

University of Twente
BSc. Psychology
Bachelor Thesis – Positive Clinical Psychology
Faculty of Behavioral, Management and Social Sciences

**Exploring the Relationship between Cognitive Reappraisal,
Perceived Stress and Negative Events in Daily Life: an Experience
Sampling Study**

Finished: 03.07.2022
Kia Lemmen

1st Supervisor: Dr. J. T. Kraiss

2nd Supervisor: K. J. M. Tönis

Abstract

Background: Previous research already investigated the relation between cognitive reappraisal and stress. Nonetheless, research is not congruent with its findings. Moreover, not much research exists on the topic of cognitive reappraisal as a moderator between negative events and perceived stress. Therefore, the goal of this research paper is to investigate the relation between cognitive reappraisal and perceived momentary stress. Furthermore, the interest lies in exploring whether cognitive reappraisal moderates the relation between perceived stress and the experience of negative events. However, many existing studies have mainly conducted cross-sectional studies, whereas this study focuses on Experience Sampling Method (ESM) measures in daily life.

Method: This study made use of an Experience Sampling Method to gather data. Participants of the study were asked to complete baseline questionnaires to assess their state measures on perceived stress and cognitive reappraisal. Additionally, daily questionnaires were administered four times a day, to assess participants' momentary state on those constructs, as well as the experience of negative events, over a period of 14 days. Findings were analyzed with a Linear Mixed Model.

Results: The main findings of this study revealed that cognitive reappraisal is weakly negatively related to perceived stress ($\beta=-.07, p<.001$). In addition, the moderation effect of cognitive reappraisal on perceived stress and negative events has been shown to be weakly negative but significant. ($\beta=-.09, p<.001$).

Conclusion: The investigation revealed that regulating emotions by the utilization of cognitive reappraisal leads to a decrease in perceived stress. Furthermore, perceived stress also decreases when experiencing negative events whilst engaging in cognitive reappraisal, indicating a moderation. This study provides a good addition to already existing studies, by using an ESM design, in the field of cognitive reappraisal and stress. It reveals the importance of the utilization of cognitive reappraisal within the context of stress in daily life. Future research should further explore this emotion regulation strategy in combination with an ESM approach in the context of interventions.

Exploring the Relationship between Cognitive Reappraisal, Perceived Stress and Negative Events in Daily Life: an Experience Sampling Study

Stress and Resilience

Every individual experiences stress at some point in their life. Stress can be defined as: “A condition or feeling experienced when a person perceives that demands exceed the personal and social resources the individual is able to mobilize” (Boyd, 2022, p. 1). A distinct definition by Maslen (2014) states that stress is “A state of mental or emotional strain or tension resulting from adverse or demanding circumstances” (p. 17). One of the largest stress research projects in 2018, performed in the UK has shown that 75% of the adult population feel stressed, overwhelmed, and unable to cope with facing demands over the year (*Mental Health Statistics: Stress*, 2020). Therefore, it is important to consider what impact the experience of stress might have on an individual and their health.

Being in a state of stress and not being able to sufficiently cope with it can have health implications for the affected individual. These can include physical and psychological consequences. Those consequences that the individual may experience can manifest in, for example, diabetes, cardiovascular disease as well as chronic pain (Danielsson et al., 2012). Health consequences of experiencing stress are not only limited to the above-mentioned physical consequences but can also manifest in mental health problems. Experience of stress is related to the onset of psychiatric disorders (Bangasser & Valentino, 2014). Research has shown that the experience of stress is associated with a higher risk of developing depression (Hammen, 2005) as well as posttraumatic stress disorder (Bangasser & Valentino, 2014). Being in a depressive state, resulting from the exposure to stress can not only result in further health implications, including, coronary heart disease and osteoporosis (Joynt et al., 2003) but also in a decrease in one’s perceived life satisfaction (Çivitci, 2015). Consequently, it is valuable to further consider the aspect of stress and what factors may help an individual deal with the experience of stress due to the possible implications this can have on an individual’s mental health.

One aspect that is relevant in this context is resilience. Resilience can be defined as “The positive adaptation or the ability to maintain or regain mental health despite experiencing adversity” (Herrman et al., 2011, p. 260). It has been seen that individuals who possess a high level of resilience are less reactive to stress (Solomon, 2013). Moreover, it can be argued that individuals who make use of resilient thinking have a quicker recovery process when confronted with adversity. This can be argued as resilience can also be defined as “Resilience encompasses a society's capacity to bounce back after a disaster, its level of preparedness to

confront or deal with a disaster and its ability to recover quickly and successfully” (Platt et al., 2016, para.5). Thus, a high level of resilience contributes to an individual's greater ability to restore normalcy after experiencing adversity. Adversity can be seen to be experienced due to the exposure negative life events. Negative life events can be defined as “A negative event is one that has the potential or actual ability to create adverse outcomes for the individual” (Taylor, 1991, p. 67). Experiencing such events has been shown to be linked to psychological, physiological (Dohrenwend & Dohrenwend, 1974) as well as social problems (Segrin, 2001). Additionally, it has been linked to poor psychological wellbeing (Beasley et al., 2003), poor mental health (Zou et al., 2018) and a decrease in physical health (Brand et al., Godaert, 2000). Moreover, the experience of such events has been seen to be linked to an increase in perceived stress by the individual (O'Dougherty et al., 2012). Arguing that the experience of negative life events has negative consequences for the affected person.

Emotion Regulation

Despite the mentioned consequences, other aspects stress can result in also have to be considered. According to Spada et al. (2008) perceiving stress can be associated with the experience of negative emotions. Those emotions must be regulated in some way by the individual. One way this can be approached is emotion regulation. Emotion regulation refers to an individual trying to influence the emotions experienced and how to experience and express them in a certain situation (Gross, 1998). A distinct definition of emotion regulation by Thompson (1994) entails that emotion regulation includes intrinsic as well as extrinsic processes which help an individual to monitor and regulate their responses to experienced emotions to reach a for them set goal. Hence, it can be concluded that an individual can regulate the experience of emotions actively and consciously by paying attention to which emotions are experienced and how those are expressed.

When experiencing stress and thus experiencing corresponding emotions, such as anxiety, sadness, or guilt (Lazarus, 1991), an individual can decide to regulate those emotions actively and consciously. Research has found that there is a link between perceived stress and emotion regulation. Making proper use of emotion regulation in a stressful situation can help the individual to better decide which emotions he/she will feel and express elicited from that situation (Wang & Saudino, 2011). Thus, making use of emotion regulation can be seen as a way of altering possible emerging negative emotions from a negative or stressful situation.

Cognitive Reappraisal

There are multiple emotion regulation strategies an individual can make use of to regulate felt emotions, eliciting from stress. Those strategies for example are, acceptance, rumination, or avoidance (Aldao et al., 2010). Another emotion regulation strategy that can be approached is cognitive reappraisal. Cognitive reappraisal can be referred to as a putatively adaptive emotion regulation strategy (Krkovic et al., 2018). It refers to an individual altering experienced emotions by changing the way one thinks, which can be seen as a cognitive process (Lazarus & Alfert, 1964). Cognitive reappraisal takes place early in the process of generating emotions. This refers to changing the experienced emotion even before the full emotional response has been elicited, by reinterpreting the emotional event (Haga et al., 2009). Descriptively, this means that a situation may elicit a for this situation typically negative emotion but the individual changes this negative emotion into a more positive one by subjectively changing the way he/she thinks about the situation just experienced. Successfully making use of cognitive reappraisal has been linked to more well-being (Shiota, 2006). A study by Kraiss et al. (2020) has also shown that cognitive reappraisal is positively related to well-being. Moreover, it has been found that cognitive reappraisal is associated with less negative felt emotions (Mauss et al., 2007), as well as fewer depressive symptoms (Garnefski & Kraaij, 2006). Research by Hu et al. (2014) supports this view by also finding a positive association between the use of cognitive reappraisal and well-being.

An example of the use of this putatively adaptive emotion regulation strategy can be given. Taking the example of losing a family member, one example for the use of cognitive reappraisal could be someone making a comment about the loss one experienced, which may be interpreted as hurtful by the receiving person. Instead of getting angry or feeling directly hurt by the comment, the individual might try to reinterpret the other person's comment and reflect on the fact that it was not meant to be hurtful, and thus using cognitive reappraisal to positively regulate the felt emotion.

