STRESS RECOVERY IN COLLEGE STUDENTS INFLUENCED BY RUMINATIVE THINKING AND SOCIAL SUPPORT – AN EXPERIENCE SAMPLING STUDY

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Abstract

Background. Without efficient coping strategies, recovery from daily stress is prolonged which leads to lower levels of well-being (Almeida, 2005). While rumination is an emotion regulation assumed to increase stress reactivity and depressive symptoms, social support is expected to counteract this effect. The current study explored the effectiveness of rumination on affective recovery following daily stress as this relationship is still understudied. Furthermore, it tested whether social support buffers the negative effects of rumination.

Method. With an Experience Sampling Method, 26 students ($M_{age} = 21.23$, $SD_{age} = 1.77$; 69.2% female) filled in a questionnaire ten times per day. Linear Mixed Model analyses with rumination and the interaction effect of rumination and social support as independent variables assessed affective recovery.

Results. The relationship between rumination and stress recovery was not significant. No interaction effect of social support and rumination on stress recovery was found. However, a significant effect of rumination on stress reactivity was detected, B = 0.10, SE = 0.02, t(728) = 4.14, p < .001, CI [0.05, 0.15]. Further, a significant three-way interaction effect between social support, rumination and stress on stress reactivity was found, B = 0.01, SE = 0.00, t(733) = 4.93, p < .001, CI [0.01, 0.02].

Conclusion. Even though no significant effects on stress recovery were found, rumination increased stress reactivity which might reflect the prolonging effects of recovery in daily life as measurements of ESM studies are naturally delayed. These time-related implications are beneficial for future ESM studies. Further, indications for a maladaptive effect of social support for high ruminators emerged.

Keywords: emotion regulation, rumination, affective recovery, daily stress, ESM

In Germany, every fourth individual is affected by a mental disorder (DGPPN, 2022). Being exposed to stress is the major factor of risk for the development of mental disorders (Almeida, 2005). Over the last few years, the stress level is continuously increasing. In 2021, a German study has shown that two out of three people reported feeling stressed regularly (Die Techniker, 2021). Further, 26% experienced excessive exposure to stress in daily life (Die Techniker, 2021). This is even more problematic when people's stress recovery is prolonged. Stress recovery is conceptualized as the process of turning back to a normal activation level (Leger et al., 2018). To understand why certain individuals suffer more from daily life stress the use of coping strategies has to be investigated, as the recovery process depends on those (Flores-Kanter et al., 2021).

Daily stressors

Across the day, several events challenge our emotional stability like a discussion with a relative or an upcoming deadline. Widely accepted, students seem to be more vulnerable to daily stress compared to other groups as they are confronted with important life choices when becoming independent (Jiang et al., 2018). While research on stress frequently focuses on traumatic life events and the physical consequences, daily stressors also have an influential impact on health (Bolger et al., 1989; Piazza et al., 2013). The investigation of daily stressors is especially important because psychological disorders may be more determined by daily stress than by major life events (Myin-Germeys et al., 2005).

Furthermore, daily stress seems to be highly influential on the emotional stress response, as expressed in mood changes (Krkovic et al., 2018). The increase in negative affect and decrease in positive affect has been proven to diminish subjective well-being (Piazza et al.,

2013). These consequences of daily stress emphasize the importance of investigating factors that influence the affective recovery from it.

Stress recovery

Mere exposure does not control how much individuals will be affected by a stressor. Instead, it is about how the person emotionally recovers from the stressor as this influences the development of symptoms (Almeida, 2005). Stress recovery can be conceptualized as the "return to baseline from a previous activation level" (Leger et al., 2018, p.1284). The effort-recovery model by Meijman and Mulder (1998, as cited in Geurts & Sonnentag, 2006) states that the recovery process is prolonged because it takes additional efforts to cope with a situation after more stress was experienced. Emotional affectivity is heightened and without emotional resources being recharged, negative mood and the receivability of mental disorders are increased (Chue et al., 2018; Geurts & Sonnentag, 2006). Further, the difference between available emotional resources and the ideal response increases affective stress and prolongs recovery (Marco & Suls, 1993).

Prior research substantiates the belief that prolonged affective recovery, the emotional part of stress recovery, causes emotional disturbances such as problems in emotion regulation, depressed feelings and an increase in emotional distress (Capobianco et al., 2018). Findings state that stress recovery is an important process that protects an individual from psychopathological illnesses (Piazza et al., 2013). However, the diverse influences on affective recovery are still understudied.

