

Bachelor's Thesis

**To what extent is the personality trait Neuroticism related to student's perceived stress levels in daily life?**

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## Abstract

**Background.** Prior studies focused on assessing the association between Neuroticism and perceived stress levels using retrospective approaches. However, this relationship has not been investigated yet in daily life neglecting the fluctuating nature of stress and leaving room for recall biases.

**Objective.** This study replicated the association between Neuroticism and general perceived stress levels using a retrospective approach. Further, the association between Neuroticism and average state stress levels was examined in daily life. Finally, it was investigated whether high Neuroticism was related to higher variations in state stress.

**Method.** An Experience Sampling Study was conducted for eight days with 44 university students (*Age* = 21.09, 81.8% females) on the basis of convenience sampling. Besides the trait measurements (Eysenck Neuroticism-Scale derived from the Eysenck Personality Questionnaire-Revised Short Form (EPQR-S) and the Perceived Stress Scale (PSS)) assessing the trait Neuroticism and general perceived stress, a single-item question (SNRS-11) assessed participants' average perceived state stress levels and state stress variations three times a day.

**Results.** Three simple linear regression analyses were used in order to assess the present hypotheses. Here, a positive significant association was found between Neuroticism and general perceived stress, implying that individuals high in Neuroticism experience higher recalled stress levels than individuals low in Neuroticism. Further, another positive significant association was discovered between Neuroticism and reported state stress, indicating that individuals high in Neuroticism reported higher average stress on a daily basis. No significant association was found between Neuroticism and variations in state stress.

**Conclusion.** This study provides insights into the association between Neuroticism and perceived stress levels. Results indicate that individuals high in Neuroticism report higher daily state stress, similarly to general perceived stress. Smartphone interventions should aim at supporting people high in Neuroticism in daily life by providing suitable coping techniques.

**To what extent is the personality trait Neuroticism related to student's perceived stress levels in daily life?**

The concept of stress has been a well-studied topic including the association between the trait Neuroticism and stress. Here, Neuroticism was positively related to stress levels (Gunthert, Cohen & Armeli, 1999; Abbasi, 2011; Mohiyeddini, Bauer & Semple, 2015). However, this relationship has not been investigated on a daily basis yet. Prior studies primarily used retrospective approaches to study individuals' stress levels in relation to Neuroticism (Ebstrup, Eplov, Pisinger & Jørgensen, 2011; Fornés-Vives, García-Banda, Frías-Navarro, Hermoso-Rodríguez & Santos-Abaunza, 2012) and thus, did not pay attention to the changeable nature of stress. As a result, stress was treated as a stable trait rather than a fluctuating state. For instance, the Perceived Stress Scale (PSS) is a questionnaire, measuring stress levels at a certain point of time asking participants to report feelings and thoughts during the last month (Cohen, 1994). As a consequence, traditional methods like the PSS leave room for recall biases (Raphael, 1987) and neglect that individuals' emotional states can vary over time through "subtle mood transitions or more sudden emotion shifts" (Kuppens et al., 2007, p. 262). The latter is especially the case for Neuroticism, as the personality trait was positively associated to affect variability implying that people high in Neuroticism vary more frequently in experiencing emotional states (Kuppens et al., 2007). Therefore, studies should focus on assessing stress levels on a daily basis due to the emotional variability of both constructs using the Experience Sampling Method (ESM).

By gaining more insights into the relationship between Neuroticism and perceived state stress, interventions can be adapted to the individuals' needs. On that basis, it is possible to support people high in Neuroticism more extensively in daily life.

## **The Nature of Stress and Associated Measures**

Stress is an inevitable phenomenon affecting many people across the world. It is known for its negative effects on health including psychological and physiological consequences (Kassin, Fein, & Markus, 2013). Stress can be defined as “an unpleasant state of arousal that arises when we perceive that the demands of a situation threaten our ability to cope with them effectively” (Kassin, Fein, & Markus, 2013, p. 573).

The construct of stress is highly dependent on external and internal circumstances. Lazarus (1990) highlighted the contextual and temporal nature of stress and emphasized to take into account the associated fluctuations. Further, he stressed that treating a construct as stable may lead to distortions of events. Linked to that, stress is a highly individualized phenomenon due to individuals’ subjective experience of stressful events (Lazarus & Folkman, 1984). Thus, perceived stress levels differ between individuals. For instance, individuals’ personality traits have a considerable impact on stress levels. Individuals high in Neuroticism experience stressful events more often (Vollrath & Torgersen, 2000) and have an increased reactivity to stressful events on a daily basis (Longua, DeHart, Tennen, & Armeli, 2009).

Extensive research has already been done using questionnaires where stress is treated as a stable construct (Ebstrup, Eplov, Pisinger & Jørgensen, 2011; Fornés-Vives, García-Banda, Frías-Navarro, Hermoso-Rodríguez, & Santos-Abaunza, 2012). Especially college students high in Neuroticism recalled more distress as a consequence of daily stressful events (Gunther, Cohen, & Armeli, 1999). However, these approaches usually gather data in a retrospective manner, leaving room for memory biases (Raphael, 1987), while neglecting the changeable nature of states (Kuppens et al., 2007). Thus, these questionnaires might not be sensitive towards student’s daily perceived stress levels and associated fluctuations.

