How Are You Feeling Right Now?

Measuring Gratitude and Stressful Events in Students' Daily Life

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Abstract

Background: Gratitude is shown to counteract various negative health outcomes assigned to stress. Previous cross-sectional studies have investigated this relationship and found a negative association between average gratitude and average stress. Many of those studies merely focused on between-person (trait-like) associations and did not measure within-person (state-like) associations. However, this distinction is crucial, as observations made at a between-person level cannot simply be inferred to a within-person level. There is a research gap regarding the association between stress and gratitude at a trait level as well as state level in undergraduates. **Objective**: The current study aimed to explore the association between stress and gratitude at the trait and state levels. It was further investigated whether participants scoring high and low on trait gratitude show different patterns in their within-person association between state stress and state gratitude. **Method**: For the study, the experience sampling method, a structured and repeated online assessment was used. To measure trait levels of gratitude, the Gratitude Questionnaire Six-Item Form (GQ-6) was utilized. To measure the state levels of stress and gratitude, a survey was created, containing five modified items in total. Those were sent for eight days, three times a day. **Results**: Trait and state levels of gratitude were significantly and positively related to each other. Additionally, measures of state gratitude and state stress showed a weak, negative association. With further analysing this relationship it became apparent that there is no significant association between state stress and momentary as well as average levels of gratitude. A cluster analysis suggested two clusters, those scoring high and those scoring low on trait gratitude. Within the second cluster, a significant, negative within-person association could be found between state stress and state gratitude. **Conclusion**: Most of the stated hypotheses could be confirmed, except for the distinction between average and momentary gratitude on stress. It can be concluded that especially university students scoring low on trait gratitude would benefit from strengthen both, state and trait gratitude to counteract the impact of stress which can be related to university workload. Further research is needed, to properly investigate the concepts in a more diverse sample.

Keywords: Experience Sampling Method, ESM, stress, gratitude, within-person association, between-person association, state, trait

Everyone experiences some form of stress at various points in their lives. Stress can be experienced in form of minor daily hassles which might include misplacing or losing certain things or arguing with a family member (Chamberlain, & Zika, 1990). In comparison, stress can also show in the form of major life events which can involve the loss of a loved one or divorce (Lazarus, 1999). Major life events are considered to be more severe and mostly outside of the control of the individual (Tessner, Mittal, & Walker, 2011). Moreover, some people get impacted heavily by seemingly minor hassles, whereas others are able to deal adequately with major life events. The resulting consequences of stress can heavily impact individuals to a varying extent (Harkness & Hayden, 2020). Studies show that prolonged stress generally leads to undesirable health outcomes such as obesity, increased risk for cardiovascular disease, and heightened cortisol levels (O'Connor, Thayer, & Vedhara, 2021) as well as somatic health complaints including fatigue, back pain, or sleeping difficulties (Verkuil, Brosschot, Meerman, &Thayer, 2012). Furthermore, frequent and high levels of stress are among one factor which may facilitate the onset of psychiatric disorders such as schizophrenia (Tessner, Mittal, & Walker, 2011), depression and anxiety disorders (Niedhammer, Malard, & Chastang, 2015) as well as substance use disorder (Keyes, Hatzenbuehler, Grant, & Hasin, 2012).

Nevertheless, there are concepts in the positive psychology domain that are shown to counteract the negative health outcomes just described (Bohlmeijer & Westerhof, 2021). One of those is the emotion of gratitude which can have numerous positive health impacts. Those can contain a reduced risk for clinical psychopathologies such as depression, general anxiety disorder, and a lower risk for developing eating disorders (Wood, Froh, & Geraghty, 2010). Besides, gratitude also leads to better physical health (Hill, Allemand, & Roberts, 2013), increased sleep quality, and better overall mood (Mills et al., 2015).

Gratitude

Within the domain of positive psychology, the concept of mental well-being has a high value. As Bohlmeijer and Westerhof (2021) argue, it is equally important to focus on a patients' mental health and well-being as it is to focus on their ill-being. Hence, the absence of psychopathology does not automatically imply that an individual is functioning properly, and consequently, it is crucial to

strengthen one's mental well-being. The researchers describe a buffering effect of well-being which can act against mental disorders such as depression or anxiety. They further argue, that especially positively experienced emotions have a strong association with buffering against psychopathology (Bohlmeijer & Westerhof, 2021).

According to Wood et al. (2010), gratitude refers to a feeling of understanding positive things in life in a habitual way. They define gratitude as "part of a wider life orientation towards noticing and appreciating the positive in the world" (Wood et al., 2010, p. 891). This includes for instance focusing on positive aspects in a present moment, feelings of appreciation when encountering nature as well as recognition of people around in a positive way. This definition implies that gratitude is seen as a trait, which indicates a stable characteristic in individuals. Nevertheless, gratitude can also be defined at a state level, operating within individuals. Hence, feelings of gratitude are shown to change across the day or might be influenced by certain situations. This further implies that the feeling of gratitude itself might vary during the day (Krejtz, Nezlek, Michnicka, Holas, & Rusanowska, 2016).

Various studies explored the effect of expressed gratitude in individuals. For instance, Cunha, Pellanda, and Reppold (2019) investigated the general influence of gratitude interventions on adults' well-being and mental health with a randomized clinical trial. They concluded that gratitude interventions had a positive effect on happiness levels within individuals as well as an increase in life satisfaction. Moreover, gratitude showed to counteract negative affect and depressive symptoms in individuals (Cunha, Pellanda & Reppold, 2019). Another study by Nezlek, Krejtz, Rusanowska, and Holas (2019), examined state levels of gratitude within people. More specifically, they investigated individual innate levels of gratitude and resulting levels of well-being on a daily basis in a sample of adults (Mean age=36.9). They concluded a replication of previous findings in the way that a higher level of gratitude predicted higher overall well-being each day (Nezlek, Krejtz, Rusanowska, & Holas, 2019). Additionally, gratitude is also shown to have a positive effect on individuals' social support system. As more grateful individuals tend to appreciate social settings in general, they in turn are more likely to perceive actual support as more valuable and altruistic (Wood, Maltby, Gillett, Linley, & Joseph, 2008). When looking at previous studies, it becomes apparent that few studies investigate the association between the trait and state levels of gratitude in the target group of university students, as studies mainly

explored the relationship in adult samples. Hence, by assessing trait levels of gratitude in undergraduates and associating them with average state level measurements of the same over a longer period, it can be examined to what extent trait levels might predict state levels of gratitude.

Stress

McEwen (2010) defined stress in general as "a real or interpreted threat to the physiological or psychological integrity of an individual that results in physiological and/or behavioural responses" (p.11). Hence, stress can be differentiated between stressors in the individual's environment, which refer to the experienced threat, as well as the way the individual responds to that stressor (Harkness & Monroe, 2016). More specifically, threats might include physical ones, such as injuries or traumas, as well as high or low temperature or exceeding noise (McEwen, 2010). Nonetheless, threats can also be of psychological nature. Hence, they can include time-pressuring tasks, situations of conflict with others, or feelings of frustration regarding certain events. Furthermore, stressful situations, or stressors, are described as demands or expectations from one's environment which exceed the capabilities to cope with those demands (Fink, 2016).

In terms of thinking about this stressful context, it seems that daily life stressors have in general more impact on individuals' mental health compared to major stressful life events (Almeida, 2005). This is resulting from the claim that major stressful life events can be viewed as relatively rare compared to daily hassles in one's life (Almeida, 2005). Hence, it is of importance to appropriately capture those daily life stressors and to examine the impact they can have on peoples' life. Previous studies showed that it is beneficial to assess those stressors in repeated measurements on a daily basis (Almeida, 2005). In that way, researchers can capture the whole extent of stressful events over several days and might be able to intervene at a given point in the future to reduce the impact of those events. Additionally, it is especially valuable to examine stress at the within-person level, as stressful events are generally perceived as highly subjective and hence, affect individuals to varying extents (Fink, 2016). In this way, some individuals might be more susceptible to stressful events in their lives (Almeida, 2005).