Experience Sampling Method

Most previous studies used cross sectional designs and did not assess the relation between cognitive reappraisal, negative life events and perceived stress, in daily life. To measure that, this study makes use of an Experience Sampling Method (ESM), also referred to as ecological momentary assessment (Shiffman et al., 2008) or intensive longitudinal assessment (Bolger & Laurenceau, 2013). Making use of ESM ensures that data on experiences and behaviors occurring in everyday life can be gathered, as well as mental changes which happen abruptly within the individual (Verhagen et al., 2016).

Moreover, it can be used to gather data from the natural environment within which the participants are currently situated, at different time points throughout the day (Van Berkel et al., 2017). As the use of ESM allows to gather data in real time, one other advantage is the minimization of the ‘memory bias’ as the data is gathered within the moment of experience (Shiffman et al., 2008). Thus, possible issues of not memorizing correctly are reduced, and the data gathered represents a more accurate state of how the participant is feeling in the given moment. As this study is going to gather measures on perceived stress and cognitive reappraisal it is of great value to make use of ESM. Those concepts are best measured in real-time as it ensures that the data gathered is an accurate representation of the moment-by-moment perception of the participants perceived stress, and how they dealt with that. Furthermore, making use of ESM allows to study people individually and not within a group, which will potentially lead to different findings in the relation between cognitive reappraisal and perceived stress, when compared to assessing this on a group level.

Cognitive Reappraisal and its Relation to Stress

People face both negative life events as well as stress throughout their lives. These experiences elicit mostly negative emotions (Shallcross et al., 2015). Those felt emotions need to be dealt with by the individual. One way to do so is using an emotion regulation strategy, namely cognitive reappraisal. As aforementioned, making use of cognitive reappraisal can positively influence a person's recovery processes after experiencing a negative event, as well as positively influence a person's well-being. Therefore, it can be speculated that the utilization of cognitive reappraisal potentially leads to a decrease in perceived stress of an individual making use of this adaptive emotion regulation strategy. Hence, the question arises whether cognitive reappraisal can also be seen as moderating the experience of negative events and perceived stress.

Some literature has investigated the relation between cognitive reappraisal and stress. A study by Moore et al. (2008) has shown that individuals who make use of cognitive reappraisal report less stress-associated symptoms. Those symptoms can include being depressed and perceiving a lower life satisfaction (Garnefski et al., 2004), and by making use of cognitive reappraisal, not experiencing those effects. Nonetheless, another study by Troy et al. (2013) has indicated that cognitive reappraisal does not have a significant influence on the perceived stress of an individual. Another study making use of ESM by Vilardaga et al. (2013) investigated the relation of using cognitive reappraisal when being faced with psychotic or stressful experiences, in a group of individuals with serious mental illness and

has shown that cognitive reappraisal seems not to be an effective strategy to use, as there was no association between cognitive reappraisal and positive as well as negative affect.

Hence, it can be argued that research seems to disagree on the effects of making use of cognitive reappraisal on stress and stress-related symptoms. Moreover, it seems that literature does not provide extensive research on cognitive reappraisal as a moderator of the relation between negative events and stress. Thus, there is an existing gap in current research wherefore this study will investigate the following research questions. *RQ 1: How is making use of cognitive reappraisal associated with momentary perceived stress? RQ 2: Does the use of cognitive reappraisal moderate the relationship between negative life events and perceived stress?* As research seems to be discordant about the relationship between stress as well as stress-associated symptoms and the use of cognitive reappraisal it is interesting to investigate this topic to potentially find a satisfactory answer to that, not clearly answered question. Until now it is not clear what the findings will reveal as existing literature argues different things. Still, assumptions can be made about the findings of this research. Firstly, it can be expected that making use of cognitive reappraisal will lead to a decrease in perceived stress of the individual, as it is a putatively adaptive emotion regulation strategy. Secondly, it can be expected that research will reveal that cognitive reappraisal moderates the relationship between negative events and perceived stress in the way of weakening the negative influence of negative events on perceived stress, and thus leads to a decrease in perceived stress.

Methods

Participants

After this study with the proposal number 220285 received approval by the ethics committee of the University of Twente, the selection of participants started. The total sample size consisted of 81 participants. This number seems sufficient as the average number of participants for an ESM study lies around 53 (Van Berkel et al., 2017). For the recruitment of participants for this ESM study, convenience sampling was chosen. Convenience sampling is a form of nonprobability or nonrandom sampling where subjects are chosen based on practical criteria, such as easy accessibility to the researchers (Etikan et al., 2016). Participants were recruited via Sona-systems, an online recruitment service provided by the University of Twente. Additionally, the researchers collected participants from their personal resource pool of friends and relatives. The criteria eligible to participate were, being in ownership of an email address and a smartphone to receive the invitation for the study, as well as having a sufficient level of English as the questionnaires were administered in English.

Design and Procedure

For this ESM study quantitative data on negative events, perceived stress and the use of cognitive reappraisal was gathered to assess if making use of cognitive reappraisal is associated with less perceived stress as well as whether the relationship between negative events and perceived stress may be moderated by the emotion regulation strategy cognitive reappraisal.

After the Ethics Committee of Behavioral, Management and Social Sciences of the University of Twente approved the study, the study was created and set up in 'Ethica Data', an online platform. After this step, a short pilot study on the smartphone app version of 'Ethica Data', which lasted for three days was conducted and ran by the researchers. This ensured that the questionnaires were administered as intended and no technical issues arose.

To start the data collection, the participants received an invitation to the study via email. They were informed that they had to download the app 'Ethica' and register as soon as possible to participate. Alongside this process, participants were presented with the online informed consent (See appendix A). The starting day of the study was the same for each participant. The data collection began on the 12th of April 2022 and ended on the 26th of April 2020.

This study made use of two different types of questionnaires, baseline questionnaires and daily ESM questionnaires. The first questionnaires that were triggered and had to be

answered were the three daily questionnaires measuring perceived stress, cognitive reappraisal, and negative events. One day after starting the study, a baseline questionnaire was triggered which had to be filled out once, assessing the participants' demographics as well as trait-like measures. Following that, the participants had to answer a baseline emotion regulation questionnaire as well as a baseline questionnaire on their perceived stress once. After completing those, the participants were asked to continue with the daily questionnaires, to assess momentary state. These questionnaires were administered to participants in a semi-random time schedule, as its results show relatively high ecological validity when using a semi-random time schedule (Myin-Germeys & Kuppens, 2021), meaning that they were triggered several times a day at predefined time intervals. They were triggered four times a day, via push messages by the app 'Ethica', for a course of two weeks. The first daily questionnaire was triggered between 10 a.m. and 11 a.m. The second one was triggered between 1 p.m. and 2 p.m. The trigger point for the third questionnaire was set between 5 p.m. and 6 p.m., and the last one was triggered between 8 p.m. and 9 p.m. All questionnaires expired two hours after being triggered. To increase compliance, reminders in form of push messages were sent to the participants, one hour after the questionnaires were triggered.

Materials

Baseline Questionnaires

Perceived Stress To investigate the general perceived stress of the participants, a self-report questionnaire developed by Cohen et al. (1983), the 'Perceived Stress Scale' (PSS) was administered (See appendix B). This scale is one of the most widely used scales to measure perceived stress (Lee, 2012). The scale consists of 10 items, with each being rated from 0 (*never*) to 4 (*very often*). A total score was calculated with a higher score indicating a higher level of perceived stress. Focusing on the psychometric qualities, Cronbach's alpha of the current study shows an alpha of .81, indicating good internal reliability, compared to a study by Roberti et al. (2011) who found a Cronbach's alpha of .89 in a sample of undergraduate college students, researching increasing stress conditions.

Cognitive Reappraisal To see whether participants make use of the emotion regulation strategy cognitive reappraisal a baseline questionnaire to measure cognitive reappraisal was administered. The chosen questionnaire was the 'Emotion Regulation Questionnaire' (ERQ) by Gross and John (2003). Only the subscale measuring cognitive reappraisal of the ERQ was used (See appendix D). The sub scale consists of six items, which had to be answered on a seven-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). The higher the score obtained on the scale the higher the tendency to utilize

cognitive reappraisal. The calculated Cronbach's alpha for the current study shows .91, indicating excellent reliability, compared to a study by Preece et al. (2019) who found a Cronbach's alpha of .89-.90, indicating excellent reliability the ERQ, within a general community sample.