The SNRS-11 is a validated tool measuring momentary and subjective stress levels across time (Karvounides et al., 2016). As a result, the SNRS-11 is often used in studies following the Experience Sampling Method (ESM). Here, momentary self-reports capture

“thoughts, feelings and behaviors as they are happening in real-time (or close to real-time)” (Conner & Barrett, 2012, p. 2). Therefore, they are susceptible towards momentary answers of participants (Conner & Barrett, 2012), as well as measure “affective variability in more detail” (Myin-Germeys et al., 2018, p. 124). Thus, the ESM is sensitive to student’s perceived stress levels on a daily basis, as participants are asked to fill out momentary surveys multiple times a day over a certain period of time (Myin-Germeys et al., 2018).

Several studies already assessed perceived stress levels in the university context following the ESM approach. For instance, Buschmeyer (2020) identified that binge watching was associated with higher subjective stress levels the following day. In addition to that, Wallisch-Prinz (2020) found a negative association between self-compassion and daily perceived stress levels.

## **Neuroticism**

The trait Neuroticism is part of the Five Factor Model of Personality representing a taxonomy to assess human personality. It can be defined as emotional stability (i.e., scoring low on the Neuroticism dimension) or instability (i.e., scoring high on the Neuroticism dimension) (Ciccarelli & White, 2018). People scoring high in Neuroticism are prone to recurring, intense negative emotions linked to uncontrollability. This includes excessive worrying, pessimism, low self-esteem, and being vulnerable to negative emotions (Barlow, Ellard, Sauer-Zavala, Bullis & Carl, 2014). Moreover, Neuroticism is related to facets like “anger, sadness, anxiety, worry and hostility” (Lahey, 2009, p. 2). This is supported by Trierweiler, Eid and Lischetzke (2002) identifying that individuals high in Neuroticism are inclined to express negative emotions. Similar results were found in a longitudinal study, finding a strong association between high Neuroticism scores and negative affect (Costa & McCrae, 1980). In contrast to that, individuals scoring low on the Neuroticism dimension tend to be emotionally stable, calm, and relaxed (Ciccarelli & White, 2018). A study demonstrated that people low in Neuroticism

are able to maintain their pleasant emotional state (Ng, 2012). This is in line with findings of Longua, DeHart, Tennen and Armeli (2019) identifying that they have a protective barrier from negative feelings.

Individuals high in Neuroticism are vulnerable to others' criticism and feel deficient. Besides critically evaluating themselves, they also interpret situations in a more negative manner (Kassin, Fein, & Markus, 2013). Therefore, incidents occurring during the day are appraised as more threatening and challenging (Ormel & Wohlfarth, 1991). Neuroticism reaches its peak level in late adolescence and decreases fairly during adulthood (Lahey, 2009) and is associated with decreased life expectancy (Jokela et al., 2020).

### **Neuroticism and Stress**

Some people are more vulnerable to stress than others. Personality seems to be of importance when it comes to stress and its associated processes (Vollrath, 2001). Especially individuals high in Neuroticism experience stressful situations more often (Vollrath & Torgersen, 2000). Supporting this, individuals high in Neuroticism were found to report higher levels of daily hassles (Vollrath, 2001). A longitudinal study highlighted that individuals who score high in Neuroticism “experience more distress across time and regardless of the situation” (Ormel & Wohlfarth, 1991, p. 752). Linked to that, a positive relationship was found between Neuroticism and self-reported stress levels in a study conducted under laboratory conditions (Mohiyeddini, Bauer & Semple, 2015). Similar results were found in a quasi-experiment by Abbasi (2011), identifying that people who score high in Neuroticism had higher perceived stress levels.

It seems to be the case that people high in Neuroticism lack emotional stability and thus, are more susceptible to negative emotional states and distress (Bunevicius, Katkute, & Bunevicius 2008; Vollrath, 2000). Particularly among students, Neuroticism is a predictor for hassles over time. Here, students are concerned with university-related worries, including

doubts regarding their academic capabilities and being uncertain about study prospects (Vollrath, 2000). In contrast to that, a study identified that college students low in Neuroticism “buffer (...) the impact of daily negative events on negative affect and night-time stress” (Longua, DeHart, Tennen, & Armeli, 2019, p. 553). This is in line with an experimental research study by Mohiyeddini, Bauer and Semple (2015) describing that people scoring low in Neuroticism perceive certain situations as less stressful than those high in Neuroticism.

### **The Present Research**

This study focuses on the relationship between Neuroticism and perceived stress levels in daily life in the university context. It is important to investigate this relationship as stress is a highly individualized construct which is sensitive to daily fluctuations. As former studies examining the impact of Neuroticism on stress were mostly conducted under laboratory conditions or using a retrospective approach, it is essential to assess perceived stress levels using the ESM. The ESM captures participants' answers on a momentary basis and is therefore highly susceptible to changes. This is specifically important when working with the trait Neuroticism. As mentioned above, it seems that people with highly neurotic tendencies have a heightened reactivity to stressful situations, as well as affect variability. Thus, their reactance to stressful events might take place more rapidly leading to sudden increases in stress levels which are overseen by traditional assessment methods. Therefore, the research question is the following: To what extent is the personality trait Neuroticism related to student's perceived stress levels in daily life?

First, it will be examined whether the relationship between the trait Neuroticism and trait stress can be replicated as found in prior research. *(1) It is expected that the association between the trait Neuroticism and trait stress is strongly positive, as people who score high in Neuroticism tend to report more perceived stress than people who score low in Neuroticism.* Second, the relationship between the trait Neuroticism and state stress will be explored. *(2) It*

*is expected that participants scoring high in Neuroticism show higher levels of average state stress compared to participants scoring low in Neuroticism.* Third, the relationship between the trait Neuroticism and variations in state stress will be investigated. (3) *It is expected that participants scoring high in Neuroticism show higher variations in state stress compared to participants scoring low in Neuroticism.*

## **Method**

### **Participants**

In the present study, English-speaking students, aged 18 years or older who owned a device capable of downloading and using the Ethica application, were eligible to take part. Participants were gathered through convenience sampling by using the Test Subject Pool System of the University of Twente (SONA), social media (e.g., Instagram) and through snowball sampling.