Experience sampling method

To assess affective recovery a momentary assessment strategy is most beneficial since it provides real-time information about individuals' experiences (Wichers et al., 2011). The

experience sampling method (ESM) is a structured diary technique that assesses thoughts and emotions at several time points during a day (Larson & Csikszentmihalyi, 1983). Consequently, ESM detects the smallest fluctuations in the variable within a person (Fisher & To, 2012; Myin-Germeys & Kuppens, 2022). ESM investigates the quickly changing concept of recovery by testing whether individuals' emotional well-being improved between two measurement points (Myin-Germeys & Kuppens, 2022). Besides, this method is beneficial because it reduces recall bias as participants report their affective state without timely distortions (Wichers et al., 2011). In addition, studies testing the feasibility of ESM have agreed that participants felt no additional stress associated with the daily measurements (Kramer et al., 2014). Particularly for the investigation of stress reactivity in psychopathology, ESM studies have shown to be useful due to their high construct validity (Vaessen et al., 2015).

Coping

To adjust to daily stressors and regulate affectivity, individuals intentionally change their thoughts and behaviour with coping strategies (Liu et al., 2022). By self-regulating behaviour, coping strategies aim to keep emotional balance (Flores-Kanter et al., 2021). The Transactional Model (Lazarus & Folkman, 1987, as cited in Obbarius et al., 2021) differentiates between coping strategies that are problem and emotion-focused. Both influence affectivity, however, the former mainly causes positive emotions, while the latter often increases negative affect because the individual constantly focuses on the negative feelings which heightens negative mood and hopelessness (Ben-Zur, 2009).

The choice of emotion regulation strategy is important for the recovery process because the strategies influence the reaction to the stressor and whether resources are recharged. To what extent a coping strategy can buffer the negative effects depends on its effectiveness (Capobianco et al., 2018). While the effectiveness of coping strategies on momentary affectivity is widely known, the influence on recovery in daily life is still unknown.

Rumination

Rumination is one coping strategy often linked to depression. It is an emotion-focused coping strategy that is characterized by repetitive thoughts about one's personal problems (Capobianco et al., 2018). Rumination is widely known to be maladaptive because it does not guide the individual towards a solution. Instead, the consequences are emotional responses like feelings of helplessness, heightened negative mood and depressive symptoms (Capobianco et al., 2018)

Prior research generally confirms that repetitive thoughts exhaust cognitive and emotional resources (De Lissnyder et al., 2012). Following this, rumination is not only a reaction to stress, but it can also create new stress due to a weakened performance and negative self-focus (Capobianco et al., 2018; Flynn et al., 2013). Consequently, influencing emotion regulation, rumination is hypothesised to prolong the affective recovery process (Capobianco et al., 2018).

Social support

The consensus has been that social support plays an important role in the process of emotion regulation (Marroquín, 2011). It is defined as "the provision of assistance or comfort to others, typically to help them cope with biological, psychological, and social stressors" (American Psychological Association, n.d). Most papers investigate the influences of social support on general well-being and present it as a protective factor for the development of mental health issues (Afifi et al., 2013; Hefner & Eisenberg, 2009). Particularly for students, the social network is highly influential as they have not fully learned how to cope with stress by themselves (Jiang et al., 2018). Based on Burleson's and Goldsmith's theory (1996) of conversationally

induced reappraisal, social support decreases emotional distress due to the positive re-evaluation of a stressor.

However, concerning rumination, ambiguity exists in how it is influenced by social support. A laboratory study by Affi and colleagues (2013) showed that social support may help find a solution to the problem and decrease rumination as the wheel-spinning cycle of negativity is disrupted. Regardless, social support has also been shown to amplify attention bias and increase ruminative behaviour in daily life (Rose, 2002). When co-ruminating, individuals repeatedly discuss personal problems with someone else and speculate about the consequences of the problem leading to increased negative affect (Rose, 2002). This multi-directionality shows that it is unknown how momentary social support influences the effect of rumination on stress recovery.

The current study

The purpose of this study was to investigate the influence of momentary rumination on affective recovery following daily stress as recovery is an important process protecting an individual from psychopathological illnesses. Because social support has been shown to have positive and negative consequences for rumination, the study explored whether social support can buffer the negative effects of rumination on stress recovery, for example, because of a reevaluation of the problem. Consequently, the following research question was investigated:

What is the effect of rumination in affective recovery from daily stressors, and does social support influences it?

Before said, particularly students seem to be vulnerable to daily stress and are influenced by their social environment, which justifies them as a target group (Jiang et al., 2018). To get an answer to the research question, it was first hypothesised that rumination following a daily

stressor is negatively associated with the efficiency of stress recovery in students. Secondly, it was tested whether the negative effects of rumination were reduced when social support was provided.