Daily Questionnaires

Perceived Stress To measure the participants' perceived stress throughout the day over the course of 14 days, one single item was created. Namely 'How stressed do you feel right now?'. This item had to be answered on a seven-point Likert scale, ranging from 1 (*not at all*) to 7 (*very much*) (See appendix C). This item was a modification of the item "I feel stressed right now" found in the "ESM Item Repository," an item database that provides items for ESM studies. It was modified to allow participants to vary the value they wished to indicate for their perceived stress at the moment. The higher the score given by the participants, the more stress they perceived.

Cognitive Reappraisal To measure momentary cognitive reappraisal two items from the ERQ were modified by adding: 'In the last hour', in front of the already existing items. Those items were: 'In the last hour, I controlled negative feelings by changing the way I think about the situation I am in.', and 'In the last hour, I tried to look at the cause of my negative feelings from a different perspective'. Those items also had to be answered on a seven-point Likert scale, with 1 indicating '*not at all*' and 7 '*very much*' (See appendix E). To assess inter-item reliability, split-half reliability was calculated (Steinke & Kopp, 2020). The split-half reliability for this study showed .84, indicating strong internal reliability of the consistency of the performance of the items.

Negative Event To investigate whether the participants face any negative events during the course of two weeks, one item was administered. This item was found in the database, 'ESM item repository' which is based on a study protocol invented by Helmich et al. (2020). The item that was chosen is 'Think of the most striking event or activity in the last hour. How (un)pleasant was this event or activity?'. This item had to be answered on a -3 (*very unpleasant*) to +3 (*very pleasant*) scale (See appendix F). For analyzing the results of this category, the item measuring the occurrence of an unpleasant event was dichotomized and used.

Analyses

The statistical program IBM SPSS Statistics version 26 was used to analyze the collected data. First, the data was imported into the program and the data was corrected, by excluding participants with a response rate lower than 50%. In accordance with literature

recommending a response rate of at least 50% (Connor & Lehman, 2012), a cut of score of 50% was chosen. Secondly, a dummy variable was created for 'negative events'. Therefore, -3 to -1 was recoded to '1', indicating the experience of an unpleasant event and 0 to +3 to '0', representing that no unpleasant event occurred. Thirdly, z-scores for perceived stress, cognitive reappraisal and negative events were calculated, by transforming variables on the same scale with a standard deviation of 1. The calculated Standardized estimates were considered weak <0.3 moderate $0.3 - 0.5$ and strong >0.5 (Cohen, 1998). Lastly, inter-correlations of the trait and state measures were calculated.

As this study made use of experienced sampling, a linear mixed model (LMM) was used to answer the research questions (West, 2009). Making use of an LMM for analyzing longitudinal data is a common practice as it accounts for nested data (Myin-Germeys & Kuppens, 2021). Nested data results from repeated measures within individuals and therefore produces multi-level data structures (Chen et al., 2017). Moreover, an autoregressive covariance structure (AR1) was administered which suggests that correlations decrease with an increase in time (Barnett et al., 2010). For the first research question, investigating the relationship between cognitive reappraisal and perceived momentary stress, an LMM was run, with perceived stress as dependent and cognitive reappraisal as independent variable (momentary state measure). For the second research question, an LMM was also run. For this analysis, perceived stress was treated as the dependent variable, the dummy variable created for negative events was treated as the independent variable, as well as cognitive reappraisal. To check for a possible moderation not only two main effects for the independent variables were included but also an interaction effect for those two. Lastly, individual cases of participants were examined to clarify and illustrate the findings of the main analysis.

Results

The final sample consisted of 60 participants, after excluding 36 participants due to a response rate lower than 50%. The age of the participants ranged from 18 to 65 with a mean age of 23.38 ($SD=8.02$). Most participants were German (68.3%) as well as the majority being female (58.3%). More sample characteristics regarding gender, nationality, occupation and educational level can be found in Table 1.

Table 1

Sample Characteristics

		N	%
Gender	Female	35	58.3
	Male	25	41.7
Nationality	German	41	68.3
	Dutch	11	18.3
	Other	8	13.3
Occupation	Working	5	8.3
	Student	34	56.7
	Studying and working	18	30.0
	Not working	2	3.3
	Other	1	1.7
Education	Bachelor	4	6.7
	High	52	86.7
	School/HAVO/VWO/HBS		
	Master	3	5.0

Table 2 shows means, standard deviations and correlations of the trait as well as state measures. The average score for the perceived stress scale of this sample is relatively high with a mean of 20.16 ($SD=6.66$) compared to a study by Andreou et al. (2011), who found a mean of 14.94 ($SD=5.29$) for a Greek sample exhibiting symptoms of stress. For the ERQ the sample scored relatively low, with a mean of 26.46 ($SD=6.52$), comparably similar to a previous study by Preece et al. (2021), who found a mean of 28.78 ($SD=7.36$) for cognitive reappraisal in a general community sample.

Table 2*Means, Standard Deviations, Inter-correlations of trait and state measures*

	Mean	SD	1	2	3	4	5
1 PSS*	20.16	6.66	-				
2 ERQ*	26.46	6.52	-.51	-			
3 Momentary stress	2.84	1.61	.45	-.41	-		
4 Cognitive reappraisal	6.03	3.01	-.03	.27	.21	-	
5 Negative events	0.24	0.40	.01	.01	.11	-.12	-

*Sum scores have been used

1 PSS = Perceived Stress Scale

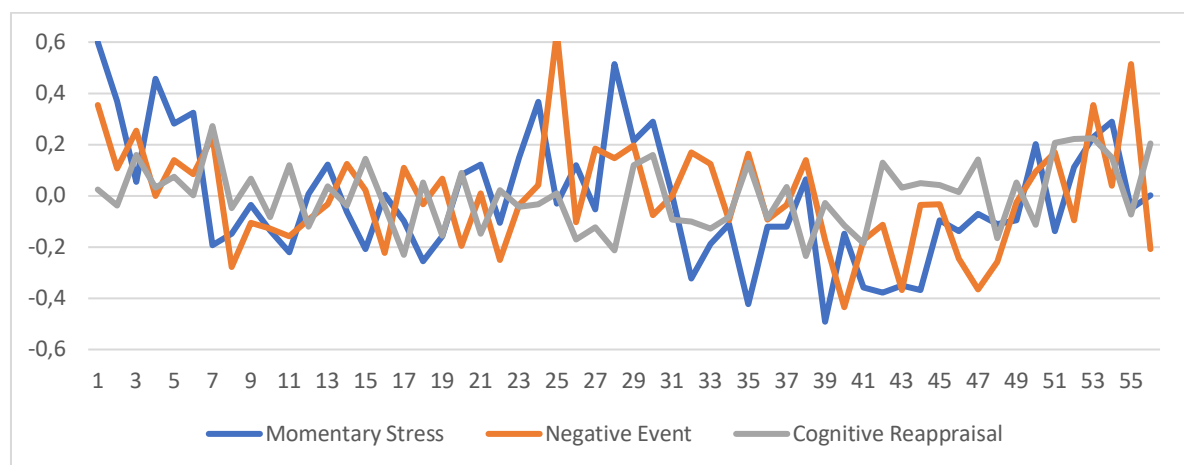
2 ERQ = Emotion Regulation Questionnaire /note

Variation of Momentary Stress, Negative Event and Cognitive Reappraisal over Time

Figure 1 displays the variables cognitive reappraisal, momentary perceived stress and negative event per measurement point. The figure aims to show the variation within the indicated scores by the participants over the period of 14 days. It can be seen that stress and cognitive reappraisal mostly behave in opposite directions and the experience of a negative event fluctuates over time.

Figure 1

Line Plot displaying Z-scores of estimated marginal means of Momentary Stress, Negative Event and Cognitive Reappraisal per measurement point



Relation between Perceived Stress and Cognitive Reappraisal

Table 3 contains all relevant information on the relationship between perceived stress and cognitive reappraisal. After calculating the Z-scores for both variables it can be seen that cognitive reappraisal is weakly negatively but significantly related to perceived stress ($\beta=-.07$, $p<.001$). This indicates that the use of cognitive reappraisal, is associated with less perceived stress, but only weakly.