### **Materials and Measures**

This study was part of a greater study, investigating other constructs besides Neuroticism, and state and trait stress. Thus, the present test battery included questionnaires measuring Neuroticism and stress, as well as questionnaires assessing emotion-focused coping, and basic need satisfaction. However, only the questionnaires of Neuroticism, trait stress and state stress were relevant to the present study and are described further.

#### *Ethica Application*

Ethica is an application for Android and IOS, developed by Ethica Data (2020) in order to measure constructs using smartphone devices. Ethica enables to ask questions on a daily basis using predetermined times and thus, is especially suitable for ESM studies. Participants receive push notification on their smartphones which function as a reminder to fill out



questionnaires. Here, surveys are asked to be completed in a certain time interval at a certain time before they expire. Collecting data using a smartphone device increases survey completion and decreases participant burden (Van Berkel, Ferreira & Kostakos, 2017).

### *Trait Measures*

**Trait Stress: The Perceived Stress Scale (PSS).** To assess the trait stress level of participants, the PSS by Sheldon Cohen (1994) was used. This questionnaire entails 12 items (see Appendix A) which measure levels of appraised stress during the last month (e.g., “In the last month, how often have you felt nervous and “stressed”?”). Participants had to indicate how often these statements applied to them, using a five-point Likert-scale, ranging from zero (“never”) to four (“always”). Six of the 12 items were positively stated (e.g., “In the last month, how often have you been able to control irritations in your life?”) and needed reversed coding. The other six statements were negatively stated (e.g., “In the last month, how often have you found that you could not cope with all the things that you had to do?”). Total scores were computed by summing all the items, resulting in a continuous score range between 0 and 40. Here, higher scores denoted higher levels of perceived stress.

**Trait Neuroticism: The Eysenck Neuroticism-Scale derived from the Eysenck Personality Questionnaire-Revised Short Form (EPQR-S).** The EPQR-S is a 48-item personality questionnaire designed by Eysenck, Eysenck and Barrett (1985) to assess the extent to which individuals score in Extraversion, Neuroticism, Psychoticism and Lying. Here, only the Neuroticism-Scale was used (Appendix B). The Neuroticism-Scale of the EPQR-S contains 12 items and uses a dichotomous scale to assess Neuroticism. However, in this study a five-point Likert-scale was used, ranging from zero (“strongly disagree”) to four (“strongly agree”) to improve the psychometric properties of the scale (Muniz, García-Cueto, & Lozano, 2004). There are no reversed items in the Neuroticism-Scale. Thus, total scores were computed by summing all items, resulting in a continuous score between 0 and 48. Higher scores indicated higher levels of Neuroticism, whereas lower scores implied lower levels of Neuroticism.

### *State Measure*

**State Stress: Stress Numerical Rating Scale-11 (SNRS-11).** State Stress was measured using the SNRS-11 which consists of a single item (“On a scale from zero to 10, with zero being no stress and 10 being the worst stress possible, what number describes your level of stress best right now?”). The scale indicated moderate to strong construct validity, as identified by Karvounides et al. (2016).

### **Psychometrics**

The reliability of the PSS and the EPQR-S was assessed by computing Cronbach’s Alpha for each questionnaire. Cronbach’s alpha coefficient ranges between 0 and 1. Here, George and Mallery (2003) provided an interpretation of the coefficient ranging from excellent ( $\alpha > 0.9$ ) to unacceptable ( $\alpha < 0.5$ ). Francis, Lewis, & Ziebertz (2006) indicated a good reliability for the EPQR-S. In the present study, the reliability of the EPQR-S was found to be excellent ( $\alpha = .91$ ). Further, previous studies indicated that the internal reliability of the PSS was found to be acceptable to excellent. Next to that, the PSS showed a satisfactory test-retest reliability (Lee, 2012). The reliability assessment of the current study revealed an excellent reliability regarding the PSS ( $\alpha = .94$ ).

For the SNRS-11, a split half reliability test was done. The strength of the Pearson’s Correlation Coefficient can be described as negligible ( $r < 0.1$ ), weak ( $r < 0.4$ ), moderate ( $r < 0.7$ ), strong ( $r < 0.9$ ) and very strong ( $r > 0.9$ ) (Schober, Boer & Schwarte, 2018). The test revealed an excellent Pearson Correlation Coefficient between the halves ( $r = .97$ ).

### **Procedure**

The design used was a quantitative online survey following the ESM approach. Surveys were distributed via the application Ethica. Prior to the actual data collection process, the study was tested in order to ensure the functionality of the Ethica application. The trial lasted four

days in order to find possible difficulties with the setup of the study. Based on this, the times of the three notifications per day were adjusted as the prior settings were not correctly informing participants.

The entire data collection process continued for 22 days. Originally, individuals were asked to complete the daily questionnaire for seven days. However, due to technical problems with the time settings, notifications for the daily survey were sent for eight days. It is recommended to have a minimum study duration of seven days to establish a representative sample (Van Berkel, Ferreira & Kostakos, 2017). After signing up to the study, participants were asked to download the Ethica application following a link which directed them either to the Google Play Store for Android or to the Apple Store for iOS. After registering for the app, participants received information about the purpose of the study, instructions on how to use the Ethica app, and an outlook on what to expect the upcoming days. On the day of registration, participants had to fill in an informed consent, as well as three different questionnaires, including the Neuroticism-Scale of the EPQR-S and the PSS.

