whether new questionnaires to answer are ready.

The information that we collect from this research project will be kept confidential. This means that only the researchers have insight into your answers. All personal data (such as age, gender etc.) will be anonymized and will not be published and/or given to a third party. Also, for the researchers it will not be possible to determine which data belongs to which participant. Your participation in this study is voluntary. You are free to withdraw from this study at any time and without giving a reason.

Contact information

If you have any questions regarding this study, you can contact the principal investigators of this project Sina Völker (s.volker@student.utwente.nl) and Jonas Möller (j.moller@student.utwente.nl).

Consent

I have read and understood the information provided and had the opportunity to ask questions. I understand that my participation is voluntary and that I am able to withdraw at any time, without a reason or cost. I hereby voluntarily agree to take part in this study.