Table 3

Estimates of Fixed Effects with Cognitive Reappraisals as Independent Variable and Perceived Stress as Dependent Variable

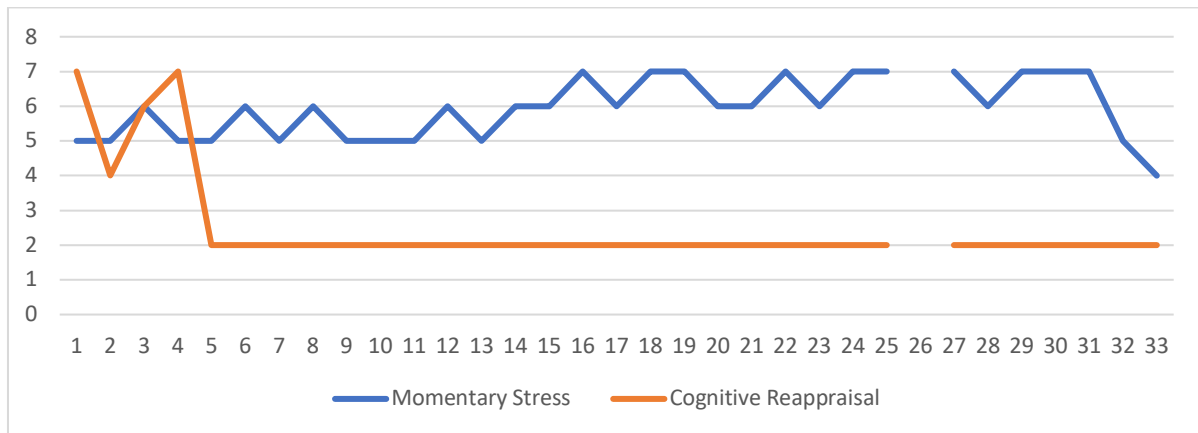
Parameter	β	b	SE	df	t	Sig	95% CI	
							Lower Bound	Upper Bound
Intercept	.03	3.12	.03	1295.29	.97	.33	2.95	3.29
Cognitive Reappraisal	-.07	-.04	.02	2377.86	-3.53	<.001	-.05	-.01

df Degrees of freedom *CI* Confidence interval of unstandardized estimates

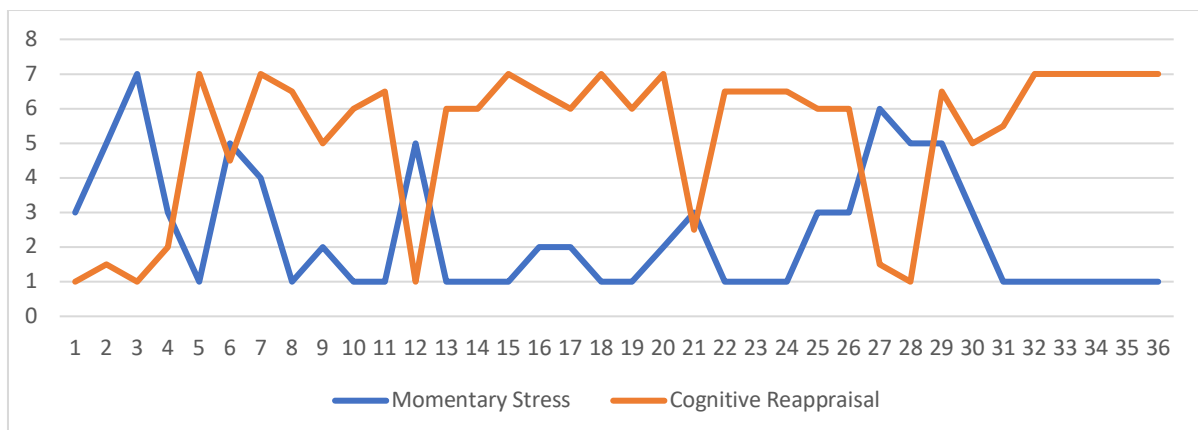
Figure 2 underlines the findings of the analysis, by displaying the scores of one participant on momentary perceived stress and cognitive reappraisal. It can be seen that this participant exhibits quite high levels of stress while not scoring high in cognitive reappraisal but rather consistently low. Figure 3 makes this even more clear, by focusing on a high exhibition of cognitive reappraisal and its visible effects on perceived stress of that individual. This participant scores quite high in cognitive reappraisal when scoring low in perceived momentary stress. Even though there are some fluctuations visible, these findings suggest an association between those two constructs over time. The fluctuations do show that at times where cognitive reappraisal is low in general, stress does increase. Hence, the Figures reveal that high use of cognitive reappraisal is associated with low levels of perceived stress whereas low utilization of cognitive reappraisal is associated with higher levels of perceived stress.

Figure 2

Line Plot displaying high momentary stress and low cognitive reappraisal per measurement point for participant 52859

**Figure 3**

Line Plot displaying low momentary stress and high cognitive reappraisal per measurement point for participant 52857



Moderation Effect of Cognitive Reappraisal and Negative Life Events on Perceived Stress

After calculating Z-scores for all three variables, for the model with perceived stress as dependent, and cognitive reappraisal and negative events as independent variables, it can be seen that the experience of a negative event is weakly positively and significantly related to the experience of stress ($\beta=.19, p<.001$). Moreover, cognitive reappraisal also appears to be significantly, but weakly negatively related to the experience of stress ($\beta=-.06, p<.001$). While testing for moderation, there is a weak negative but significant interaction effect for cognitive reappraisal and negative events on perceived stress ($\beta=-.09, p<.001$). The findings of this model can be found in Table 4.

Table 4

Estimates of Fixed Effects with Cognitive Reappraisal and Negative events as Independent Variable and Perceived Stress as Dependent Variable Testing for Moderation

Parameter	β	b	SE	df	t	Sig	95% CI	
							Lower Bound	Upper Bound
Intercept	.01	2.77	.03	1543.29	.06	.54	2.60	2.94
Negative Event	.19	1.53	.01	2078.21	11.86	<.001	1.23	1.82
Cognitive Reappraisal	-.06	-.01	.02	2376.36	-3.24	<.001	-.03	.01
Cognitive Reappraisal*Negative Event	-.09	-.12	.02	2016.32	-5.24	<.001	-.17	-.07

df Degrees of freedom *CI* Confidence interval of unstandardized estimates

Figure 4 highlights the above-mentioned findings visually by focusing on one participant, scoring low in momentary stress and high in cognitive reappraisal while the experience of a negative event. It can be seen that at moments of experiencing a negative event, stress increases when cognitive reappraisal is low. In contrast, when experiencing a negative event and exhibiting a higher level of cognitive reappraisal, this participant seems to score lower on perceived stress. Moreover, Figure 5 displays the findings of another participant who scores generally lower in cognitive reappraisal compared to the scores of the participant which are displayed in Figure 4. Comparing the findings of Figure 4 and Figure 5, levels of stress are generally lower for the individual who exhibits higher levels of cognitive reappraisal when a negative event is present. Thus, it seems that higher utilization of cognitive reappraisal, when experiencing a negative event is associated with less momentary perceived stress.