Subsequently, participants received notifications three times a day over a period of eight days between 9AM to 10.30AM, 2PM to 3.30PM, and 8PM to 9.30PM. The daily questionnaires consisted of eight items in total. In this study, the SNSR-11 was used which consists of one item only. Thus, it took participants a maximum of five minutes to complete the daily survey. The length of the questionnaire ensures the maintenance of participant motivation (Van Berkel, Ferreira & Kostakos, 2017). Each item had to be answered in order to get access to the next one. This was done to reduce incomplete data. Participants who were students at the University of Twente and registered via the Test Subject Pool System gained 1.5 research credits after successfully completing the study.

## Data Analysis

After the data collection process, the data was exported from Ethica Data using a CSV file and imported into SPSS. Here, the SPSS version 27.0 was used including two-tailed tests. The significance level for all analyses was set to  $p < .05$ . First, the data had to be adjusted to fit the corresponding analyses. Here, two datasets were established including the trait measurements and state measurements. Whereas one dataset was kept in the wide-format, another one was modified into a long-format. Participants who did not complete the PSS and the EPQR-S entirely, as well as individuals with a response rate of 60% or lower were excluded from the analyses.

Descriptive statistics regarding means and standard deviations were calculated in order to outline the participants' demographic data, as well as characteristics on Neuroticism and trait stress. Total scores of Neuroticism and trait stress were computed by adding up the corresponding items. Prior to all linear regression analyses, homoscedasticity and normality were checked, as well as the absence of outliers. The variables used in the following analyses were standardized by computing the z-scores. This ensures that the results obtained can be compared.

To investigate the first hypothesis, a linear regression analysis was used to investigate whether a positive association between Neuroticism and trait stress is present. Here, the dataset in wide format, as well as the total scores of Neuroticism and trait stress were used. Neuroticism was set as the predictor, whereas trait stress was determined as the outcome variable.

The second hypothesis was examined using a second linear regression analysis. Using the dataset in long format, a Linear Mixed Model (LMM) was performed to compute the estimated marginal means (EMM) of state stress. State stress (EMM) was used as the outcome variable. In contrast to that, Neuroticism was determined as the predictor.

To investigate the third hypothesis, the wide format was used. Here, a third regression analysis was performed by computing a variable including the standard deviations of state stress

for each participant. This was determined as the outcome variable, whereas Neuroticism was identified as the predictor.

Further, to check the reliability of the trait measures, Cronbach’s alpha was computed for the PSS and the EPQR-S. The reliability of the repeated item of the SNRS-11 was assessed by splitting the state measurements into halves based on odd and even numbers of the timepoints. On that basis, two new variables were computed for each half and correlated by using Pearson’s Correlation Coefficient.

## Results

### Participant Flow

In total, 63 participants took part in the present study. However, participants who did not fully complete the trait questionnaires and with a response rate of 60% or less were excluded from the sample (n = 19). Hence, for the final analysis 44 participants were used.

### Descriptive Statistics

In the sample, participants’ age ranged from 18 to 27 ( $M = 21.09$ ,  $SD = 1.82$ ). 81.8% of the participants identified as female, while 18.2% were male. Further, the majority of the participants were from Germany (65.9%) and the Netherlands (22.7%), followed by participants from Romania (4.5%), Great Britain (2.3%), Italy (2.2%) and the USA (2.3%). Descriptive data on the trait measurements are listed in Table 1.

Table 1. *Minimum, maximum, mean and standard deviations of the trait variables of the final sample*

Variable	Minimum	Maximum	Total (N = 46)
	(Scale Minimum)	(Scale Maximum)	M (SD)

Trait Neuroticism	4 (0)	42 (48)	24.34 (9.80)
Trait Stress	3 (0)	40 (40)	19.09 (8.47)

In total, 899 state measurements were recorded. Here, the minimum score obtained was 0, whereas the maximum score obtained was 10. Participants showed substantial variability in state stress levels (Figure 1), indicating that individuals vary in their experiences of momentary stress. Moreover, there was considerable variation within persons, but also between persons.

