# The Relationship between Cognitive Reappraisal and Mental Health in the Context of Resilience: An Experience Sampling Study

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**Abstract**

**Background:** The adaptive nature of cognitive reappraisal on mental health through beneficial effects on affective states has repeatedly been expressed in cross-sectional studies. However, emerging ESM studies conveyed mixed findings, expressing that reappraisal does not show a consistent pattern in relation to negative affect. Moreover, reappraisal has been linked to resilience, offering the perspective of its usefulness in contexts of adverse circumstances. The current study examined the moderating effects of reappraisal on the association between stressful events and negative affect by employing Experience Sampling Methodology. Moreover, it was investigated whether daily reappraisal use significantly differs among less versus more trait resilient individuals.

**Method:** Participants ($n=60$, mean age=23, 58% female, 42% male) were asked to self-report stressful events, state negative affect and momentary reappraisal use four times a day for two weeks using the app Ethica Data. Additionally, a baseline assessment of mental health, depression symptoms, trait reappraisal and trait resilience was administered. For the moderation analysis, multilevel modeling was employed while an independent-samples t-test was conducted to assess differences in state reappraisal for the less and more resilient groups.

**Results:** A significant negative moderation effect of reappraisal on the association between stressful events and negative affect ($b=-.123$, $p<.001$) was found. No significant differences in reappraisal use were observed for less versus more resilient individuals ($p=.42$).

**Conclusion:** Results suggest that cognitive reappraisal shows to have beneficial moderating effects on negative affect in the context of stressful events in daily life. As reappraisal frequency does not show to significantly differ between less and more resilient groups, it is suggested to explore alternative mechanisms in which reappraisal possibly promotes resilience, i.e. through reappraisal quality. Nonetheless, current findings express the apparent benefit of reappraisal on affective outcomes, further advocating its use in Ecological Momentary Interventions to promote adaptability to stressful events.

**Introduction**

Earlier or later, everyone will experience life events that are perceived as negative or unpleasant. However, there seem to be differences between individuals in how they cope with and adapt to adversity. The ability to bounce back from unfavorable situations in life and overcome adversity is called resilience (Block & Block, 1980 as cited in Tugade & Frederickson, 2007). Being resilient has been shown to promote mental health and healthy functioning following traumatic events as well as situations of hardship in daily life (Jose & Novaco, 2016; Tugade & Fredrickson, 2007). The study of Jose and Novaco (2016) for instance expressed that intimate partner abuse victims who score high on resilience differed from less resilient victims by expressing less psychological distress. Both, perceived stress as well as mood symptoms have shown to be significantly lower for people characterized by resilience, potentially protecting them more from psychological disturbances such as depression or anxiety (Jose & Novaco, 2016). Moreover, resilience has been identified as a skill that can be learned despite inherent individual differences which led to significant attention within the scientific community for its potential use in interventions (Peng et al., 2014; Tugade & Fredrickson, 2007).

Due to the positive effects on mental health, the underlying mechanisms of resilience have been explored. Correlational studies repeatedly expressed the positive relationship between resilience and certain emotion regulation strategies suggesting that resilient individuals manage to effectively cope with emotions arising from situations of adversity (Tugade & Fredrickson, 2007; Polizzi & Lynn, 2021). Emotion regulation (ER) refers to the process of altering emotional experiences in order to cope with a present or anticipated situation and its environmental demands appropriately (Gross, 1998). If used adaptively, regulating emotions has been shown to serve multiple purposes for health, such as the maintenance of psychological and physiological well-being (Doorley & Kashdan, 2021). Moreover, the inability to effectively regulate emotions has been linked to several psychopathological outcomes such as borderline personality disorder, major depressive disorder, or generalized anxiety disorder, among others, making salient its significant role in healthy psychological functioning (Kraiss et al., 2020). However, enhanced effects on well-being have been associated with some ER strategies more than with others, leading to a distinction in literature between the labels of adaptive and maladaptive ER strategies (Aldao et al., 2010; Brockman et al., 2016; Kraiss et al., 2020). Yet, recent findings suggest that the argued adaptive or

maladaptive nature of ER strategies heavily relies on the context in which they are employed, highlighting that additional factors are able to influence the outcomes of emotion regulation (Brockman et al., 2016), such as the social environment for instance (Gross, 2015).

One emotion regulation strategy that is seen as putatively adaptive is the strategy of cognitive reappraisal (CR), also referred to as cognitive restructuring (Brockman et al., 2016; McRae et al., 2011). Cognitive reappraisal is the skill of cognitively reframing situations to modify their emotional impact (Gross & John, 2003). As such, situations that are initially viewed as negative can be altered to a more positive viewpoint. Cross-sectional as well as experimental studies have shown that the use of CR increases positive and decreases negative affect, thus emotionally benefitting well-being (Chen & Wang, 2014; Southward et al., 2021). This twofold benefit for the emotional state is furthermore suggested to play a remarkable role in resilience (Chen & Wang, 2014; Tugade & Fredrickson, 2007). The systematic review by Polizzi and Lynn (2021) on the relationship between ER and resilience expressed a repeatedly found positive association between cognitive reappraisal and trait resilience (Hong et al., 2018; Karreman & Vingerhoets, 2012; Mestre et al., 2017). It is hypothesized that the act of reappraisal strengthens the ability to distinguish between positive and negative affective states (Johnson et al., 2016). Thus, when experiencing and identifying positive affect, no further regulation is employed, whereas when identifying negative affect, regulation is required which is achieved by reframing the emotionally loaded situation. By flexibly altering the emotional valence of a given event, especially subjectively perceived negative events, individuals' resilience is theorized to be facilitated, as the adaptive perspective helps to deal with and overcome adverse situations (Polizzi & Lynn, 2021).