Figure 4

Line Plot displaying low momentary stress, high cognitive reappraisal and experience of a negative event per measurement point for participant 52857

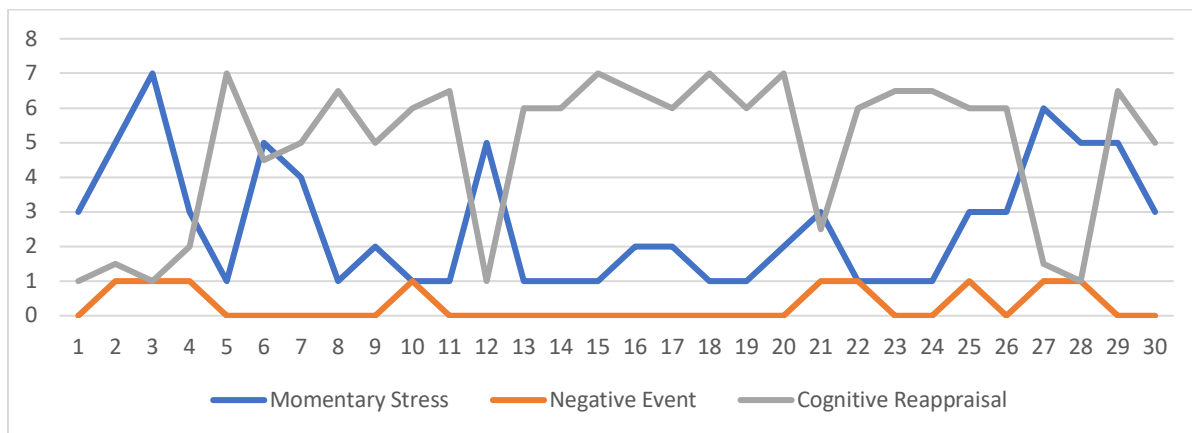
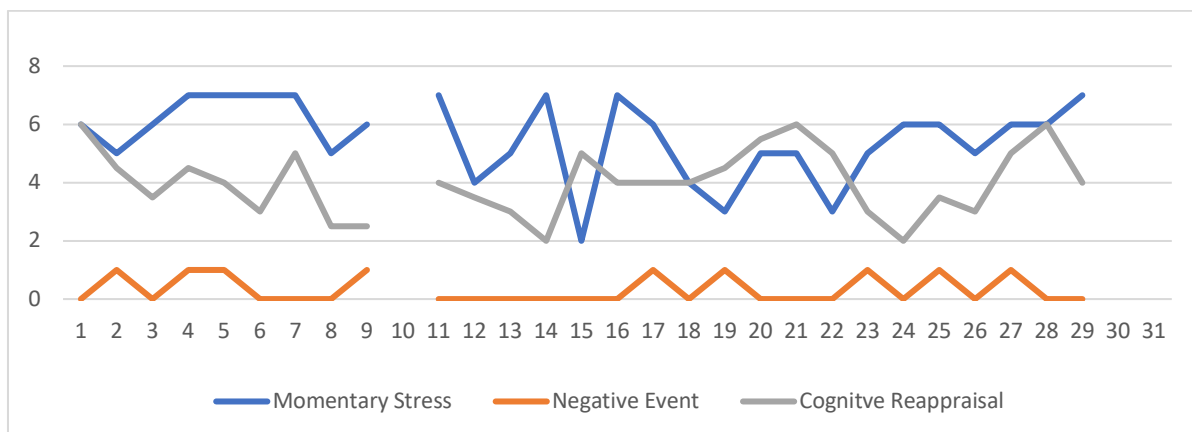


Figure 5

Line Plot displaying high momentary stress, low cognitive reappraisal and experience of a negative event per measurement point for participant 52695



Discussion

This study aimed at further investigating the relation between the putatively adaptive emotion regulation strategy cognitive reappraisal and the perception of momentary perceived stress. In addition, it was of interest to explore the experience of negative events and how cognitive reappraisal may moderate the relationship between momentary stress perception and the experience of negative events. The findings revealed that cognitive reappraisal is weakly negatively related to the perception of stress. Moreover, the results indicate that cognitive reappraisal does negatively moderate the relation between perceived momentary stress and negative events.

Main Findings

Previous studies have already investigated the consequences stress can have on an individual. Those consequences can result in physiological but also psychological health problems (Bangasser & Valentino, 2014). Therefore, studies have considered the emotion regulation strategy cognitive reappraisal and the possible positive implications of this rather adaptive strategy on perceived stress. A study by Chen et al. (2020) has shown that the use of cognitive reappraisal in moments of experiencing stress, has a buffering effect on perceived stress, as those constructs are weakly negatively related. Meaningfully, individuals who make use of cognitive reappraisal perceive less stress. Additionally, Moore et al. (2008) investigated the relation between cognitive reappraisal and stress-related symptoms. The study findings revealed that cognitive reappraisal is associated with low stress-related symptoms. The current study adds on this by also finding a significant relation between the concepts, cognitive reappraisal and perceived stress. This indicates that momentary perceived stress decreases as cognitive reappraisal increases. Existing research already suggests that cognitive reappraisal is an adaptive emotion regulation strategy, meaning that it can be linked to an increase in psychological health (Troy et al., 2013). Therefore, the expectation for this ESM study was to find less perceived stress within individuals who engage in a high utilization of cognitive reappraisal, which was validated by the findings. Hence, individuals who make use of cognitive reappraisal when being faced by stress experience less stress and thus experience less (mental) health issues which are related to the exposure of stress. Thus, it can be argued that cognitive reappraisal indeed appears to be an adaptive emotion regulation strategy which, when utilized to a high degree, protects the individual's wellbeing from deterioration.

Nonetheless, less research exists on the possible moderation effect of cognitive reappraisal on the relation between perceived stress and the experience of negative events.

Previous research has shown that experiencing a negative event is associated with stress-related symptoms such as experiencing anxiety or (mental) health problems such as depression (Zou et al., 2018). One way to deal with the emerging implications of experiencing a negative event is through emotion regulation (Garnefski et al., 2001). This can potentially help an individual avoid being overwhelmed by the triggered emotions or stress-related symptoms that result from experiencing a negative event (Garnefski et al., 2001). Not only the emerging consequence from such negative events need to be dealt with by the individual but also the negative event itself. One possible approach that for example can be taken is cognitive reappraisal. A study by Cohen et al. (2014), has proposed that the engagement in cognitive reappraisal, when faced with a negative event is associated with an inhibition of negative content, resulting from such events and hence resulting implications on the individual's (mental) health. As this is only a suggestion made, the current study was interested in investigating the relation between cognitive reappraisal and negative events to further investigate the proposed adaptive association between those two constructs.

Moreover, as a high utilization of cognitive reappraisal seems to be related to less perceived stress, it is of great interest to see whether this emotion regulation strategy does also influence the relation between perceived stress and the experience of negative events. The current study found a weak negative moderation for those constructs. This indicates that perceived stress is lower when being faced with a negative event while increasingly engaging in cognitive reappraisal. By finding that perceived stress, when being faced by a negative event is lower when exhibiting high levels of cognitive reappraisal, compared to exhibiting lower levels of cognitive reappraisal it again, suggests that cognitive reappraisal is an adaptive emotion regulation strategy from which the individuals who engage in it benefit in terms of (mental) health.

Nevertheless, one aspect that should be focused on when considering the main findings is the high variability that was observable. This aspect has to be acknowledged when looking at the findings. It became apparent that there is an association between the concepts of perceived stress, cognitive reappraisal and negative events. Looking at individual cases of participants of this study has shown that there is a high variability of these concepts within one person. Within-person association refers to the variation in an individual's relationship to measured constructs across multiple measurements (Hamaker et al., 2007). A previous ESM study by Kraiss et al. (2020) investigated the concepts of psychological distress and mental wellbeing. It was found that there is a high inter-individual variability when unraveling between and within-person association. This does not only suggest that there is a high

variability within one participant over the course of the investigative period of 14 days, but also that this potentially can be applied to the overall sample of this study. In specific, it is possible that for some individuals there is an association between the above-mentioned concepts, but this does not necessarily apply to every individual.

Strengths and Limitations

One strength of the current study is the longitudinal design that was chosen. Data was gathered over a course of 14 days, with four measurement points per day, which allows for the assessment of momentary states and therefore the acknowledgment of abrupt changes within the participants (Verhagen et al., 2016). By choosing this design the study setup was well adapted to collect the desirable data of momentary state and accounted for possible changes in mood and state of the participants. Furthermore, the choice of a longitudinal design and a semi-random time schedule accounted for the reduction of recall bias (Shiffman et al., 2008). Furthermore, the semi-random time schedule, within which the questionnaires were administered, which allowed for an answering span of two hours gave the participants the possibility to be flexible within answering the triggered questionnaires and therefore, reduced the possibility of many missing values. Lastly, the semi-random time schedule accounts for a relatively high ecological validity (Myin-Germeys & Kuppens, 2021).

Besides the strengths of this study, some limitations also exist. The first limitation this study exhibits is the fact that some quite high timely demands were placed on participants who decided to participate in this ESM study. This can potentially account for the 36 of the 96 recruited participants that had to be excluded due to a response rate lower than 50%. The participants were asked to fill out daily questionnaires four times a day, which puts the participants into the position of taking time four times a day to properly participate. By triggering items multiple times a day, it is possible that individuals who for example have a nine to five occupation are not able to answer items frequently. Therefore, it is possible that daily life interferes with such a study setup.