Methods

Design

This study applied an empirical quantitative research design consisting of daily momentary assessment to explore daily-life processes. ESM is most beneficial for assessing recovery because people report their current emotions and thoughts several times a day without adapting to their daily life (aan het Rot et al., 2012). Data was obtained digitally because this allowed individuals to respond directly after they get the notification from the application (Almeida, 2015). Following the recommendations of Myin-Germeys and Kuppens (2022), a study duration of six days was chosen to include weekdays as well as weekend days as these differently impact individuals' moods. A quantity of ten measurements per day was set to ensure that not too much time between the notifications passes. Too large gaps in time could risk that the participant had already recovered from the stressor and that fluctuations in the recovery process would be undetectable. The questionnaires were triggered semi-randomly with a time interval of 30 minutes to 1.5 hours between each measurement, resulting in increased ecological validity (Myin-Germeys & Kuppens, 2022). A minimum of 30 minutes after the previous measurement was established to increase the chance that a new important event occurred. During the day, the triggers came in between 7.00 and 22.00. Each questionnaire took approximately one minute. After 40 minutes of not responding to the reminders, the daily measurement expired.

Participants

The recruitment strategy for this study was convenience sampling by asking people on social media platforms or in-person to participate in the study. Besides, the study was listed on the SONA platform, which is a participant tool accessible for students of the University of Twente.

According to the recommendation of van Berkel et al. (2017), a sufficient sample in ESM studies includes 19 participants. Accordingly, the aim was to recruit 30 participants to also meet this recommendation after the exclusion of participants due to drop-outs or data with a response rate below the threshold of 30%.

The four inclusion criteria for participation were to be a student, to be over 18 years old, to have a mobile device with a stable internet connection and to be able to read and understand English as this was the study's app set up. To secure the participants rights, the BMS Ethics committee approved the study (approval number: 220345).

Procedure

After approval, the data collection started. Students that signed up for participating, received a Qualtrics URL for the written briefing (https://www.qualtrics.com). Participants were informed about the aim, the duration, the procedure of the study and the storage of their data (see Appendix A). By giving consent, they agreed to voluntarily participate in the study with the possibility to drop out at any time without having to provide a reason.

Participants were asked to use their smartphones and received instructions on how to install the application "Ethica" and to create an account (see Appendix B). For this, a valid email address and a password was needed. In the app, participants had to give informed consent for a second time. Ethica collects data of participants anonymously and allows the research team to implement certain tools such as reminders and randomized time gaps (Ethica Data, 2022).

Furthermore, participants were told to fill in the measurements as soon as possible after each notification.

The following six consecutive days, the main ESM study took place. The daily questionnaires included six items that measure positive and negative affect and two items concerning the coping regulation strategies.

Following the ESM phase, participants were asked whether they might have any last comments regarding the study. Moreover, they were thanked for their participation.

Measures

Demographics

On the day before the actual study started, participants were asked to provide information about their age, gender, nationality, ethnicity, and study program.

Event-related stress

To measure how participants perceived and reacted to daily events, first, they were asked to "think about the most important event since the last measurement. This event was ...". How pleasant or unpleasant they perceived the event was rated on a 7-point bipolar scale ranging from -3 "very unpleasant" to 3 "very pleasant". Based on this, a dichotomous stress variable was computed. The value 0 included all pleasant and neutral events, and the value 1 indicated that the event was perceived as stressful, ranging from -1 to -3. With this, only the unpleasant events were included in the analysis. The stress variable was lagged to "stresst_1" controlling for subsequent stress that is expected to increase negative affect when an unpleasant event is followed by another unpleasant event.

Affective recovery

To identify the positive and negative affect of the momentary assessments, a total of six items were used. The goal was to assess how the participants feel and if they have recovered compared to the previous stressful event. Positive affect refers to an enthusiastic and active state, whereas negative affect represents personal experienced distress. Furthermore, studies agreed that negative affect is associated with several unpleasant events (Watson et al., 1988). Myin-Germeys and colleagues (2003) have investigated several studies on the influence of stress reactivity on affect before (Klippel et al., 2018). Due to high internal consistency, expressed by a high Cronbach's alpha, the items of this study were inspired by Myin-Germeys' studies (Klippel et al., 2018; Myin-Germeys et al., 2003). Participants filled out to what extent they agreed on a 7-point Likert scale. For this study, the items stated: "Please indicate how you felt during the time since the last measurement. At the moment, I feel... "(see Appendix C). To measure positive affect the items ended with "cheerful", "satisfied" and "relaxed" ($\alpha = 0.97$) (Klippel et al., 2018; Myin-Germeys et al., 2003). Negative affect was measured with the items "down", "anxious" and "insecure" ($\alpha = 0.85$) (Klippel et al., 2018; Myin-Germeys et al., 2003, 2001).

For the analysis, only negative affect was important to investigate. After combining all three negative mood items to the variable NA, the participant's means (NA_mean) and participant's mean-centered scores (NA_centered) about the average negative affect were calculated. Computing a lagged variable of NA_centered compared the average negative affect of one participant with the next average negative affect value of the same participant.