Based on that susceptibility, literature shows that prolonged stress generally leads to various negative outcomes within individuals. Specifically, evidence suggests that stress can lead to feelings of

anxiety and fear, as well as the development of mental disorders such as depression or phobias (Fink, 2016). Moreover, one study by Neveu et al. (2012) investigated perceived stress levels among university students. The researchers compared different study programmes in relation to stress risk factors and coping strategies. They concluded that high perceived risk is especially prevalent in study programmes of medicine and psychology. Here, especially students with high trait anxiety were more vulnerable to perceive higher levels of stress (Neveu et al., 2012).

Another factor that currently might influence stress levels in people is the Covid-19 pandemic. Husky, Kovess-Masfety, and Swendsen, (2020) investigated the impacts of Covid-19 on students' mental health. Specifically, they examined students' stress levels in relation to the confinement measures taken by the French government. The results showed that students generally reported higher stress levels as well as an increase in anxiety. Nevertheless, those findings showed limitations in ways of not adjusting for possible other factors, such as financial resources or family situations (Husky, Kovess-Masfety, & Swendsen, 2020). Another study by Pan et al. (2021) examined the impact of Covid-19 on a sample of individuals with mental illnesses. Interestingly, their findings suggested that people with severe mental health disorders experienced fewer symptoms, whereas feelings of loneliness, anxiety, and worrying increased in people with less severe mental health disorders as well as in people without any mental health disorders. These findings imply that not only people with mental health disorders suffer from the implications of the Covid-19 pandemic, but also those who can be considered as more stable individuals. Hence, it becomes apparent that it is important to also assess how people without mental health issues might be affected by stressful contexts in general.

Stress and Gratitude

Both described constructs of stress and gratitude can be considered as dispositional characteristics which are relatively stable over one's lifetime or as emotions varying throughout a certain period. This differentiation can be classified as trait- or state-like. Trait-like emotions are experienced on a relatively consistent level which differs from person to person (Gallagher, Solano, & Liporace, 2020). In comparison, state levels of emotions can vary from day to day or even from moment to moment (Nezlek, Krejtz, Rusanowska, & Holas, 2019). Furthermore, state emotions are of temporal nature and

associated with longer mood durations (Wood, Maltby, Stewart, Linley, & Joseph, 2008). When considering that stress levels, as well as levels of gratitude, can vary from moment to moment, it can be interesting to examine in what way the two concepts might be associated with each other.

It is further important to continue research in trait- and state-like associations of stress and gratitude, as few studies before investigated possible associations between the two concepts. Most research done before focused on the trait level (i.e. between-person association) of both concepts and treated them as dispositional, stable characteristics. Even though gathering data with longitudinal studies is very common nowadays, most researchers do not differentiate appropriately between within-person and between-person effects (Curran & Bauer, 2011). Nevertheless, stress and gratitude are subjectively experienced emotions, and hence, it is crucial to differentiate and explore how they might be associated at state levels (i.e. within-person association). Mechanisms of stress and gratitude mainly operate within a person and cannot be easily generalized to lots of different individuals within the general population.

Considering previous studies, the concepts of stress and gratitude are shown to be related. Accordingly, in a study investigating associations between stress and gratitude, the researchers concluded that stronger feelings of gratitude within participants provided them with more resources which they could draw upon in case of stressful events. This buffering effect can be especially valuable in counteracting negative health impacts associated with stressful events (Krejtz, Nezlek, Michnicka, Holas, & Rusanowska, 2016). Additionally, another study showed that generally grateful people experienced lower levels of stress (Wood, Maltby, Gillett, Linley, & Joseph, 2008). The researchers suggested that a grateful personality, hence trait levels of gratitude, has positive effects on people's stress levels, which might, in turn, be also beneficial for a person's overall well-being. In comparison, one study by Nezlek, Krejtz, Rusanowska, and Holas (2019) investigated the concepts of stress, gratitude, and well-being on state levels. More specifically, they examined the relationship between gratitude and well-being and in which way stressful events might influence this relationship. Hence, they suggested that stressful events might lead to decreased well-being and that a higher gratitude level in turn would weaken this relation. Their results showed that people experienced a higher well-being on days they perceived as less stressful. Additionally, they concluded that gratitude regulated this relationship in a positive way. Hence, the association between stressful events and the participants' well-being was

weaker when daily gratitude was high. The set-up of the study required participants to report their gratitude levels as well as their well-being and any events they experienced, once a day over the course of two weeks (Nezlek, Krejtz, Rusanowska, & Holas, 2019). In comparison, the study at hand aims at measuring state levels of gratitude and stress three times a day for one week. Hence, by measuring both concepts multiple times a day, the results might provide more insight in which way state gratitude and stress are associated with each other.

The current study

When looking at the previous findings, it becomes apparent that studies investigated the relationship between stressful events and gratitude but neglected within-person and between-person differentiation. Thus, it would be of interest to examine in what way stressful events might be associated with average and momentary state levels of gratitude in university students, as it was shown that this group suffers from rather high stress levels (Reddy, Menon, & Thattil, 2018). Furthermore, it is of importance to replicate previous findings, which state that people who consider themselves to be generally grateful also experience those feelings on a daily basis (McCullough, Tsang, & Emmons, 2004). To the author's knowledge, this is one of very few studies which examines varying state levels of gratitude by associating them with stressful events. Based on that, it is firstly hypothesized that there is a positive association between trait levels and average state levels of gratitude. Secondly, it is hypothesized that average high levels of state stress are negatively associated with trait and state gratitude. Next, it will be investigated to what extent the relation between state stress is associated with momentary feelings of gratitude (within-person association) and average feelings of gratitude (between-person association). In the last step, it will be examined whether there are meaningful groups among the participants. It might be possible to group the participants according to their scores on trait gratitude. It can be expected that those scoring higher on trait gratitude also score higher on average gratitude combined with higher average levels of stress which would indicate a buffering effect and display a positive within-person association. In this scenario, it might be probable that resources which can be drawn from gratitude get activated when experiencing high stress levels, like researchers suggested before (Krejtz, Nezlek, Michnicka, Holas, & Rusanowska, 2016). Nonetheless, it could also be possible

7

that participants indicating lower levels of trait gratitude show higher levels of state stress with lower levels of state gratitude and vice versa, which would then indicate a negative within-person association. To discover the nature of this relationship, it will be lastly hypothesized that people with higher trait gratitude will have a positive within-person association, whereas people who score lower on trait gratitude will have a negative within-person association.

Methods

Study Design

For this study, the Experience Sampling Method (ESM) was used for the target group of university students. The ESM is a structured self-report method that aims at studying natural human behaviour (Berkel, Feirreira, & Kostakos, 2017). The method seeks at getting insight into people's daily life and in which way their behaviour might be related to events that happen throughout the day (Myin-Germeys et al., 2018). For this purpose, participants are required to answer a set of usually identical questions throughout the day (Berkel, Feirreira, & Kostakos, 2017). For the study at hand, it was important to understand state stress and gratitude in a daily life context to capture possible fluctuations over the day.

The time frame for the data collection was a period of about one month, from March to April 2021. Ethical approval was obtained from the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences (BMS) of the University of Twente before the start of the study (Request Number 210220).

Participants

The convenience sampling method was used to gather participants for the study. All people who were older than 18 years, had sufficient English-speaking skills, and were enrolled at a university were invited to take part in the study. Furthermore, participants had to own a mobile device, to be able to install and use the Ethica application. The participants were gathered on the Test Subject Pool System of the University of Twente (SONA) as well as by request of the researchers' social environment.