A second limitation that can be thought about, is the sampling method that was chosen. Researchers chose to recruit participants via convenience sampling. This method of sampling is part of non-probability sampling (Etikan et al., 2016). Convenience sampling includes participants been chosen who meet certain practical criteria, such as easy accessibility, geographic proximity, or a willingness to participate in the study (Etikan et al., 2016). This sampling method was chosen as the researchers had limited time to recruit participants as well as limited resources, due to the academic context within which the study was conducted. Choosing this type of sampling can have implications. Through convenience

sampling not every individual of the population has the same chance to participate in the study. Therefore, the results are hard to generalize as the sample does not show an accurate representation of the whole population (Etikan et al., 2016), and therefore the results neither. This has to be kept in mind when wanting to generalize the findings.

Future Research

After focusing on the limitations of the current study a suggestion for future research would be to see how the measured constructs behave in a larger and more inclusive context. The study was limited to a quite small sample with a number of 60 participants, mainly female university students, or individuals with quite high academic achievements. This is not a very representative sample of the overall population, which makes it difficult to generalize the findings. Conducting such a study in a more diverse and more representative sample would possibly yield different results as well as more representative data of the overall population. Hence, for future research it would be of great interest to see how results would differ within a more diverse and larger context.

A second interesting suggestion for future research would be to conduct such an ESM study in combination with an intervention. As the findings of this study suggest that the utilization of cognitive reappraisal is associated with less perceived stress, it indicates that the engagement in this emotion regulation strategy is beneficial for the wellbeing of individuals who are exposed to stress or stressful events. As aforementioned, stress can have (mental) health implications when experienced and is part of everyone's daily life. Therefore, the interest should lie in supporting the general population within their (mental) health. Future research could therefore investigate the effects cognitive reappraisal interventions possibly have on an individual wellbeing and (mental) health. Interventions focusing on cognitive reappraisal already exist. For example, Kivity and Huppert (2016), investigated the effects of a micro intervention between the use of cognitive reappraisal and anxiety. Nonetheless, a combination of a cognitive reappraisal intervention and the use of an ESM study setup are rather limited. By combining ESM with a cognitive reappraisal intervention, assessment of the extent to which participants experience stress and the degree to which they make use of cognitive reappraisal could be ensured before the intervention took place and afterwards. Moreover, the ESM setup allows for daily life assessment. This would allow for checking for the possible positive association of the use of cognitive reappraisal and perceived stress and which changes took place within the utilization of cognitive reappraisal after taking part in the intervention.

Implications

As the results of this study show that cognitive reappraisal is negatively associated with perceived stress it can be argued that cognitive reappraisal indeed seems to be an adaptive emotion regulation strategy, as research by Krkovic et al. (2018) also suggests. Therefore, it could be of value to consider or pay more attention to this emotion regulation strategy in future interventions, although interventions making use of cognitive reappraisal in, for example, form of Cognitive behavioral therapy (CBT) already exist. One example is a meta-analysis by Kowalik et al. (2011), who investigated the relation between CBT and pediatric post-traumatic stress disorder.

Nonetheless, the current study brought insights into the efficacy of the pure application of cognitive reappraisal itself and extends previous findings into the context of daily life, by using an ESM study design. A positive psychology approach could be taken for interventions that rely solely on cognitive reappraisal, as cognitive reappraisal can be considered an adaptive emotion regulation strategy. In specific, a positive psychological approach focuses on positive behaviors or positive feelings, which in turn can increase wellbeing (Sin & Lyubomirsky, 2009). Such interventions are also called positive interventions and focus on maintaining good wellbeing or increasing it (Yaden et al., 2018). Increasing wellbeing could possibly be achieved by training individuals in making use of cognitive reappraisal when being faced with stress or negative events. This could lead to less (mental) health implications for the individuals taking part in these interventions, as the experience of stress is associated with a decrease in (mental) health. The insights this study provides yield ground for future interventions that are aimed at either decreasing stress, maintaining good wellbeing, or avoiding health implications through the experience of stress, by focusing on the use of the emotion regulation strategy cognitive reappraisal, in everyday life.

Conclusion

This study investigated the relation between the emotion regulation strategy cognitive reappraisal, stress and negative events. Findings revealed that cognitive reappraisal is negatively associated with perceived momentary stress as well as moderating the relation between perceived stress and negative events, negatively. Hence, it can be concluded that individuals who make use of cognitive reappraisal experience less stress in these situations. Moreover, this study revealed that individuals who make use of cognitive reappraisal when experiencing a negative event experience a decrease in perceived stress. For future research it would be interesting to see how the findings would differ with a more diverse and larger sample, as well as focusing on cognitive interventions combined with an ESM study. Lastly,

the study brought insight into the use of cognitive reappraisal within an everyday life context and yields ground for future interventions focusing more on cognitive reappraisal in combination with the use of ESM.

References

- Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish journal of emergency medicine, 18*(3), 91-93. <https://doi.org/10.1016/j.tjem.2018.08.001>
- Alliger, G. M., & Williams, K. J. (1993). Using signal-contingent experience sampling methodology to study work in the field: A discussion and illustration examining task perceptions and mood. *Personnel Psychology, 46*(3), 525-549. <https://doi.org/10.1111/j.1744-6570.1993.tb00883.x>
- Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review, 30*(2), 217–237. <https://doi.org/10.1016/j.cpr.2009.11.004>
- Andreou, E., Alexopoulos, E. C., Lionis, C., Varvogli, L., Gnardellis, C., Chrousos, G. P., & Darviri, C. (2011). Perceived stress scale: reliability and validity study in Greece. *International journal of environmental research and public health, 8*(8), 3287-3298. <https://doi.org/10.3390/ijerph8083287>
- Arean, P. A., Hallgren, K. A., Jordan, J. T., Gazzaley, A., Atkins, D. C., Heagerty, P. J., & Anguera, J. A. (2016). The use and effectiveness of mobile apps for depression: results from a fully remote clinical trial. *Journal of medical Internet research, 18*(12), e6482. <https://doi.org/10.2196/jmir.6482>
- Bangasser, D. A., & Valentino, R. J. (2014). Sex differences in stress-related psychiatric disorders: neurobiological perspectives. *Frontiers in neuroendocrinology, 35*(3), 303-319. <https://doi.org/10.1016/j.yfrne.2014.03.008>
- Barnett, A. G., Koper, N., Dobson, A. J., Schmiegelow, F., & Manseau, M. (2010). Using information criteria to select the correct variance-covariance structure for longitudinal data in ecology. *Methods in Ecology and Evolution, 1*(1), 15-24. <https://doi.org/10.1111/j.2041-210X.2009.00009.x>

- Beasley, M., Thompson, T., & Davidson, J. (2003). Resilience in response to life stress: the effects of coping style and cognitive hardiness. *Personality and Individual Differences, 34*(1), 77-95. [https://doi.org/10.1016/S0191-8869\(02\)00027-2](https://doi.org/10.1016/S0191-8869(02)00027-2)
- Bolger, N., & Laurenceau, J. P. (2013). *Intensive longitudinal methods: An introduction to diary and experience sampling research*. Guilford press. <https://bit.ly/3E6SLPD>
- Boyd, D. (2022, March 30). *Daily Life*. The American Institute of Stress. <https://www.stress.org/daily-life>
- Brand, N., Hanson, E., & Godaert, G. (2000). Chronic stress affects blood pressure and speed of short-term memory. *Perceptual and Motor Skills, 91*(1), 291-298. <https://doi.org/10.2466%2Fpms.2000.91.1.291>
- Chen, Q., Luo, W., Palardy, G. J., Glaman, R., & McEnturff, A. (2017). The efficacy of common fit indices for enumerating classes in growth mixture models when nested data structure is ignored: A Monte Carlo study. *Sage Open, 7*(1), 2158244017700459. <https://doi.org/10.1177%2F2158244017700459>
- Çivitci, A. (2015). Perceived stress and life satisfaction in college students: Belonging and extracurricular participation as moderators. *Procedia-Social and Behavioral Sciences, 205*, 271-281. <https://doi.org/10.1016/j.sbspro.2015.09.077>
- Connor, T. S., & Lehman, B. (2012). *Getting Started: Launching a Study in Daily Life* (M. R. Mehl, Ed.; 1st ed.). The Guilford Press.
- Cohen, J. (1998). The significance of a product moment rs. In *Statistical power analysis for the behavioral science* (pp. 75 – 108). New York, new York: Academic press. <https://doi.org/10.4324/9780203771587>
- Cohen, N., Daches, S., Mor, N., & Henik, A. (2014). Inhibition of negative contentâ€™a shared process in rumination and reappraisal. *Frontiers in Psychology, 5*. <https://doi.org/10.3389/fpsyg.2014.00622>

- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of health and social behavior*, 385-396.
<https://www.jstor.org/stable/2136404>
- Danielsson, M., Heimerson, I., Lundberg, U., Perski, A., Stefansson, C. G., & Åkerstedt, T. (2012). Psychosocial stress and health problems: Health in Sweden: the National Public Health report 2012. Chapter 6. *Scandinavian journal of public health*, 40(9_suppl), 121-134. <https://doi.org/10.1177%2F1403494812459469>
- Dohrenwend, B. S., & Dohrenwend, B. P. (1974). *Stressful life events: Their nature and effects*. John Wiley & Sons. <https://psycnet.apa.org/record/1975-05437-000>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American journal of theoretical and applied statistics*, 5(1), 1-4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Garnefski, N., & Kraaij, V. (2006). Cognitive emotion regulation questionnaire—development of a short 18-item version (CERQ-short). *Personality and individual differences*, 41(6), 1045-1053. <https://doi.org/10.1016/j.paid.2006.04.010>
- Garnefski, N., Kraaij, V., & Spinhoven, P. (2001). Negative life events, cognitive emotion regulation and emotional problems. *Personality and Individual Differences*, 30(8), 1311–1327. [https://doi.org/10.1016/s0191-8869\(00\)00113-6](https://doi.org/10.1016/s0191-8869(00)00113-6)
- Garnefski, N., Teerds, J., Kraaij, V., Legerstee, J., & van Den Kommer, T. (2004). Cognitive emotion regulation strategies and depressive symptoms: Differences between males and females. *Personality and individual differences*, 36(2), 267-276.
[https://doi.org/10.1016/S0191-8869\(03\)00083-7](https://doi.org/10.1016/S0191-8869(03)00083-7)
- Gross, J. J. (1998). Antecedent-and response-focused emotion regulation: divergent consequences for experience, expression, and physiology. *Journal of personality and social psychology*, 74(1), 224.
<https://www.wisebrain.org/media/Papers/EmotionsAntecedencesResponsesReg.pdf>

- Haga, S. M., Kraft, P., & Corby, E. K. (2009). Emotion regulation: Antecedents and well-being outcomes of cognitive reappraisal and expressive suppression in cross-cultural samples. *Journal of happiness studies*, *10*(3), 271-291. <https://doi.org/10.1007/s10902-007-9080-3>
- Hamaker, E. L., Nesselroade, J. R., & Molenaar, P. C. (2007). The integrated trait–state model. *Journal of Research in Personality*, *41*(2), 295–315. <https://doi.org/10.1016/j.jrp.2006.04.003>
- Hammen, C. (2005). Stress and depression. *Annu. Rev. Clin. Psychol.*, *1*, 293-319. <https://doi.org/10.1146/annurev.clinpsy.1.102803.143938>
- Helmich, M. A., Snippe, E., Kunkels, Y. K., Riese, H., Smit, A., & Wichers, M. (2020). Transitions in Depression (TRANS-ID) Recovery: Study protocol for a repeated intensive longitudinal n= 1 study design to search for personalized early warning signals of critical transitions towards improvement in depression. <https://doi.org/10.31234/osf.io/fertq>
- Herrman, H., Stewart, D. E., Diaz-Granados, N., Berger, E. L., Jackson, B., & Yuen, T. (2011). What is resilience?. *The Canadian Journal of Psychiatry*, *56*(5), 258-265. <https://doi.org/10.1177%2F070674371105600504>
- Hu, T., Zhang, D., Wang, J., Mistry, R., Ran, G., & Wang, X. (2014). Relation between emotion regulation and mental health: a meta-analysis review. *Psychological reports*, *114*(2), 341-362. <https://doi.org/10.2466%2F03.20.PR0.114k22w4>
- Joynt, K. E., Whellan, D. J., & O'connor, C. M. (2003). Depression and cardiovascular disease: mechanisms of interaction. *Biological psychiatry*, *54*(3), 248-261. [https://doi.org/10.1016/S0006-3223\(03\)00568-7](https://doi.org/10.1016/S0006-3223(03)00568-7)
- Kivity, Y., & Huppert, J. D. (2016). Does cognitive reappraisal reduce anxiety? A daily diary study of a micro-intervention with individuals with high social anxiety. *Journal of Consulting and Clinical Psychology*, *84*(3), 269. <http://psycnet.apa.org/doi/10.1037/ccp0000075>

- Kowalik, J., Weller, J., Venter, J., & Drachman, D. (2011). Cognitive behavioral therapy for the treatment of pediatric posttraumatic stress disorder: A review and meta-analysis. *Journal of behavior therapy and experimental psychiatry*, *42*(3), 405-413. <https://doi.org/10.1016/j.jbtep.2011.02.002>
- Kraiss, J. T., ten Klooster, P. M., Moskowitz, J. T. & Bohlmeijer, E. T. (2020). The relationship between emotion regulation and well-being in patients with mental disorders: A meta-analysis. *Comprehensive Psychiatry*, *102*, 152189. <https://doi.org/10.1016/j.comppsy.2020.152189>
- Krkovic, K., Clamor, A., & Lincoln, T. M. (2018). Emotion regulation as a predictor of the endocrine, autonomic, affective, and symptomatic stress response and recovery. *Psychoneuroendocrinology*, *94*, 112-120. <https://doi.org/10.1016/j.psyneuen.2018.04.028>
- Lazarus, R. S., & Alfert, E. (1964). Short-circuiting of threat by experimentally altering cognitive appraisal. *The Journal of Abnormal and Social Psychology*, *69*(2), 195. <https://psycnet.apa.org/doi/10.1037/h0044635>
- Lazarus, R. S. (1991b). *Emotion and Adaptation* (1st ed.). Oxford University Press. <https://bit.ly/3zNALJM>
- Lee, E. H. (2012). Review of the psychometric evidence of the perceived stress scale. *Asian nursing research*, *6*(4), 121-127. <https://doi.org/10.1016/j.anr.2012.08.004>
- Luthar, S. S., Cicchetti, D., & Becker, B. (2000). The construct of resilience: A critical evaluation and guidelines for future work. *Child development*, *71*(3), 543-562. <https://doi.org/10.1111/1467-8624.00164>
- Maslen, M. (2014). *The stress timebomb? - ProQuest*. ProQuest. <https://www.proquest.com/openview/6d6caf249cdd71aa8043943b9a87c864/1?pq-origsite=gscholar&cbl=2028822>

- Mauss, I. B., Cook, C. L., Cheng, J. Y., & Gross, J. J. (2007). Individual differences in cognitive reappraisal: Experiential and physiological responses to an anger provocation. *International Journal of Psychophysiology*, *66*(2), 116-124. <https://doi.org/10.1016/j.ijpsycho.2007.03.017>
- Mental health statistics: stress*. (2020, 16. Januar). Mental Health Foundation. <https://www.mentalhealth.org.uk/statistics/mental-health-statistics-stress>
- Moore, S. A., Zoellner, L. A., & Mollenholt, N. (2008). Are expressive suppression and cognitive reappraisal associated with stress-related symptoms?. *Behaviour research and therapy*, *46*(9), 993-1000. <https://doi.org/10.1016/j.brat.2008.05.001>
- Molenberghs, G., & Verbeke, G. (2001). A review on linear mixed models for longitudinal data, possibly subject to dropout. *Statistical Modelling*, *1*(4), 235-269. <https://doi.org/10.1177%2F1471082X0100100402>
- Myin-Germeys, I., & Kuppens, P. (2021). *The open Handbook of Experience Sampling Methodology*. KU Leven. <https://www.kuleuven.be/samenwerking/real/real-news/launch-open-handbook-of-experience-sampling-methodology-1>
- O'Dougherty, M., Hearst, M. O., Syed, M., Kurzer, M. S., & Schmitz, K. H. (2012). Life events, perceived stress and depressive symptoms in a physical activity intervention with young adult women. *Mental health and physical activity*, *5*(2), 148-154. <https://doi.org/10.1016/j.mhpa.2012.05.001>
- Platt, S., Brown, D., & Hughes, M. (2016). Measuring resilience and recovery. *International Journal of Disaster Risk Reduction*, *19*, 447-460. <https://doi.org/10.1016/j.ijdr.2016.05.006>
- Preece, D. A., Becerra, R., Hasking, P., McEvoy, P. M., Boyes, M., Sauer-Zavala, S., ... & Gross, J. J. (2021). The emotion regulation questionnaire: Psychometric properties and relations with affective symptoms in a United States general community sample. *Journal of Affective Disorders*, *284*, 27-30. <https://doi.org/10.1016/j.jad.2021.01.071>