Afterwards, the affective recovery of one person at every measurement point (recovery_t1) was calculated by subtracting NA_centered_t1 from NA_centered.

Rumination and social support

Next, two emotion regulation strategies assessed how participants dealt with the event. The items were inspired by an emotion-regulation study by Brans and colleagues (2013). The items stated: "I kept thinking about it" to measure rumination and "I talked about it with others" to investigate social support. Both items referred to the previously experienced event. The participant's agreement was shown on a 7-point Likert scale ranging from 1 (not at all) to 7 (very).

Data Analysis

The data was exported from Ethica Data and transformed into a .sav data file suitable for the software IBM SPSS Statistics Version 25 in that all statistical analyses were run. Before data analysis, the final data set was set by excluding data of participants that completed less than 30% of the measurements. Second, descriptive statistics about gender, age and nationality were calculated to get an overview of the sample. Furthermore, the data set was checked for measurement points that are useful for analyses. The measurement of an unpleasant event needed a follow-up measurement to compute affective recovery. Assumption checks for normality showed the distributions of negative affect and the dependent recovery variable.

As ESM results in nested observations within subjects that are dependent on each other, the data set had multiple levels. The first level was about the individual observations nested within individuals as the second level. To answer the research question, Linear Mixed Model analyses were conducted. These analyses consider similarities in the measurements of one person, taking the dependency of measurements within one person into account (Magezi, 2015).

For the first hypothesis, a linear mixed model with recovery as the dependent variable and rumination as the independent variable was performed. Enhancing the internal validity of the model and decreasing the influence of external variables, stress_t1, age and gender were

included in the model. The participant variable was included as the subject. This analysis was also undertaken excluding the subsequent stress variable to test for an overlap between subsequent stressors because people kept ruminating.

For the second hypothesis, social support was integrated as a moderating variable into a second linear mixed model. Defining whether affective recovery is influenced by rumination when social support is also provided, those variables together with an interaction effect of rumination and social support were included as independent variables. Like the previous model, it was controlled for subsequent stress, age, and gender while participant was included as subject.

Results

Demographics

In total, N = (51) voluntarily participated in this study. The final data set was reduced to 26 participants, because N = (25) were below the threshold of 30% response rate. As shown in Table 1, all participants were students from different study fields. The ages ranged from 18 to 27 (M = 21.23, SD = 1.77).

Table 1Frequencies of Gender, Nationality and Field of Study

	N	%
Gender		
Female	18	69.2
Male	8	30.8
Nationality		
German	20	76.9
Dutch	3	11.5
Other	3	11.5
Field of Study		
Psychology	15	57.5
Communication Science Other	2	7.7
	9	34.6

Total number of valid observations

Overall, the data set consisted of N = (1427) measurement points. Out of these, only 11%, N = (164) measurement points were used for the analyses as these indicated a stressful event and had a subsequential measurement point.

Distributions

To get an overview of the scale distributions, the descriptive statistics for negative affect, rumination and social support are presented in Table 2.

Table 2
Scale Distributions for Negative Affect, Rumination and Social Support

Scale	M	SD	
Negative Affect	2.5	1.30	
Rumination	3.89	1.92	
Social Support	3.49	2.07	

Note. N= 164.

Doing the assumption check for normality showed that normality was violated. As Figure 1 shows, the data was negatively skewed. That means that more participants experienced less negative affect than the average and only a small number of measurement points represented experiences of negative affect.

Figure 1Scatterplot of Distribution of Negative Affect

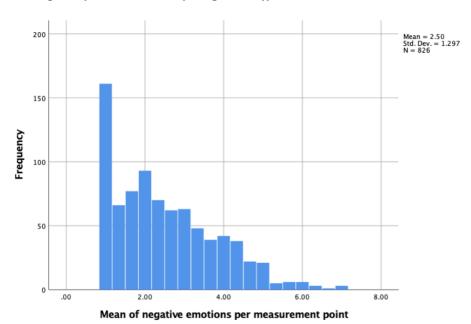
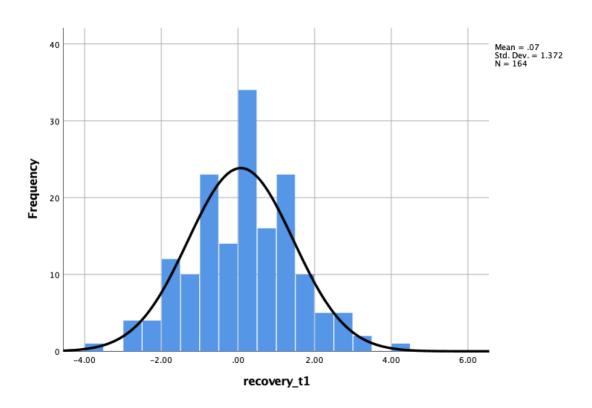


Figure 2 shows that among the sample, the dependent variable stress recovery was normally distributed and had a mean of 0.07 with a standard deviation of 1.37. This suggests that on average participants quickly returned to baseline following a stressful event, independent of any other variables influencing it.