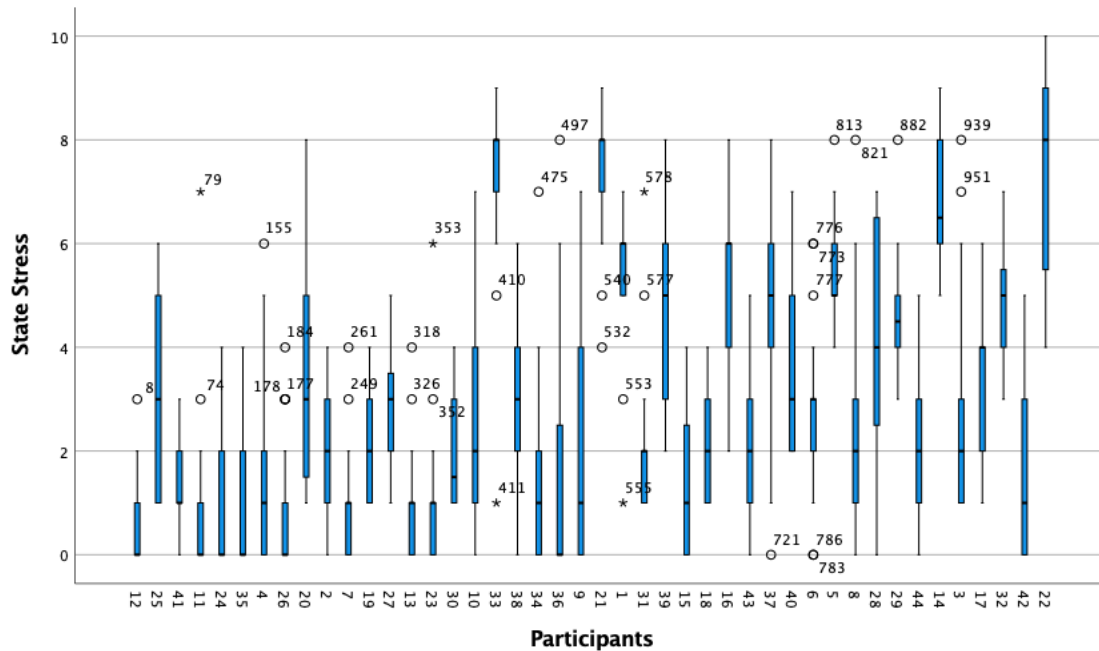


Figure 1. Boxplot showing the variation in state stress for each participant sorted by ascending Neuroticism scores with reference line set at the group mean of state stress ( $M = 3.00$ ).

### Trait Neuroticism and Trait Stress

The association between Neuroticism and trait stress was examined using a simple linear regression analysis. The results of the regression indicated that Neuroticism explained 58% of the variance,  $R^2 = .58$ ,  $F(1, 42) = 57.97$ ,  $p < .001$ . Neuroticism significantly predicted total scores of trait stress,  $\beta = .76$ ,  $p < .001$ . Figure 2 shows a scatterplot illustrating the association between Neuroticism and trait stress. The regression analysis indicates that

individuals scoring high in Neuroticism tend to perceive higher trait stress compared to individuals scoring low in Neuroticism.

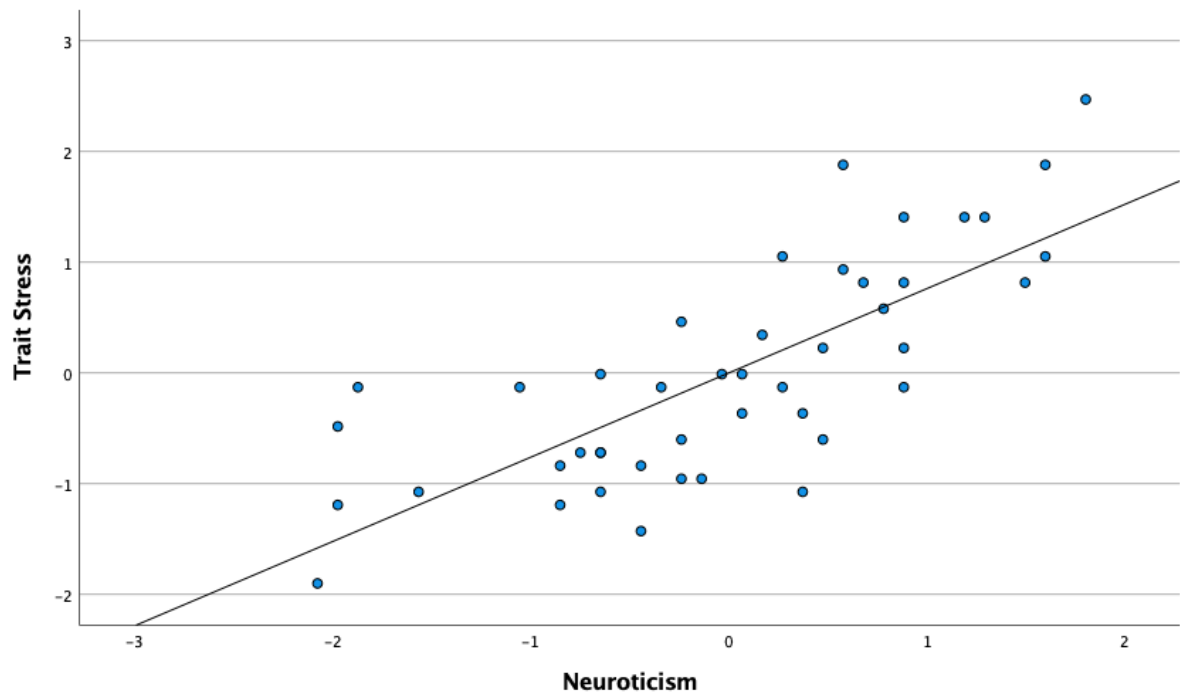


Figure 2. Scatterplot with fit line of Neuroticism by trait stress depicting the association between Neuroticism and trait stress using the standardized scores.

### Trait Neuroticism and Average State Stress

The association between Neuroticism and average state stress was examined using a simple linear regression analysis. The results of the regression suggest that Neuroticism explains 26.5% of the variance,  $R^2 = .26$ ,  $F(1, 42) = 15.16$ ,  $p < .001$ . It was found that Neuroticism significantly predicts average state stress,  $\beta = .52$ ,  $p < .001$ . Figure 3 shows a scatterplot representing the association between Neuroticism and average state stress. The regression analysis indicates that individuals scoring high in Neuroticism tend to perceive higher daily state stress compared to participants scoring low in Neuroticism.