Participants who enrolled via SONA were compensated for their engagement in the study with 1.5 SONA credit points.

Materials and Measures

This study is part of a larger research and, therefore, the questionnaires presented to the participants consisted not only of trait and state measures of gratitude and stress but also of state measures of academic motivation and self-confidence. Nevertheless, for the current study, only the measurements of state stress, as well as state and trait gratitude, will be used and further explained.

Ethica

Ethica is an online platform that provides researchers with the possibility to gather quantitative data on human behaviour. The platform can be used as a desktop version (available at https://ethicadata.com/), as well as an application, which can be installed on any smartphone. On the desktop version, researchers are able to set up surveys that can be designed for smartphone or wearable use. In addition, the desktop version allows the researcher to monitor participants' activities and engagement with the app, create new surveys as well as setting triggering logistics which can be set to a specific time frame so that the participants receive pop-up notifications (Ethica, 2021).

Trait Measures

Trait Gratitude: The Gratitude Questionnaire Six Item Form (GQ-6). In order to measure trait gratitude in the sample, the GQ-6 was used (McCullough, Emmons, & Tsang, 2001). The questionnaire consists of 6 items in total (see Appendix A). Examples of those would be "I am grateful to a wide variety of people" and "When I look at the world, I don't see much to be grateful for." Participants were required to indicate to what extent they agree with the statements on a 7-point Likert-Scale ranging from 1 (strongly disagree) to 7 (strongly agree). Hence, scale scores range from 6 (minimum) to 42 (maximum), with high scores indicating a higher level of gratitude. Previous studies reported high internal consistency of a Cronbach's alpha value of 0.82 (McCullough, Emmons, & Tsang, 2002) as well as high test-retest reliability (Jans-Beken, Lataster, Leontjevas, & Jacobs, 2015). Additionally, the

questionnaire shows correlation with other measures of gratitude (Jans-Beken, Lataster, Leontjevas, & Jacobs, 2015). Furthermore, the GQ-6 shows a positive correlation with overall life satisfaction and positive affect as well as a negative correlation with negative affect and psychological symptoms such as anxiety and depression (McCullough, Emmons, & Tsang, 2002).

State measures

As few studies investigated the association between state levels of gratitude and stress with the ESM, two items were chosen from the GQ-6 and modified accordingly. The items were selected based on their factor loadings and their adjustability to daily measures. Balgiu (2020) investigated the validity of the GQ-6 in a sample of Romanian undergraduates. The researcher showed that item 1 ("I have so much in life to be thankful for.") as well as item 2 ("If I had to list everything that I felt grateful for, it would be a very long list.") displayed the highest factor loadings, namely 0.80 and 0.87, respectively (Balgiu, 2020). The reframed question for the first item will be: "*Right now*, I have so much in life to be thankful for." Similarly, the question for the second item will be modified: "If I had to list everything that I felt grateful for *right now*, it would be a very long list."

In order to measure stressful events in the participants' life, three questions will be presented to them. A study by Zautra, Berkhof, and Nicolson (2002) assessed stressful events in a sample of managerial employees by asking about stressful situations which may have arisen since the last measurements point. This type of question was also used in the current study and extended by the intensity and nature of the stressful event. Hence, participants in the current study should first indicate whether a stressful event occurred since they last used the app ("Since the last time you answered a questionnaire for this study, has there been any event that caused you stress?"). If this question would be answered with "Yes", participants were asked to rate the intensity of the event ("How stressful was this event for you?"). This was done on a 4-point Likert-Scale ranging from 1 (slightly stressful) to 4 (extremely stressful). Last, participants were requested to answer what the stressful event was about, with several possibilities to choose from, as having an argument or finding out about a health-related issue (see Appendix B2).

Procedure

When designing the before described survey for the study, several propositions were implemented (van Berkel, Ferreira, & Kostakos, 2017). First, it is advised to limit the study duration to two weeks. However, for the purpose of this research, the study duration was one week to further reduce the participants' burden. Next, van Berkel et al. (2017) suggest that the frequency of sending the daily survey should be adjusted to the number of questions the survey contains. Hence, the survey in this study which consists of five questions in total, was sent three times a day. Consequently, assuming a response rate of 100%, 21 data points per participant would be gathered over the course of one week. In addition, a cut-off percentage of 60% was applied to ensure sufficient measurement points. When adopting the suggestions, it can be accomplished to minimize the burden for participants whilst ensuring to gather enough data for the researchers and to give a sufficient overview of the participants' moods and activities throughout the week.

Overall, the study took place over a period of eight consecutive days. On the first day, participants were required to download the Ethica application on their mobile devices and join the study with a given code. After successfully setting up an account, the first page stated general information about the study and explained the procedure for the following days. It was emphasized that participation was voluntary, and that participants could end the study at any time without giving a reason. It was further explained that the gathered data would be used for no other purpose than for the current bachelor's thesis and that all obtained data would remain anonymous and confidential (see Appendix B5). This was stated in the consent form when registering on Ethica and a second time before starting the surveys.

Next, participants were reminded to turn on their notification system, so that they would receive pop-up messages from Ethica. Furthermore, they were required to state general information including their age, gender, and nationality as well as to complete the trait questionnaire for gratitude. By providing the trait questionnaire before starting the daily surveys, it was ensured that the scores of the trait measures would not be biased due to the answers given on the daily state measures. After completing the first questionnaire, participants were thanked for their participation and informed that all activities required for the first day were completed. Moreover, it was stated that the daily measures

would start the following day and that they could report any problems with the setup of Ethica to the researchers.

Starting from the next day (day 2), the participants were provided with five questions, two for state gratitude and three for state stress, for the following seven days (day 2-8). The notifications for completing the survey were randomly sent between the time frames from 9 to 10:30 (morning), 14 to 16:30 (afternoon), and 20 to 21:30 (evening). The randomization of the notifications should prevent habituations of the participants. The possibility to answer the survey would expire after 90 minutes to ensure a sequential gathering of the data points. To illustrate, if a trigger was sent to the participant at 9:30, the survey would expire at 11. This would ensure, that the survey measured three different time points throughout the day, instead of gathering all data at the end of the day in case of not completing the surveys on time. Once a trigger started, a reminding notification was sent every 30 minutes (see Appendix B3). This was done to minimize participants' burden by providing proactive reminders instead of letting participants give answers at their own rate (Berkel, Feirreira, & Kostakos, 2017).

In order to ensure a trouble-free administration, the questionnaires were tested beforehand by two trial participants in a three-day pilot test. This was done to detect possible inconsistencies in the set-up of the study and ensuring a user-friendly interface interaction. At the beginning of each questionnaire, a short text stated to read the questions carefully and to choose the best possible answer. Furthermore, at the end of completing each questionnaire, a motivating statement was given to encourage the participant's engagement with the study (see Appendix B4). The response activities were monitored throughout the study, with contacting participants when they did not complete the questionnaires on multiple consecutive days.

Data analysis

The statistical programme IBM SPSS (version 25) was used to perform the analyses. First, the participants' demographic data (gender, nationality, and age) were included in the descriptive statistics. Besides, mean scores for state and trait gratitude, as well as state stress and the number of stressful events, were computed.

In the next step, the GQ-6 was checked on its reliability by computing Cronbach's alpha. For the state measures, split-half reliability was computed. Tavakol and Dennick (2011) suggested that alpha

values above .7 can be considered acceptable with values above .9 being excellent. Additionally, scores between .5 and .7 are considered moderate whereas scores below .5 are low. Moreover, Pearson correlation was computed to show the validity between the average state items of gratitude and the GQ-6. Akoglu (2018) indicated that values above .7 show a strong correlation, whereas scores ranging from .4 to .6 indicate moderate correlation. Weak correlation shows in scores below .4.