Figure 2

Scatterplot of Dependent Variable Stress Recovery



Influence of Rumination on Stress recovery

Testing the first hypothesis that rumination has a negative influence on stress recovery, a linear mixed model with stress recovery as the dependent variable was used. No significant effect for rumination on stress recovery was found, B = 0.05, SE = 0.05, t(157) = 1.00, p = .32, CI [-0.05, 0.16]. This suggests that higher levels of rumination are not associated with slower

stress recovery. A significant relationship was found between subsequent stress and recovery, B = -1.05, SE = 0.21, t(157) = -5.07, p < .001, CI [-1.46,-0.63]. That means that subsequent stress increases negative affect and prolongs the recovery process. Without controlling for subsequent stress, no significant effect for rumination on stress recovery was found, B = 0.09, SE = 0.06, t(159) = 1.51, p = .13, CI [-0.03, 0.20]. Because the correlation coefficient became larger and the p-value decreased slightly, evidence of a prolonging effect of rumination became stronger. This suggests that overlap exists between subsequent stressors and people's ruminative behaviour. However, ruminative thinking does not significantly affect the process of stress recovery when subsequent stress is controlled for.

Interaction Effect of Social Support and Rumination on Stress Recovery

To answer the second hypothesis whether rumination prolongs affective recovery when social support is present, a linear-mixed model was run with stress recovery as dependent variable and rumination, social support and the interaction between rumination and social support as independent variables. The interaction between rumination and social support was not significant, B = -0.04, SE = 0.03, t(155) = -1.39, p = .17, CI [-0.09, 0.01]. This suggests that social support does not moderate the association between rumination and affective recovery and therefore it does not buffer the effect of rumination.

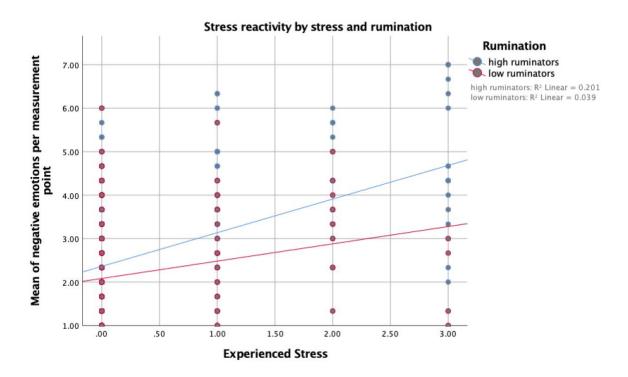
Exploratory Analysis

Due to the low number of measurement points that may influence the findings, additional analyses were run focusing on stress reactivity as this concept allows to include more data points. Stress reactivity expressed by negative affect is the "intensity of affective responses" (Howland et al., 2016, p. 121). The event-related stress variable was recoded into a numeric variable, called "experiencedstress". The value 0 included all neutral and pleasant events, and for unpleasant events, higher values reflected more unpleasantness (1 'mildly unpleasant' to 3 'very

unpleasant') (Jacobs et al., 2007). The greater size of measurement points (N=747) increased statistical power. A linear mixed model with experienced stress, rumination and the interaction of both as independent, and negative affect as dependent variable was run. A significant interaction effect between rumination and stress on negative affect was detected, B = 0.10, SE = 0.02, t(728) = 4.14, p < .001, CI [0.05, 0.15]. This suggests that rumination in combination with stress slightly increases stress reactivity. Also, as Figure 3 shows, it seems like higher levels of rumination and experienced stress explain a larger increase in stress reactivity compared to lower levels of rumination.

Figure 3

Scatterplot of Stress Reactivity of High and Low Ruminators

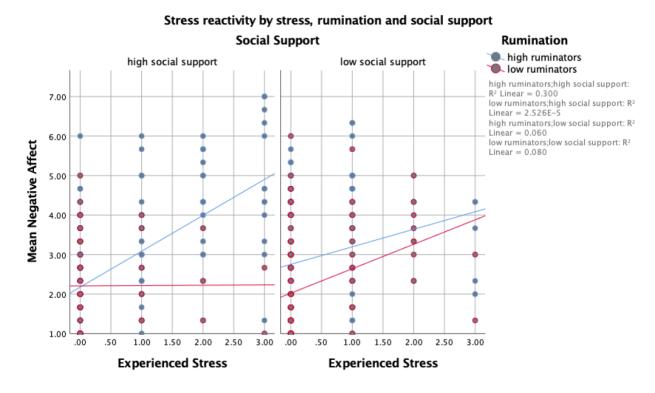


Note. Rumination (Mdn = 4.00) was turned into a categorical variable with a median split. Values above the median represent high levels of rumination.