- Preece, D. A., Becerra, R., Robinson, K., & Gross, J. J. (2019). The emotion regulation questionnaire: psychometric properties in general community samples. *Journal of personality assessment*. <https://doi.org/10.1080/00223891.2018.1564319>
- Roberti, J. W., Harrington, L. N., & Storch, E. A. (2006). Further psychometric support for the 10-item version of the perceived stress scale. *Journal of College Counseling*, 9(2), 135-147. <https://doi.org/10.1002/j.2161-1882.2006.tb00100.x>
- Segrin, C. (2001). Social skills and negative life events: Testing the deficit stress generation hypothesis. *Current Psychology*, 20(1), 19-35. <https://doi.org/10.1007/s12144-001-1001-8>
- Shallcross, A. J., Troy, A., & Mauss, I. B. (2015). Regulation of emotions under stress. *Emerging Trends in the Social and Behavioral Sciences: An interdisciplinary, searchable, and linkable resource*, 1-16. <https://bit.ly/3Oa1zIv>
- Shiffman, S., Stone, A. A., & Hufford, M. R. (2008). Ecological momentary assessment. *Annu. Rev. Clin. Psychol.*, 4, 1-32. <https://doi.org/10.1146/annurev.clinpsy.3.022806.091415>
- Shiota, M. N. (2006). Silver linings and candles in the dark: differences among positive coping strategies in predicting subjective well-being. *Emotion*, 6(2), 335. <https://psycnet.apa.org/doi/10.1037/1528-3542.6.2.335>
- Sin, N. L., & Lyubomirsky, S. (2009). Enhancing well-being and alleviating depressive symptoms with positive psychology interventions: A practice-friendly meta-analysis. *Journal of clinical psychology*, 65(5), 467-487. <https://doi.org/10.1002/jclp.20593>
- Solomon, O. (2013). Exploring the relationship between resilience, perceived stress and academic achievement. <https://e-space.mmu.ac.uk/id/eprint/576570>
- Spada, M. M., Nikčević, A. V., Moneta, G. B., & Wells, A. (2008). Metacognition, perceived stress, and negative emotion. *Personality and Individual Differences*, 44(5), 1172-1181. <https://doi.org/10.1016/j.paid.2007.11.010>

- Steinke, A., & Kopp, B. (2020). RELEX: An Excel-based software tool for sampling split-half reliability coefficients. *Methods in Psychology*, 2, 100023.
<https://doi.org/10.1016/j.metip.2020.100023>
- Taylor, S. E. (1991). Asymmetrical effects of positive and negative events: the mobilization-minimization hypothesis. *Psychological bulletin*, 110(1), 67. <https://bit.ly/3OzcxYc>
- Thompson, R. A. (1994). Emotion Regulation: A Theme in Search of Definition. *Monographs of the Society for Research in Child Development*, 59(2/3), 25–52.
<https://doi.org/10.2307/1166137>
- Troy, A. S., Shallcross, A. J., & Mauss, I. B. (2013). A person-by-situation approach to emotion regulation: Cognitive reappraisal can either help or hurt, depending on the context. *Psychological science*, 24(12), 2505-2514.
<https://doi.org/10.1177/0956797613496434>
- Van Berkel, N., Ferreira, D., & Kostakos, V. (2017). The experience sampling method on mobile devices. *ACM Computing Surveys (CSUR)*, 50(6), 1-40.
<https://doi.org/10.1145/3123988>
- Verhagen, S. J. W., Hasmi, L., Drukker, M., van Os, J., & Delespaul, P. A. E. G. (2016). Use of the experience sampling method in the context of clinical trials. *Evidence-based mental health*, 19(3), 86-89. <https://doi.org/10.1136/ebmental-2016-102418>
- Vilardaga, R., Hayes, S. C., Atkins, D. C., Bresee, C., & Kambiz, A. (2013). Comparing experiential acceptance and cognitive reappraisal of psychotic symptoms as predictors of functional outcome among individuals with serious mental illness. *Behaviour research and therapy*, 51(8), 425. <https://dx.doi.org/10.1016%2Fj.brat.2013.04.003>
- Wang, M., & Saudino, K. J. (2011). Emotion regulation and stress. *Journal of Adult Development*, 18(2), 95-103. <https://doi.org/10.1007/s10804-010-9114-7>

- West, B. T. (2009). Analyzing longitudinal data with the linear mixed models procedure in SPSS. *Evaluation & the health professions, 32*(3), 207-228.
<https://doi.org/10.1177/0163278709338554>
- Xu, C., Xu, Y., Xu, S., Zhang, Q., Liu, X., Shao, Y., Xu, X., Peng, L., & Li, M. (2020). Cognitive Reappraisal and the Association Between Perceived Stress and Anxiety Symptoms in COVID-19 Isolated People. *Frontiers in Psychiatry, 11*.
<https://doi.org/10.3389/fpsyt.2020.00858>
- Yaden, D. B., Eichstaedt, J. C., & Medaglia, J. D. (2018). The future of technology in positive psychology: methodological advances in the science of well-being. *Frontiers in psychology, 9*62. <https://doi.org/10.3389/fpsyg.2018.00962>
- Yurtsever, G. (2008). Negotiators' profit predicted by cognitive reappraisal, suppression of emotions, misrepresentation of information, and tolerance of ambiguity. *Perceptual and Motor Skills, 106*(2), 590-608. <https://doi.org/10.2466%2Fpms.106.2.590-608>
- Zou, P., Sun, L., Yang, W., Zeng, Y., Chen, Q., Yang, H., Zhou, N., Zhang, G., Liu, J., Li, Y., Ao, L., & Cao, J. (2018). Associations between negative life events and anxiety, depressive, and stress symptoms: A cross-sectional study among Chinese male senior college students. *Psychiatry research, 270*, 26-33.
<https://doi.org/10.1016/j.psychres.2018.09.019>

Appendix

Appendix A

Informed Consent

INFORMED CONSENT

Dear participant,

Thank you for your participation in this study. Before you participate, it is important that you understand the goal of this research and what the study will ask from you. The purpose of this study is to find out how mental health is related to emotion regulation. To explore this relationship, we want to measure fluctuations in emotions in daily life.

For this study, we will ask you to fill in several questionnaires on your mobile phone. All questionnaires will be completed in the Ethica app. The study will start with a questionnaire concerning your demographics and general mental health. This initial questionnaire will take about 10 minutes to complete. Afterwards, you will receive four questionnaires per day for a period of two weeks. Notifications will remind you about the next questionnaire. One daily questionnaire takes approximately 3 minutes to complete. It is important that you answer the questionnaires as soon as possible. *Please make sure that you turn on the notifications for the Ethica app on your mobile device.*

The information that we collect from this research project will be kept confidential. This means that only the researchers have insight into your answers. All personal data (such as age, gender etc.) will be anonymized and will not be published and/or given to a third party. Your

participation in this study is voluntary. You are free to withdraw from this study at any time and without giving a reason.

Consent

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

Appendix B

Perceived Stress Scale

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?

5. I control my emotions by changing the way I think about the situation I am in.	□	□	□	□	□	□	□
6. When I want to feel less negative emotion, I change the way I am thinking about the situation.	□	□	□	□	□	□	□

Appendix E

Items Cognitive Reappraisal

'In the last hour, I controlled negative feelings by changing the way I think about the situation I am in'.

'In the last hour, I tried to look at the cause of my negative feelings from a different perspective'.

Appendix F

Items Stressful Events

'Think of the most striking event or activity in last hour. How (un)pleasant was this event or activity?'. 'Think of the most striking event or activity in the last hour. How stressful was this event or activity?'