Next to that, a Linear Mixed Model (LMM) analysis was performed as the study at hand is concerned with repeated measures, and the model accounts for effects of clustering. The model was first used to determine correlations between both state measures and then to compute correlations between trait gratitude and the Estimated Marginal Means (EMM) of state stress.

It was further necessary to differentiate between within-person association and between-person association for the LMM analyses. In this way, relations between constructs that were associated within persons, as well as relations that are associated across persons, could be captured appropriately (Curran & Bauer, 2011). To compare differences between the participants, the Person Mean (PM) was calculated for each participant. This was done for all measurements of gratitude and stress. Hence, individuals could be compared at the between-level. Next, the Person Mean-Centred (PMC) was calculated by subtracting the mean scores of state gratitude and stress from the individual scores, which allows for within-person analyses.

The LMM was then used to determine whether the relationship between stress and gratitude is trait-like (between-person association) or state-like (within-person association). In other words, this would indicate to what extent the participants' momentary feelings of stress are associated, on the one hand, with average levels of gratitude and, on the other hand, momentary levels of gratitude. In order to perform the LMM analyses, the scores of state and trait gratitude, as well as state stress, had to be standardized. For the analysis, state stress was determined as the dependent variable. In addition, the measures of PM state gratitude (between-person association) and PMC state gratitude (within-person association) were set as fixed covariates.

In the last step, a K-means cluster analysis was applied to the variable of trait gratitude. With this analysis, it was possible to identify underlying grouping patterns which may arise in the dataset. Those identified groups share common characteristics. Hence, distinct profiles could be created which

also showed how many participants could be assigned to the specific cluster (Wu, 2012). Furthermore, the clusters showing in trait gratitude were analysed regarding their within-person association between state stress and state gratitude. In this way, it was possible to capture potential differences within the participants who were in the different groups.

Results

Descriptives

Overall, 38 students signed up to participate in the study. Out of those, 4 were excluded due to a response rate of below 60%. The remaining 34 participants were between 18 and 24 years old (M = 21.12, SD = 1.7). Furthermore, 91.2% were female and 8.8% were male. Out of the 34 participants, 79.4% were German, 11.8% Dutch, and 8.8% from other nationalities. Their scores, including minimum, maximum, as well as means, and standard deviation of the four measures can be seen in Table 1. The average response rate in this study for all included participants was 92.58%.

In regard to the experienced stressful events, participants could choose between a total of six options. The option which was indicated the most was work-related events which were mentioned 99 times (65.6%), followed by health-related events which were named 32 times (21.2%). Next, Covid-19-related events were mentioned 8 times (5.3%), and lastly, home-related events, as well as arguments, were both mentioned 6 times (4%). The option "other event not listed" was not mentioned. In total, 151 events were indicated by the participants. For a better understanding, the list of the possible options, together with an example are listed in Appendix B2.

Table 1

Minimum, maximum, mean scores, and standard deviation (SD) of the questionnaires.

Variables	Minimum (scale minimum)	Maximum (scale maximum)	Mean	SD
GQ-6	3.67 (1)	6.83 (7)	5.69	.74
State Gratitude	1.5 (1)	7 (7)	5.71	1.06
State Stress	1 (1)	4 (4)	2.20	1.01
Stressful events	0	20	4.35	3.93

Pearson's correlation between the state measures of gratitude (Person Mean) and the GQ-6 showed a significant and moderate positive correlation ($r=.65$, $p<.001$). This indicates that people who scored high on trait gratitude also scored high on average state gratitude. Moreover, the GQ-6 showed acceptable reliability ($\alpha=.73$, $p<.001$). The state measures also indicated acceptable reliability with state gratitude showing excellent split-half reliability ($r=.98$, $p<.001$) and state stress showing moderate split-half reliability ($r=.59$, $p=.001$).

Associations between gratitude and stress

As expected, the LMM analyses showed a significant, but weak negative association between the state measures of gratitude and state stress ($\beta=-.27$, $p<.001$). This indicates that participants who scored higher on state gratitude scored lower on state stress. Furthermore, the LMM showed a significant, weak, and negative correlation between trait gratitude and the EMM of state stress ($\beta=-.16$, $p=.001$). Hence, the results suggest that people who scored high on measures of trait gratitude scored lower on state stress. Additionally, it became evident that the measures were all significantly associated with each other.

The LMM was further used to determine to what extent gratitude was associated with average levels of stress over the week (between-person association) and momentary stress (within-person association). The results indicated that state stress was neither associated with momentary levels of gratitude ($\beta=-.15$, $SE=.15$, $p=.32$, CI [-.46, .15]) nor with average levels over the week ($\beta=-.15$, $SE=.16$, $p=.35$, CI [-.48, .17]), as both associations showed to be non-significant. Hence, this implied that higher

15

levels of state stress cannot be associated with either momentary gratitude or average levels of gratitude. In the analysis, it became further apparent that both associations showed large confidence intervals which contain the number zero. This indicates that there is a lot of individual variation within the sample. The rather large confidence intervals might be also due to a relatively small sample size in the current study.

Individual case analysis

Figure 1 presents a visual depiction of each participant with their respective state and trait measures, ordered by their trait scores of trait gratitude. Here, it can be seen that the majority of the participants scored high on state and trait levels of gratitude and indicated little stressful events with low intensity. Nevertheless, participants number 8, 11, 13, 28, and 33 scored above the overall mean of state stress (M=2.2). As for trait gratitude, participants number 2, 13, 31, 32, and 33 scored higher than the mean of 5.69. Moreover, most participants show little differences in the measures of trait and state gratitude. Especially, participants number 3, 4, 9, 14, 18, 29, and 34 indicate almost identical levels of trait and state gratitude.

Figure 1

Mean scores for trait gratitude, state gratitude, state stress, and the sum of stressful events sorted by trait gratitude.
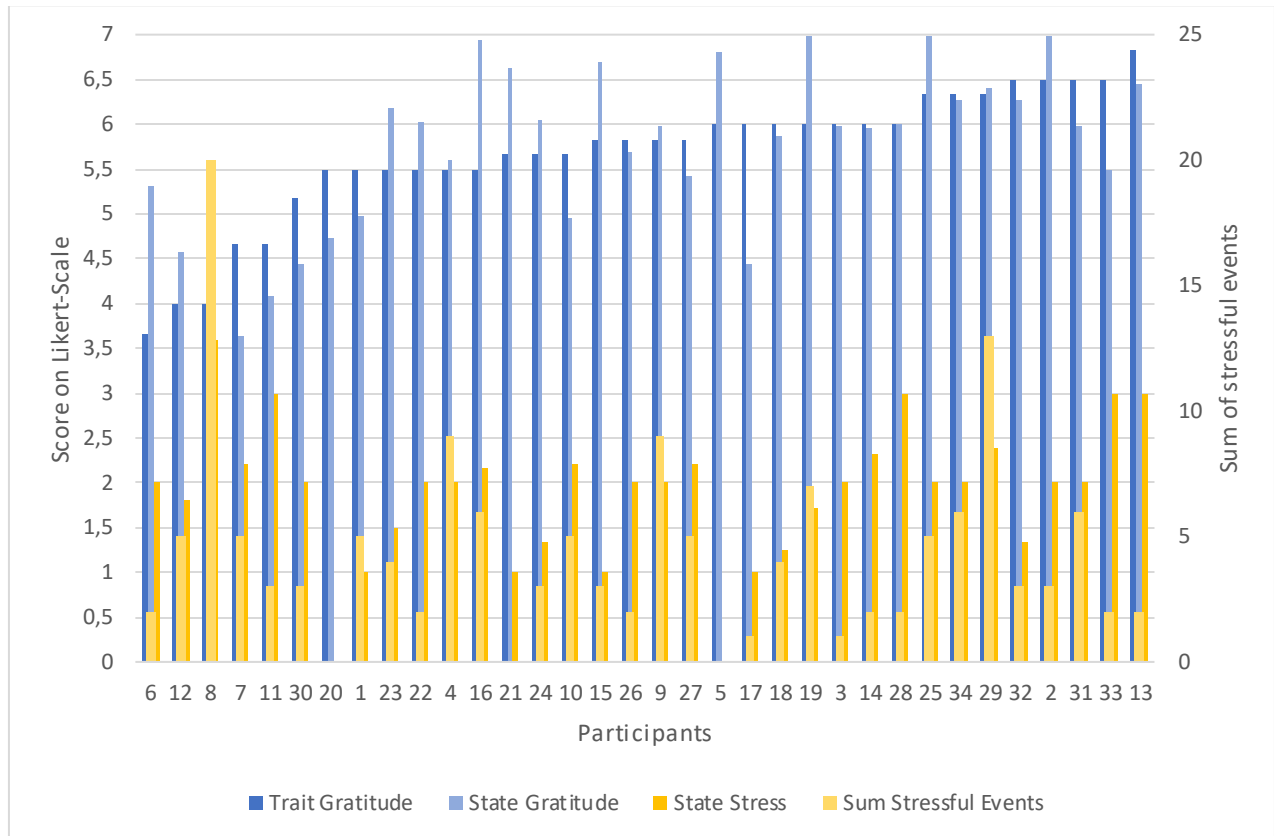