The same linear mixed model was run with the addition of a three-way interaction effect between experienced stress, rumination and social support. A significant interaction effect was found, B = 0.01, SE = 0.00, t(733) = 4.93, p < .001, CI [0.01, 0.02]. Because the correlation estimate became smaller, these results show that overall social support decreases the effect of rumination on stress reactivity. However, as Figure 4 shows, high levels of social support increase negative affect when combined with high levels of experienced stress and rumination.

Figure 4

Scatterplot of Stress Reactivity of High and Low Ruminators and High and Low Social Support



Note. Rumination (Mdn = 4.00) and social support (Mdn = 4.00) were transformed into categorical variables with a median split. Values above the median represent high levels of each variable.

Discussion

The purpose of the current study was to test whether rumination has an influence on affective recovery from daily stress and whether social support buffers this effect. The results of this study do not support a hypothesised relationship between rumination and stress recovery, nor an effect of social support. However, a positive relationship between rumination on stress reactivity was found. Further, social support seemed to buffer this relationship.

Reactivity vs. Recovery

Taking these results together, it means that there seems to be no effect of rumination for the consecutive measurement after a stressful event, expressed in stress recovery. Instead, only the measurement of the stressful event itself shows an influence of rumination on momentary affectivity, measured by stress reactivity. Following from this, questions concerning the mechanism of recovery in daily life arise.

The current findings contradict previous research on stress recovery. In a laboratory study by Capobianco et al. (2018), a prolonging effect of rumination measured by skin conductance levels was found. Also, a laboratory study by LeMoult and colleagues (2013) found an association between momentary rumination and prolonged sadness. Important to note that these studies measured stress recovery in the laboratory which means that rumination was triggered by experimental manipulations. In the laboratory, the recovery, as well as reactivity process can be assessed by fixed measurement points following a clear time frame (Capobianco et al., 2018). Contrary, within ESM studies, recovery is assessed by the difference between two measurement points that are semi-randomly triggered within a certain time frame (Myin-Germeys & Kuppens, 2022). It might be that the time between two measurement points was too long for a prolonging effect to be detected, particularly, for healthy individuals. An ESM study by Vaessen et al (2019)

underlines this because healthy participants recovered within the first 90 minutes after the stressful event.

However, because in ESM studies with semi-random triggers there is always a delay between the occurrence of a stressful event and the measurement of it, stress reactivity measured in daily life might be a measure of stress recovery. In this study, the influence of rumination on stress reactivity means that rumination increased negative affect at least half an hour and up to 90 minutes after the stressful event. Therefore, this study gives important insight into the mechanism of stress recovery measured in daily life. Future ESM studies of healthy individuals should use stress reactivity as a measure for stress recovery. Further, it should be tested whether a change in the scheduled beeps (i.e., increasing or reducing the duration of beeps) produces different outcomes.

Rumination does not prolong long-term affective recovery

However, the current study implied that an individual's affective recovery is not influenced by previous ruminative thoughts longer than 90 minutes after the occurrence of a stressful event. So far, rumination was widely known as a maladaptive emotion regulation strategy, expected to enhance the development of depressive symptoms in long term (Capobianco et al., 2018).

Nevertheless, it could be that rumination has some advantages, especially for healthy individuals as they are less vulnerable to its negative effects (Aker et al., 2014). Because rumination causes people to re-think the situation, it might feel productive to them, giving them a good feeling and decreasing distress. Additionally, it may help to come up with a solution to the problem resulting in a reduction of stress. These assumptions corroborate and add knowledge to the findings of Lyubomirsky and Nolen-Hoeksema's laboratory study (1993). Their dysphoric

participants reported that momentary rumination improved their insight into the problem. The same might be true for healthy individuals.

Furthermore, in the current study, rumination was related to a specific event. It could be that rumination only prolongs affective recovery in the long term after the occurrence of more than two unpleasant events over a longer period. It might be that people ruminate more about many events together at the end of a day because they have more time to think about them (Lancee et al., 2015). To the best of the author's knowledge, no studies investigated the differences between daytime and nighttime rumination yet. In the future, it might be interesting to assess whether individuals ruminate more at night and whether this prolongs their affective recovery.