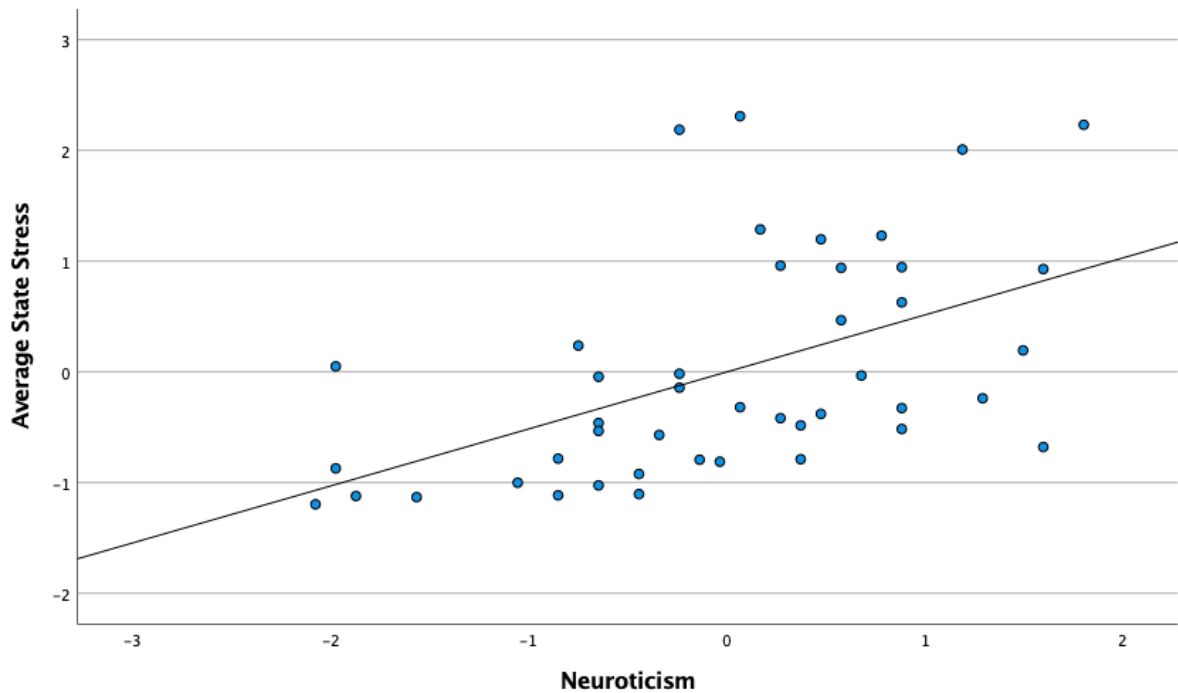


Figure 3. Scatterplot with fit line of Neuroticism by trait stress representing the association between Neuroticism and state stress using the standardized scores.

### Neuroticism and the Variability of State Stress

The association between Neuroticism and the variation of state stress was used using a simple linear regression analysis. The results of the regression revealed a non-significant association between Neuroticism and the standard deviation of state stress,  $\beta = .27$ ,  $p = .08$ , CI [-.03, .57]. The results suggest that there is no association between Neuroticism and the variation in state stress.

### Discussion

The aim of this study was to examine the association between Neuroticism and perceived stress levels in daily life. Based on prior studies, it was investigated whether the correlation between Neuroticism and perceived stress levels could be replicated. Further, the association between Neuroticism and average daily perceived stress level was explored. Finally, the association between Neuroticism and the variability of state stress was examined. The study



provides three main findings. First, this study replicated the findings that Neuroticism and trait stress are strongly positively correlated, indicating that individuals high in Neuroticism experience higher general perceived stress levels (Abbasi, 2011; Mohiyeddini, Bauer & Semple, 2015). Second, it was found that Neuroticism was positively associated with average state stress levels, suggesting that individuals in high Neuroticism experience higher average levels of daily state stress. Third, the inferential statistics indicated a non-significant association between Neuroticism and the variability of state stress, implying that high Neuroticism is not related to high fluctuations in state stress. These results could have been present due to the small sample size of the current study. The wide confidence interval implies that there is considerable variation of state stress between participants.

## **Interpretation of Results**

### *Neuroticism and Stress*

The present study supports the hypothesis which aimed at replicating prior studies. Having the predisposition of high Neuroticism is highly positively correlated to levels of perceived trait stress. This is in line with results of Abbasi (2011) and Mohiyeddini, Bauer and Semple (2015) identifying a similar pattern that individuals high in Neuroticism experience higher levels of perceived trait stress. They explain that high Neuroticism might inhibit the ability to behaviourally cope with stress. High Neuroticism seems to counteract stress regulating behaviour leading to higher perceived stress levels.

Moreover, as anticipated, the current study found out that individuals high in Neuroticism perceive higher levels of average perceived state stress compared to individuals low in Neuroticism. To the researcher's knowledge, no prior study investigated this association following the ESM before. Thus, the number of comparable research is limited. However, Neuroticism is strongly associated with negative affectivity (NA) (Costa & McCrae, 1987). Here, an ESM study identified that individuals high in NA reported higher distress to daily

struggles than participants low in NA (Marco & Suls, 1993). Marco and Suls (1993) concluded that individuals high in NA are more reactive to daily problems and thus, experience higher everyday distress. This might be applicable to Neuroticism as well.

Applying the Diathesis-Stress model, Neuroticism can be seen as a predisposition, making individuals scoring high on the trait more susceptible to stressors. Here, the model states that stress itself might have considerable impact on people having a certain predisposing basis compared to people that do not have such a vulnerability. Thus, people high in Neuroticism might be more susceptible to stress, as their threshold is lower than that of emotionally stable individuals (Zuckerman, 1999). Supporting the previous findings, Vollrath (2000) and Bunevicius, Katkute, and Bunevicius (2008) state that individuals high in Neuroticism are more prone to negative emotional states and distress. Further, people high in Neuroticism evaluate events as more adverse and challenging (Ormel & Wohlfarth, 1991), and are more reactive to stressful events (Longua, DeHart, Tennen, & Armeli, 2009). This might result in reporting higher stress levels, as found in the present study.