In the following, some participants will be exemplarily used in order to further demonstrate the association between stress and gratitude as measurements over a period of time.

First of all, participant 8 showed one of the lowest scores for trait gratitude (4) as well as below-average levels of state gratitude (3.82). Furthermore, he or she displayed high state stress (3.59) and indicated the highest number of stressful events (20) among all participants (see Figure 1). The described pattern is visually displayed in Figure 2. After initial small fluctuations in his or her state levels of gratitude, the participant stayed rather constant in his or her state gratitude from measurement point 3 onwards. The participant showed a peak in his or her state gratitude at measurement point 12, whilst experiencing no stressful event at that time.
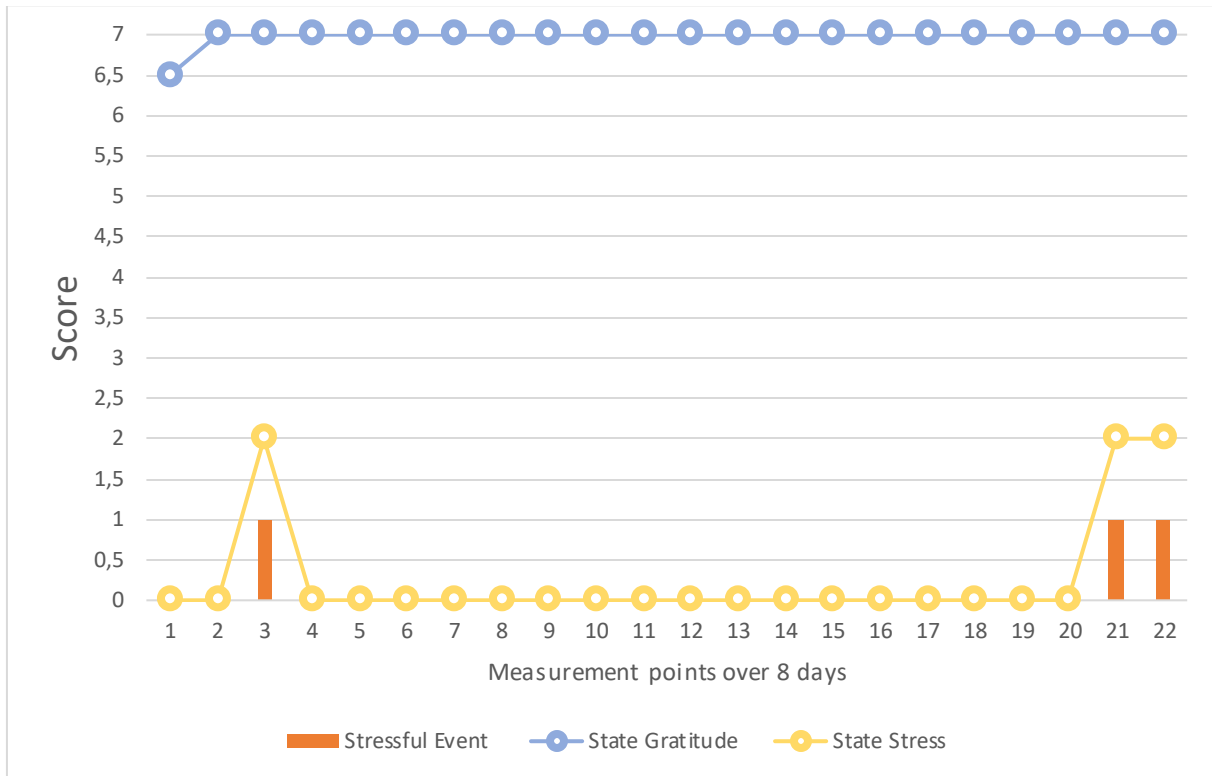
Figure 2

Daily scores of participant number 8 of state gratitude (blue), state stress (yellow), and the number of stressful events (orange).
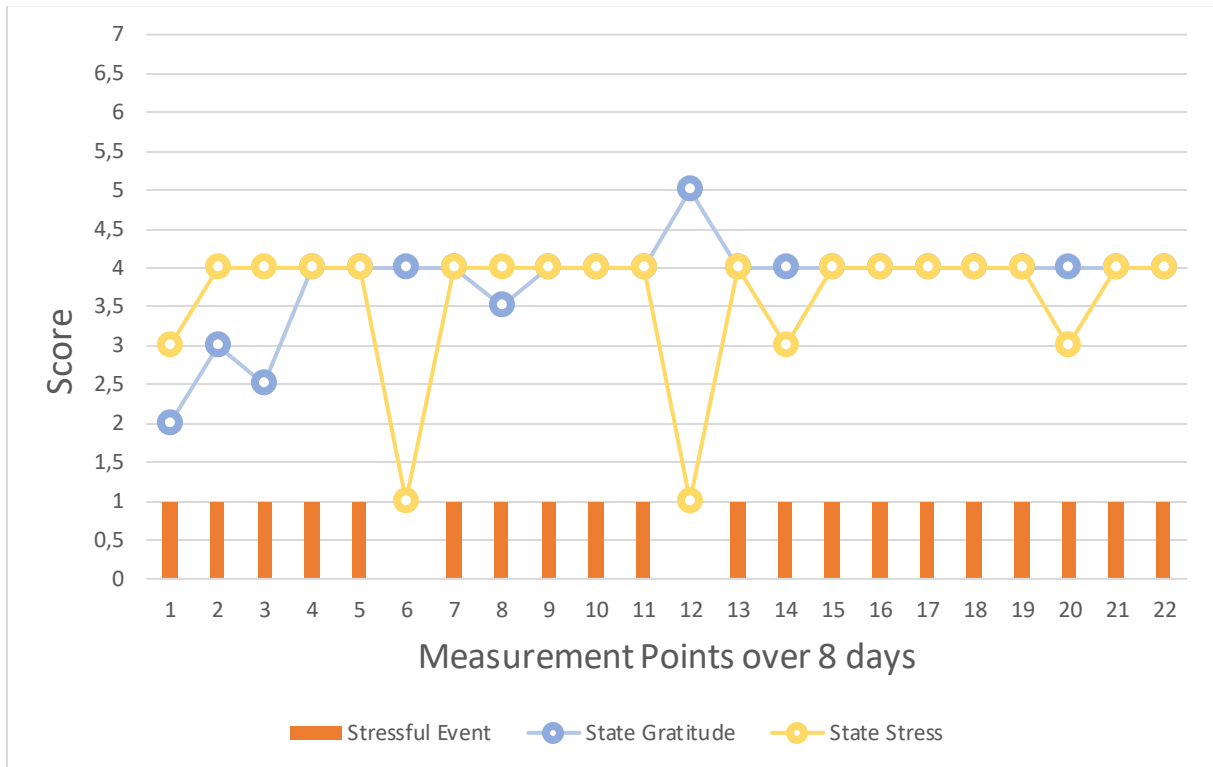
In comparison to that, participant 2 showed above-average levels of trait gratitude (6.5) as well as above-average levels of state gratitude (6.98). As it can be seen in Figure 3, he or she displayed low levels of state stress (2), which is comparable to the overall mean of 2.2. Furthermore, the participant experienced few stressful events throughout the week. Moreover, this participant has little fluctuations in state gratitude over the period of seven days. Regardless of the experienced stressful events at timepoints 3, 21, and 22, the participant experienced constant high levels of state gratitude.