Lastly, it could be that the daily stressors of this study were not severe enough, explaining why no effect of rumination on long-term recovery was found (Blanke et al., 2022). In this sample, negative affect was not normally distributed, meaning that most participants experienced little negative affect. Evidence exists that higher levels of stress explain the increased association between rumination and negative affect (Blanke, et al., 2022). Also, compared to clinical samples that most research focuses on, participants of the current study felt less stressed and therefore, they might be less vulnerable to the effects of rumination. Ruscio et al. (2015) have promoted those effects of momentary rumination are larger in clinical samples as already pre-exposed individuals are more vulnerable to the negative effects of maladaptive emotion regulation strategies. Furthermore, this paper confirms the findings of Vaessen and colleagues' (2019) ESM study as levels of negative affect and stress reactivity were larger in people suffering from mental illnesses compared to healthy individuals. In the future, the same

ESM study should be replicated with groups with different mental health statuses as well as healthy individuals to compare different impacts of ruminative thoughts.

Social support is not always a protection

Previous research on social support and rumination has shown that ruminators might benefit from the provision of social support (Afifi et al., 2013). Current findings indicated that social support slightly decreases the effect of rumination on stress reactivity, measured by negative affect. As above-mentioned, in ESM studies, reactivity might be a measure of recovery which would mean that social support can buffer the prolonging effect in short term.

Nevertheless, this paper questions the idea that social support buffers the negative effects of rumination long term and therefore contradicts Burleson's and Goldsmith's (1996) theory stating that social support decreases distress. Even though no significant effect was found, a direction change in the effects of rumination on recovery was detected. While rumination alone showed a positive, but insignificant, relationship with stress recovery, social support reversed this effect. Furthermore, the findings of stress reactivity show that high levels of social support drastically increased negative affect in high ruminators. Carefully it can be assumed that social support in combination with rumination might prolong the stress recovery process long term. One special form of rumination that might explain this, is co-rumination. This means sharing and discussing depressed feelings with someone else (Rose, 2002). Co-rumination could increase the burden long term because a person is repetitively confronted with the problem by their social surrounding. While so far, little is known about the effect of co-rumination on stress recovery, laboratory, as well as field studies, confirmed that the habitual use of co-rumination enhances stress reactivity (Byrd-Craven et al., 2011; Starr, 2015). Hence, the current findings raise the question of whether the habitual use of co-rumination indeed prolongs affective recovery. Future

research should test whether there is an effect that remained undetected in this sample by replicating the study with a larger sample.

Limitations and strengths

This study has multiple strong points, mainly due to the use of an experienced sampling method. ESM is especially effective in investigating affect in real-time settings which served the purpose of this study. Previous research has proven that ESM reduces recall bias and adequately investigates fluctuations in variables because it assesses the experience of participants close to the occurrence (Wichers et al., 2011). Another strength of this study is the high ecological validity since participants used their own smartphones which made answering the questionnaire an everyday task. Lastly, the current study did not manipulate rumination experimentally or measured it based on physiological measures like the skin conductance level as it was done in existing research (Ruscio et al., 2015). Contrary, the current study assessed rumination naturally based on a self-report measure without using prompts.

However, there are some drawbacks of this study limiting the reliability of the results. To begin with, the low number of measurement points highly impacted the statistical power of the results and decreased the chance of detecting a true effect (Type II Error). Consequently, future research should brief participants personally and only grant participants with an answer rate of 80% the study credits. Additionally, convenience sampling resulted in a homogeneous sample of higher-educated students decreasing the generalizability of the results.

Furthermore, this study used single items for the investigation of rumination and social support. Even though previous studies used these items, research supports that using only one item provides the least amount of assurance about the reliability and validity of a construct (Fuchs & Diamantopoulos, 2009). In the future, multiple items from self-report questionnaires,

such as the Ruminative Response Scale and the Student Social Support Scale should assess the constructs (Malecki & Elliott, 1999; Treynor et al., 2003).

Lastly, existing research already detected inconsistencies between physiological measures and self-report measures. Scepticism arises about whether the results truly reflect the participant's experience (Scollon et al., 2009). Capobianco et al. (2018) also found no effect based on self-report measures while physiological measures showed a prolonged recovery process in their sample. These distortions might be due to limited self-reflection and biases in the detection of stressors (Lavrakas, 2008; Ruscio et al., 2015). Consequently, for future research, a multi-method report including physiological and self-report measures combined with context-related questions is recommended.

Conclusion

In sum, this ESM study adds to the growing body of research on daily stress by looking at the association between rumination and affective recovery. At first, it seems like the findings contradict previous research because rumination did not prolong recovery. It may be that for people with low levels of negative affect, the repetitive thoughts help them to find a solution. However, combined with the findings on stress reactivity, it was concluded that rumination increases negative affect but that healthy individuals seem to recover after more than 90 minutes after the occurrence of a stressful event. This would explain why no prolonging effect on the stress recovery variable was found. Therefore, the major implication of this study is that contrary to laboratory studies, in ESM studies stress reactivity can be a measure of stress recovery because there is always some delay between an event and its measurement. The other implication is that social support may only momentarily buffer the negative consequences of rumination, but in the long-term indications for a contrary effect emerge. Whether these unexpected outcomes reflect reality gives fruitful ground for future research. Especially the underlying time-related

determinants of recovery should be investigated after improving the methodological limitations of this study.