The trait Neuroticism is also known for its affect variability (Kuppens et al., 2007). Taking into account fluctuations in state stress is especially important when working with a trait like Neuroticism which is associated with sudden mood changes (Chandler, Ebmeier & Stewart, 2012). Consequently, it was argued that people high in Neuroticism have higher variations in perceived state stress. The present study could not confirm this assumption. High Neuroticism was not associated with high variations in state stress. These results are supported by Kalokerinos et al. (2020) using a diary approach, as well as an ESM. They concluded that Neuroticism is related to stronger negative emotions but not to higher variations in these feelings. This is in line with another ESM study stating that “high Neuroticism was associated with high emotional intensity” (Atkinson & Violato, 1994, p.778). These studies represent the results as found in the present research. Individuals high in Neuroticism perceived higher

average state stress levels but no association between Neuroticism and state stress variation was present.

However, the present non-significant results should be interpreted with caution. The current study collected state measurements three times a day over eight days with 44 participants only. An ESM study by Dauvier, Pavanu, Vigouroux, Kop & Congard (2019) discovered that individuals high in Neuroticism showed more variation in their emotional states including positive and negative feelings. Their study design was based on 191 participants who were assessed five times a day over a two-week period. Therefore, the findings of this study might have been a result of the present study design. Taking into account responses of more participants who have been assessed multiple times a day over an increased period might result in capturing more potential fluctuations.

Moreover, the wide confidence interval indicates that there is considerable variability between participants present. In line with that, Figure 1 suggests that high Neuroticism seems to be related to high state stress variability, as multiple participants conform with this pattern. However, some participants deviate from it. For example, participants 10, 20 and 25 score low in Neuroticism but show considerable stress variability. Further, participants five and six score high in Neuroticism but do not represent as much variability as other participants high in Neuroticism.

Other variables might have impacted the association between Neuroticism and the variability of state stress. For instance, situational or contextual factors might have had a possible influence. Here, the trait-situation interaction model provides an explanation indicating that an interplay between personality and situational factors is present resulting in individual's thoughts, feelings and behaviours (Taylor & Morse, 2020). According to this theory, "certain *kinds* of persons will behave in certain *kinds* of ways in certain *kinds* of situations" (Bem, 1983, p. 566). Therefore, taking into account internal and external impacts might provide a better understanding of behaviour (Taylor & Morse, 2020). Especially the construct of stress is highly

susceptible to external and internal circumstances due to its contextual and temporal nature (Lazarus, 1990). Consequently, the current findings might have been the result of disregarding potential situational factors impacting the association between Neuroticism and state stress variability.

To conclude, the present results suggest that high Neuroticism makes individuals more vulnerable to perceived stress levels. This is applicable to general perceived stress, as well as to daily average perceived stress. Further, the results imply that Neuroticism is not associated with the variability of state stress, only to the extent of it.

### **Neuroticism and Stress Measures**

The present study was based on two different approaches to assess perceived stress levels in relation to Neuroticism. Whereas the first hypothesis used a retrospective approach (PSS) to measure general perceived stress levels, the second hypothesis focused on measuring daily perceived stress levels following the ESM. Here, both approaches presented similar results implying a positive association between Neuroticism and perceived stress levels. However, the retrospective approach indicated a slightly higher positive association between Neuroticism and general perceived stress compared to the relation between Neuroticism and average perceived state stress.

Conner and Barrett (2012) linked different approaches to measure self-reported constructs to different selves. For instance, the researchers argue that traditional retrospective questionnaires, like the PSS, capture the “remembering self” resulting in answers related to what participants remember or believe about themselves. Contrary to that, the ESM as part of the ambulatory momentary tools is associated with assessing the “experiencing self”. The experiencing self is closely connected to the present environment, as well as to bodily processes (Conner & Barrett, 2012). Applying this to the current findings, the “remembering self” and the “experiencing self” of individuals high in Neuroticism seem to be approximately similar

when assessing perceived stress levels. This might indicate that the beliefs of individuals high in Neuroticism about their prior perceived stress levels for the past month are related to their average perceived state stress of the past week.

The slightly stronger association between Neuroticism and general perceived stress might be due to slightly overestimating prior experiences of perceived stress. Linked to that, an EMA study examining subjective distress in terms of quitting smoking identified a recall bias. Participants' immediate responses differed from retrospective answers due to overemphasizing their recalled experience (Shiffman et al., 1997). Especially individuals that tend to Neuroticism recall incidents more negatively than experienced in real life (Larsen, 1992). Furthermore, a study by Lloyd and Lishman (1975) identified that individuals high in Neuroticism recall negative events faster than positive events. Consequently, people high in Neuroticism might be inclined to negatively evaluate their past, leading to a minor negative connotation when recalling prior experiences. This might lead to the present results identifying slightly higher general perceived stress levels compared to reported average state stress in relation to Neuroticism.

To conclude, both approaches assessing perceived stress levels seem to provide similar results. A possible explanation might be that average daily perceived stress and general perceived stress in the context of Neuroticism seem to be closely related. Moreover, a slight recall bias might be present when assessing perceived trait stress due to slightly overestimated stress levels.