Figure 3

Daily scores of participant number 2 of state gratitude (blue), state stress (yellow), and the number of stressful events (orange).

As visually displayed in Figure 4, participant 11 experienced little stressful events (3), which were however of higher intensity (3) compared to the mean (M=2.2). Nevertheless, in contrast with participant 2, he or she showed higher fluctuations in their level of state gratitude (Figure 4). At measurement point 20, the participant experienced high levels of stress (4), whilst indicating lower gratitude (1.5) which is below the overall mean score.

Figure 4

Daily scores of participant 11 of state gratitude (blue), state stress (yellow), and the number of stressful events (orange).
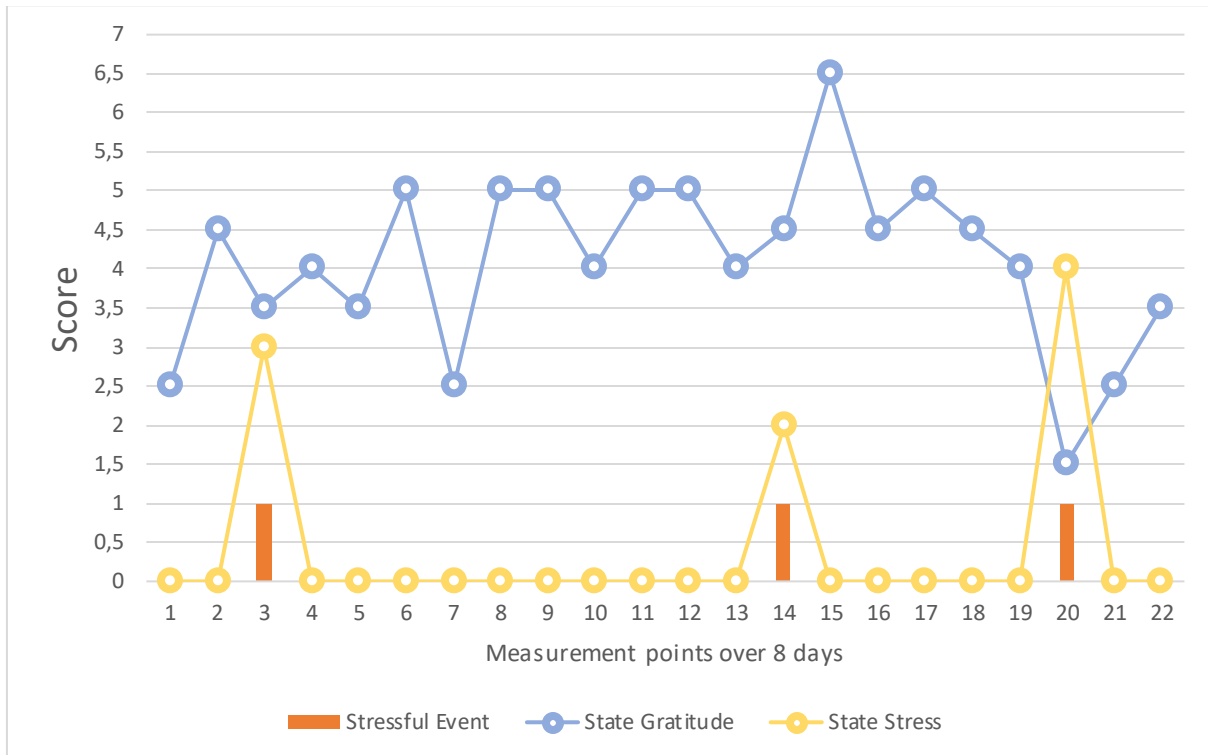

Overall, the individual analyses show that the participants who experienced little stressful events of moderate intensity also displayed higher gratitude at those measurement points.

Cluster Analysis

In the last step, a K-means cluster analysis was applied to the measures of trait gratitude in order to identify underlying patterns of groups which may have arisen in the dataset. Two clusters were identified within the trait gratitude measurements. The clusters are visually presented in Figure 5.

Figure 5

Cluster analysis showing the patterns of average state stress and average state gratitude in participants with low levels of trait gratitude (blue) and high levels of trait gratitude (yellow).
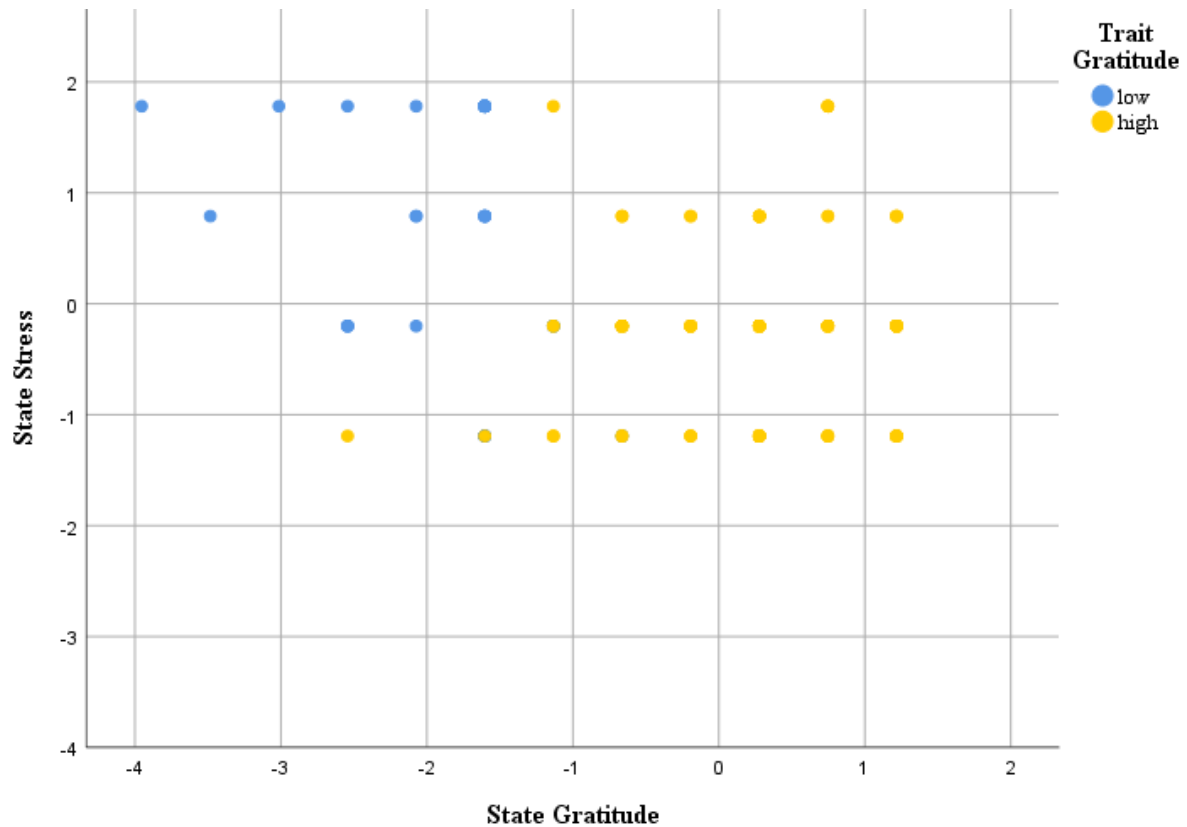
The cluster analysis showed that that the majority of the participants who scored low on trait gratitude show higher levels of state stress combined with lower levels of state gratitude, with average trait gratitude of 4.36. On the other hand, it can be seen that most of the participants scoring higher on trait gratitude indicated lower levels of state stress and higher levels of state gratitude. Participants in the second cluster show an average trait gratitude value of 5.97. Nevertheless, there is one exception to the described pattern, which can be seen in the bottom left corner. He or she might be misclassified. Out of the 34 participants, 7 could be assigned to the first cluster, whereas 27 participants were in the second cluster.