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Appendix A

Participant Information and Informed Consent

Welcome to our study. First of all, we would like to thank you for helping us with this project. We are three third-year Psychology students, currently doing our bachelor thesis and the purpose of this project is to understand how students perceive events of their daily life. We are interested in how you feel about and react to the many things that happen during the day, no matter if it is only a small event such as a spilled cup of coffee.

For your information, the study will take 6 days. As you already have read in the invitation to this study, it is a diary study and you will work with the app "Ethica". You will be asked to fill in the same set of questions several times a day. In general the questions are about how you feel, what you think in relation to the last important event that you experienced during the day. You will get a notification every 1.5 hours because we really want to gain insight into your daily life. The app will send you a notification as a reminder to answer the questions. The reminders will allow us to get in-moment information without any recall bias. Also, it is important that you answer the questions right after you receive the notification.

The procedure of this study looks like the following: On the day before the main study starts you

The procedure of this study looks like the following: On the day before the main study starts you will have to fill in a questionnaire about some general information about you and your current emotional state. This will already take place via the app. This questionnaire needs to be filled in only once. The day after, you will start with the main study, which means that you will have to fill out the same set of questions 10 times a day.

For your explanation, one of the questions says "Think about the most important event since the last hour. This was...". With "important events" we mean any event that was meaningful for you. Even if nothing really important happened, please pick the most important event that happened since the last questionnaire/beep and answer the questions. After the last measurement of the sixth day, you successfully ended the study. We would like to stress that there are no right or wrong answers. Some questions may seem a bit strange or not applicable to you in that situation, but still try to answer them honestly. Also, if you have any questions during the conduction of the study or if you come across problems with the app feel free to contact us any time. Moreover, you can always contact us during the study, if any additional questions arise.

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Moreover, your data will be treated confidentially. This means that the answers and information you give will remain anonymous. Please read the information on the following page carefully before you agree.

After you gave consent, you will receive all the information how to download the app and create an account. Additionally, you will get an access code for the study.

Informed Consent

You are being invited to participate in a research study about your perception of events in daily life. This study is being conducted by students from the Faculty of Behavioural,

Management and Social Sciences at the University of Twente as part of their bachelor thesis. The purpose of this research is to measure how you perceive daily life events throughout the day.

This study will run for 6 days. On the first day we will ask for your informed consent and you will be presented with short questions about your demographics, a questionnaire about your well-being, and a questionnaire about your use of coping strategies. These questions just need to be filled out once. Ten times a day (7am-10pm), randomly in a time span of 1.5h, you will be asked to answer a very short questionnaire for 6 consecutive days. Completing one questionnaire will take approximately 1 minute of your time. After filling in the last questionnaire on the sixth day, the study will end. You will receive daily reminders to complete the questionnaires. We are aware that you might be quite occupied during the day, but still we want to ask you to fill in as many questionnaires as possible. For us, it is especially important that you do not adjust your daily routine to the study. Instead, please fill in the questionnaires directly after receiving the notification. Also, the questions will expire after 40 minutes.

Moreover, we would like to inform you that your participation in this study is entirely voluntary. You can withdraw from the study at any time, without having to give a reason. Your answers in this study are confidential. All data are collected anonymously as directly identifying information will not be obtained.

study is approved by the BMS ethics committee. You can contact them if you want to file a complaint (ethicscommittee-bms@utwente.nl). If you have any questions about this study, please contact one of the involved students: c.bahlkow@student.utwente.nl h.rathmer@student.utwente.nl w.s.nipper@student.utwente.nl

Appendix B

Instructions to Download the App

Step 1: Download the App

You can download the App "Ethica" via the following links:

iOS: https://apps.apple.com/ca/app/ethica/id1137173052

Android: https://play.google.com/store/apps/details?id=com.ethica.logger

Step 2: Sign up as Participant

After you have installed the app you can sign up for a new account. By that, you enter your e-mail address and choose a password.

Step 3: Enroll in the study

You can access the study via the URL or by entering the registration code

URL: https://ethicadata.com/study/2433/

Study Registration code: 2433

By clicking on "Participate" you successfully have finished the enrollment process. We hope that setting up the app was easy. However, if you came across difficulties please contact us right away.

Appendix CDaily-Questionnaire in the Ethica-App

At the moment I feel down. not at all very Tap on the line to start!