### **Strengths and Limitations**

This study adds to literature concerning Neuroticism and perceived stress levels with focus on stress in the daily context. It provides unique insights into the association between Neuroticism and average daily state stress. To the researcher's knowledge, no prior study investigated this relationship following the ESM. The ESM provides advantages concerning

participant's experienced emotional states as it represents "subjective experiences situated in a particular time and context" (Conner & Barrett, 2012, p.2). Therefore, this study provides a better understanding of average perceived stress in the daily context.

Moreover, this study shows excellent psychometric properties of the scales. In this sample, an excellent reliability of the PSS and the EPQR-S was identified, indicating high internal consistency. This represents a higher reliability than assessed in previous studies (Francis, Lewis, & Ziebertz, 2006; Lee, 2012). The SNRS-11, measuring daily perceived stress levels, had an excellent correlation between the two halves of the state items. Therefore, this study provides a very good basis due to excellent reliability of the measures.

However, there are limitations. The sample size of this study could have been greater to increase the variability of participants' characteristics. The sample resulted in an overrepresentation of females (81.8%). A study conducted by Jorm (1987) identified that females presented higher scores of Neuroticism than males. As a result, this sample might represent higher Neuroticism scores than found in the general population.

### **Future Research and Implications**

Based on the mentioned limitations, future research should take into account some implications. A replication of this study might be beneficial to confirm the present findings. Here, future research should pay special attention to the nature of the chosen measurement tools aiming at assessing perceived stress levels. It is advisable to carefully select self-report measurements representing the selves that are intended to be measured to ensure construct validity. It might be valuable to extend the current research design by using additional physiological measures. This can be done through assessing "autonomic arousal through heart rate, respiration rate, blood pressure or sweat gland activity" (Kassin, Fein, & Markus, 2013, p. 574). Doing this would give valuable insights into the quality and reliability of the participants' reported responses (Van Berkel, Ferreira, & Kostakos, 2017).

Moreover, future research should focus on an adequate sample size to increase the variability of participants' characteristics to diminish overrepresentation. Further, the present study assessed participants' momentary answers three times a day over a period of nine days and with university students only. Here, increasing the number of the assessed state measures per day and the overall time frame of these assessments might be beneficial. Next to that, it might be interesting to examine different samples to ensure the representativeness of the broader population. Finally, it is advisable to identify potential situational variables when assessing Neuroticism and the variability of state stress. For instance, as this study was conducted using university students only, participants' state measurements might have been impacted by the scheduled activities of their universities. This might lead to more variation in state stress or less depending on events, for example, exam periods or vacation breaks.

In general, the findings of this study indicate that high Neuroticism is related to high perceived stress levels, whether it be general perceived stress or daily average state stress. This insight might be valuable for smartphone-based interventions which aim at providing "crowd therapy". For instance, Paredes et al. (2014) provided stress-reducing interventions via smartphone based on the user's characteristics and "their temporal circumstances over time" (p.1). After a four-week period, users reported facilitated self-awareness concerning stress. Next to that, they acquired simple techniques to cope with stress. Based on that, users engaged in more helpful coping behaviors related to reducing stress (Paredes et al., 2014). Therefore, individuals who score high in Neuroticism might benefit from smartphone interventions that are available at any time. These might increase their understanding of their vulnerability to high stress levels and provide a basis for engaging in coping strategies that reduce stress in daily life.

Moreover, although this study found a non-significant association between high Neuroticism and state stress variability, multiple participants being high in Neuroticism showed higher variations in state stress in this study (Figure 1). Thus, smartphone interventions might

be particularly suitable as they are available at any time, giving participants with highly neurotic tendencies immediate help when needed.

## **Conclusion**

Most studies use a retrospective approach to investigate the relationship between Neuroticism and stress. The present study gives insights into the association between Neuroticism and general perceived stress, as well as average perceived state stress using the ESM. Both associations provided similar results indicating that individuals who score high in Neuroticism report higher perceived stress levels. Here, these individuals reported slightly higher trait stress compared to average state stress. Further, no association between Neuroticism and variations in state stress was found. The results suggest that high Neuroticism makes individuals more susceptible to high perceived stress levels. Thus, it is of utmost importance that stress-reducing interventions incorporate this vulnerability by providing daily stress-coping techniques that are available at any time through smartphone devices.



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## **Appendix A - Trait Stress: The Perceived Stress Scale (PSS)**

(\* ) Reverse Scored Item.

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 how often you felt or thought a certain way.

1. In the last month, how often have you been upset because of something that happened unexpectedly?
2. In the last month, how often have you felt that you were unable to control the important things in your life?
3. In the last month, how often have you felt nervous and “stressed”?
4. In the last month, how often have you felt confident about your ability to handle your personal problems? (\*)
5. In the last month, how often have you felt that things were going your way? (\*)
6. In the last month, how often have you found that you could not cope with all the things that you had to do?
7. In the last month, how often have you been able to control irritations in your life? (\*)
8. In the last month, how often have you felt that you were on top of things? (\*)
9. In the last month, how often have you been angered because of things that were outside of your control?
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?



**Appendix B - The Eysenck Neuroticism-Scale derived from the Eysenck Personality Questionnaire-Revised Short Form (EPQR-S)**

1. Does your mood often go up and down?
2. Do you ever feel 'just miserable' for no reason?
3. Are you an irritable person?
4. Are your feelings easily hurt?
5. Do you often feel 'fed-up'?
6. Would you call yourself a nervous person?
7. Are you a worrier?
8. Would you call yourself tense or 'highly strung'?
9. Do you worry too long after an embarrassing experience?
10. Do you suffer from 'nerves'?
11. Do you often feel lonely?
12. Are you often troubled about feelings of guilt?