When further analysing both clusters with the LMM, it became apparent that there was a weak and negative significant within-person association between gratitude and stress for the first cluster ($\beta=$ -.32, $SE=$.08, $p=$.001, CI [-.50, -.14]). In comparison, the second cluster showed a non-significant within-

person association between stress and gratitude (*ß= -.05, SE=.13, p=.68, CI* [-.32, -.21]). This indicates that people scoring lower on trait gratitude show higher levels of state stress combined with lower levels of state gratitude at the within-person level.

After the conducted analyses, it can be said that participants in the current study generally experienced high state gratitude and lower state stress. Nevertheless, there are also some exceptions which show that higher average stress was in turn associated with lower trait and state gratitude.

Discussion

Current Findings and Previous Research

The study at hand aimed to investigate in which way trait and state levels of gratitude and the experience of stressful events might be associated with each other. First, the results suggest that trait and state levels of gratitude are positively associated, which indicates that people who consider themselves to be grateful on a trait level also display this tendency on a state level. Hence, the hypothesis that state and trait levels of gratitude are positively associated with each other could be confirmed. Here, previous studies showed a strong positive relationship between trait gratitude and momentary feelings of happiness (Watkins, Woodward, Stone & Kolts, 2003). Those feelings of happiness can also be linked to higher momentary states of gratitude, as Wood, Froh, and Geraghty (2010) argue, happiness and gratitude are closely related to each other. Consequently, individuals who express more gratitude might be happier in general. Moreover, a study by McCullough, Tsang, and Emmons (2004) showed that dispositional gratitude in individuals was associated with higher general gratitude throughout the day, regardless of fluctuations due to gratitude eliciting events. Hence, those findings are in line with the current study.

Considering the second hypothesis that higher state levels of gratitude would be positively associated with lower state stress levels, the results are shown to be significant. As indicated before, there was a weak, negative association between state gratitude and state stress. Hence, the study showed that there is no buffering effect of gratitude, as participants tended to display higher levels of state gratitude combined with lower levels of state stress. In line with this, when comparing average scores

of all participants, it becomes apparent that the majority experienced high trait as well as state gratitude, whilst indicating little stressful events with rather low intensity. This described pattern could be observed in participant number 2 shown above. His or her levels of state gratitude were all at a high level regardless of the stressful events which happened throughout the week. Considering this, it can be argued whether this participant could be labelled as a serious one since his or her state levels of gratitude were almost consistent over the measurement period. Another explanation for this would be that the participant did not answer the survey seriously and would, hence, not provide reliable data. The finding was replicated in a study by Nezlek, Krejtz, Rusanowska, and Holas (2019), who investigated the effect of gratitude in individuals in connection to stress. The researchers concluded that on days where participants showed more gratitude, they experienced less stress in general, which in turn led to higher well-being. Participants of the described study were asked to report any events that happened once a day in a diary study. In comparison, the current study investigated the association of stress and gratitude in a more distinct way, by extending the measures to three times a day.

The association between gratitude and stress explained in the previous paragraph was further qualified in a more distinct way. Here, the study aimed at identifying to what extent state stress would be associated with momentary and average gratitude. This distinction could not be accomplished based on the current study, as the results of the LMM showed to be non-significant and, hence, state stress is neither associated with momentary (within-person) or average (between-person) feelings of gratitude. This implies that varying average levels of stress might be due to other factors which cannot be located within or across the participants. This is not in line with findings obtained by Wood, Maltby, Gillett, Linley, and Joseph (2008) who suggested that individual variance in daily gratitude could be explained to a greater extent by a within-person association compared to between-person differences. For the study at hand, it can be concluded that gratitude levels in the sample were neither determined by varying situations in the participants' lives nor by individual differences between them. Hence, it might be possible that other mechanisms, different from state stress, are responsible for the negative association. Thus, some studies argue that gratitude can be influenced by many other environmental and social factors. Hence, factors like parental upbringing (Watkins, & Bell, 2017), religion, and culture are shown to influence the development of gratitude within individuals (Ting, 2017).

The last hypothesis aimed at identifying meaningful groups within the sample. Two groups could be found with the cluster analysis. Specifically, the first cluster included participants scoring high on state gratitude and low on state stress, whereas the second cluster contained participants showing low scores of state gratitude and high scores of state stress. Here, it was of importance to indicate whether people show a positive or negative within-person association within the groups. This hypothesis could be partly confirmed, as the results were only significant for the negative within-person association holding for people who experience lower state gratitude and are thus located in the second cluster. The expected positive within-person association for the first cluster was not significant. Consequently, this indicates that only those who scored lower on state gratitude experience higher stress. Thinking further, the results also predict a negative between-person association, which shows that people who experience lots of gratitude on average have lower average stress levels. Those findings are not in line with previous research done in the field (Krejtz, Nezlek, Michnicka, Holas, & Rusanowska, 2016; Bohlmeijer & Westerhof, 2021). Accordingly, earlier studies suggested that gratitude can counteract the impact of stressful events in someone's daily life. Thus, the positive health outcomes associated with gratitude are shown to buffer against those of experienced stress (Wood, Froh, & Geraghty, 2010).

Strengths, Limitations, and Future Implications

There are strong points as well as limitations that need to be considered when evaluating the setup and the results of the study at hand. Based on this, it is possible to think of further research which could be done to maximize the strengths as well as minimize potential issues.

A first strong point would be the use of the Experience Sampling Method over the course of one week. As the measures were conducted at three different time points during the day, the study was able to appropriately capture possible fluctuations in the average levels of gratitude and stress in a daily life context of students. Csikszentmihalyi and Larson (2014) argued that the ESM is a particularly useful method in capturing individual differences across various situations, as it not only collects data from one single questionnaire but relies on repeated measurements over a longer period. Linked to that, another strength of the study is that it highlights the difference between within- and between-person association of gratitude and stress. As stated before, most studies neglected this differentiation and

focused mainly on dispositional characteristics. Nevertheless, as Curran and Bauer (2011) stated, it is of utmost importance to differentiate between within- and between-person effects. It is possible that there are fluctuations when investigating distinct concepts, which can only be captured appropriately when using repeated measurements and accounting for different effects. Those can further provide insight which can be beneficial when drawing implications from the studies.

Last, the study contributed to further investigating associations between gratitude and stress in the target group of university students. This is of importance, as students can experience high workload and might suffer from stressful events related to their studies. This was suggested by the current study, as the majority of the indicated stressful events were linked to university workload, like working on assignments. In line with this, a study by Reddy, Menon, and Thattil (2018) showed that within a sample of university students, half of them experienced average to high stress due to academic pressure. This can lead to negative health outcomes, such as symptoms of depression, unhealthy eating, and sleeping patterns as well as behavioural problems (Reddy, Menon, & Thattil, 2018). With this in mind, it is of utmost importance to further investigate in which way university students are affected by high stress levels and how to counteract possible negative consequences for their mental health and well-being.

In contrast to the stronger points of the study, there are also some limitations that need to be considered. First of all, the sample of the current study consists mainly of highly educated women which most probably have a higher socio-economic status (SES). Considering the high proportion of females in the sample, it might be possible that those women show higher gratitude in general which in turn also shows in the daily measures. This can be also seen in the cluster analysis. Here, more participants were in the first cluster displaying higher state gratitude and lower state stress. In line with this, a study by Reckart, Huebner, Hills, and Valois (2017) indicated that women expressed higher gratitude than men. Furthermore, a lower SES was associated with lower gratitude, as well as a higher number of stressful life events. Nevertheless, the sample in the described study consisted of adolescents in middle schools with an age range from 10 to 16 years (Reckart, Huebner, Hills, & Valois, 2017). In order to counteract this weakness of the study, it is necessary to replicate the study with a larger sample. Accordingly, the sample should also include male and female participants from more diverse socioeconomic backgrounds. Csikszentmihalyi and Larson (2014) elaborated that studies using ESM might risk self-

selection bias, which means that it is possible that only a certain type of people is willing to participate in ESM studies. Consequently, it is crucial to further investigate gratitude in relation to stress in a more varied sample of university students.

Regarding the findings of the study, some practical implications can be drawn concerning future research of the field. First, the results suggest that it would be beneficial to strengthen gratitude within people, as this shows to be associated with lower levels of stress. Previous studies generally showed that gratitude interventions can improve subjective well-being and the mood of participants (Cunha, Pellanda & Reppold, 2019). Hence, it is of importance to further investigate the research field of gratitude as it seems beneficial for increasing people's overall mental health. Linked to that, especially gratitude in relation to stress seems to be of importance, as our daily lives can potentially become even more stressful. Thus, it is essential to engage in preventive care so that individuals don't suffer from the various negative health outcome described before, which can even lead to suicide (Kaniuka, Kelliher Rabon, Brooks, Sirois, Kleiman, & Hirsch, 2020). Nevertheless, it might be also possible that there are many other mechanisms that operate between and within individuals which can influence levels of stress and gratitude in different ways. Here, it would be of importance to identify those mechanisms with future research.

In light of this study, it is further important to invest more in the research of within-person effects. As mentioned before, many psychological theories operate at the within-person level, whereas the measurement of those theories is of between-person nature (Curran & Bauer, 2011). The study at hand shows that especially those participants who scored lower on gratitude scored higher on stress at the within-person level. This indicates that those students respond to stressful events with a decrease in their level of momentary gratitude. It is of importance to strengthen those momentary feelings of gratitude to decrease the impact of stressful events in students' lives.

In conclusion, it can be said that the study at hand was an important step to take in closing the knowledge gap regarding the association between stress and gratitude in undergraduates. It became apparent that both concepts are related to each other, and that especially those scoring low on state gratitude reported higher stress levels. As suggested by researchers before, it is of importance to increase feelings of gratitude in individuals, as this can potentially reduce negative outcomes in relation to stress.

The current study further showed that especially university-related tasks seem to cause higher stress in students, and hence, it is of importance to investigate this relationship further. Then it can be possible to intervene at a given point in time and counteract this negative impact accordingly, for instance by enhancing gratitude levels in students.

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The Gratitude Questionnaire – Six Item Form (GQ-6)

The Gratitude Questionnaire-Six-Item Form (GQ-6) is a six-item self-report questionnaire designed to assess individual differences in the proneness to experience gratitude in daily life.

Instructions: Using the scale below as a guide, write a number beside each statement to indicate how much you agree with it.

1 = strongly disagree

2 = disagree

3 = slightly disagree

4 = neutral

5 = slightly agree

6 = agree

7 = strongly agree

_____1. I have so much in life to be thankful for.

_____2. If I had to list everything that I felt grateful for, it would be a very long list.

_____3. When I look at the world, I don't see much to be grateful for.

_____4. I am grateful to a wide variety of people.

_____5. As I get older I find myself more able to appreciate the people, events, and situations that have been part of my life history.

_____6. Long amounts of time can go by before I feel grateful to something or someone.

Scoring: Compute a mean across the item ratings; items 3 and 6 are reverse-scored.

Appendix B.

Ethica

B-1 *Daily questions for measuring state gratitude*

Right now, I have so much in life to be thankful for.

- ○ strongly disagree
- ○ disgaree
- ○ slightly disagree
- ○ neutral
- ○ slightly agree
- ○ agree
- ○ strongly agree

If I had to list everything that I felt grateful for right now, it would be a very long list.

- ○ strongly disagree
- ○ disgaree
- ○ slightly disagree
- ○ neutral
- ○ slightly agree
- ○ agree
- ○ strongly agree

B-2 *Daily questions for measuring state stress*

Since the last time you answered a questionnaire for this study, has there been any event that caused you stress?

- ○ yes
- ○ no

How stressful was this event for you?

If there was no event that caused you stress, please skip this question.

- ○ slightly stressful
- ○ moderately stressful
- ○ very stressful
- ○ extremely stressful

What was the stressful event about? Please choose the category which you think is fitting best.

If there was no event that caused you stress, please skip this question.

- ○ event related to Covid-19 (e.g. self-isolation)
- ○ work or study related event (e.g. working on assignments)
- ○ home related event (e.g. expensive bill)
- ○ argument or disagreement with anyone (e.g. arguing with someone)
- ○ health related event (e.g. finding out about health issue)
- ○ other event not listed

B-3 *Daily reminders on the web page*

N ID: 63

Offset   Send the notification immediately.

In-App   Can you tell us how are you feeling right now?
              Fill in the short questionnaire.

N ID: 62

Offset   Send the notification after 30 minutes

In-App   Don't forget to fill in the questionnaire.
              Thank you!

N ID: 61

Offset   Send the notification after 1 Hour

In-App   Don't forget to tell us how you feel.
              Thank you!

B-4 *Motivating statements for the participants at the beginning and the end of the questionnaires*

Hello!

Thank you for your involvement with our study. We appreciate your contribution. Today we will ask you to fill in three short questionnaires.

This questionnaire is about gratitude. Generally, gratitude is about appreciating little things in life in a habitual way.

On the next page, you will be presented a set of statements. Please indicate for each statement how much you agree with it. Have fun! 🌞

Thank you for filling in this questionnaire!

Don't forget to fill in the remaining two questionniares. If you did that already, great! Then, that is all you have to do for toady.

Tomorrow morning we will start with the daily questions. If you have any questions or issues with the app, please do not hesitate to contact us 🆘.

Enjoy the rest of the day 🙆!

B-5 *Consent Form presented to the participants before the start of the study*

Your participation in this study is completely voluntary and all your responses are treated anonymously. None of the responses will be connected to identifying information and wouldn't be shared with third parties. The data and information you give will only be used for statistical analyses. You can withdraw from the study at any time without giving any reasons! You can simply stop answering the daily questions.

If you would like to have further information about the research, now or in the future, feel free to contact us:

Lucie Pieroth (l.j.a.pieroth@student.utwente.nl)

Daniela Jäschke (d.s.jaschke@student.utwente.nl)

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(s), please contact the Secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente by ethicscommittee-bms@utwente.nl