Cross-sectional designs have since laid the foundation for most research conducted in the area of well-being and ER and repeatedly demonstrated that the use of CR is positively associated with positive outcomes for affective states (Brockman et al., 2016; Gross & John, 2003). Additionally, experimental studies built on this notion and expressed similar findings. In the study by Southward et al. (2021) which investigated the influence of cognitive reappraisal on affective changes, participants were instructed to think back to an upsetting memory and rate the intensity of their positive and negative affect. Afterwards, participants were asked to reappraise the upsetting memory and write down how they view the situation after having deliberately reframed it. Lastly, positive and negative affect ratings were given to assess the potential differences in affect induced by reappraising. Findings reflected the

previously established notion that cognitive reappraisal exerts its influence on positive affect by increasing it and reducing negative affect. However, one limitation of this study is that it only provides insights into how CR works in a controlled environment. Since laboratory environments differ from naturalistic ones however, the question remains if findings would yield similar results when using more ecologically valid measurement techniques.

One method that aims to overcome the aforementioned limitations is a self-report measure termed Experience Sampling Methodology (ESM). ESM aims to expand the scientific inquiry outside the laboratory setting and bring it into daily life by measuring concepts of interest multiple times a day with the help of technological devices (Myin-Germeys & Kuppens, 2021). Since ESM is closely integrated into the participants' daily life and aims to explore current moods, behaviours and thinking patterns it enables a significant reduction in memory recall bias compared to other methodologies (Scollon et al., 2009). For instance, in the current study participants will be asked about their emotional state and reappraisal use four times a day which facilitates recall concerning details of emotion eliciting situations and subsequent emotional regulation, thus strengthening the accuracy of the given data. Additionally, ESM enables gathering data that concern within-person effects, contrary to between-person data, as obtained in cross-sectional research. The foundation of research in the field of ER has heavily relied on cross-sectional data (Brockman et al., 2016) which can lead to misleading results when transferring group findings to the individual level (Curran & Bauer, 2011). This phenomenon is termed ecological fallacy (Curran & Bauer, 2011) and can potentially lead to inaccurate inferences of the investigated psychological concept from the group to the individual level. While the current study will not explicitly focus on disentangling between- from within-person associations, it still aims to exploratively examine a few examples of individual emotion regulation trajectories to gain a more accurate picture of CR on the individual level.

Especially in the context of ESM studies it also remains worthwhile to distinguish state from trait measurements. Trait measurements capture general, habitual tendencies to regulate emotions while state measurements aim to reflect the dynamic, momentary regulation of emotions (Maxwell et al., 2018). As emotion regulation compromises a cognitive process that persistently occurs in daily life (Tugade & Fredrickson, 2007) it becomes apparent that measuring its use on the state level is crucial in order to gain full understanding of the nature of cognitive reappraisal. This means not to discard previous findings based on trait

measurements but to complement the picture on CR by looking at the broader context and situational details in which the individual makes use of this strategy. Additionally, employing state measurement is expected to demonstrate similar, however still distinguishable results to trait measurements, as both would measure the same underlying construct but the momentary impact of the natural environment might reveal deviations from previously established findings that sharpen further understanding of CR.

In line with previous considerations, results of ESM studies have indeed shown to partly deviate from earlier findings displayed in cross-sectional research. Specifically the established conception that CR is negatively related with negative affect has been substantially challenged. Brockman et al. (2016) investigated the relationship between cognitive reappraisal and positive as well as negative affect in the context of an ESM study and results expressed that the use of cognitive reappraisal is positively associated with positive affect, however there is contradicting evidence for the emotion regulation strategy to be negatively associated with negative affect. In half of the sample ($n$=187) no association between cognitive reappraisal and negative affect could be observed, thus unfolding further questions when it comes to the associations between cognitive reappraisal and negative affect. Surprisingly, increases in momentary negative affect were observed among adolescents (aged 17-19) when reappraising, not only highlighting the context-dependent nature of the construct but challenging its previously generalized adaptive characteristics.

Since previous ESM studies have solely expressed the relationship between CR and significant increases in positive affect, yet have yielded contradictory results regarding negative affect (Brockman et al., 2016; Nezlek & Kuppens, 2008), the present study will thus focus on the aspect of negative affect. Furthermore, the notion that trait resilient individuals employ CR has found common ground (Polizzi & Lynn, 2021), yet has not been investigated in naturalistic settings extensively enough to uncover crucial regulatory processes that unfold in daily life. In this case, examining if the use of CR can be observed timely near to instances of negative affect could give more insight on which emotional states elicit or prompt the use of CR. Connected to that, it is worthwhile to look into these dynamics in the context of resilience, to explore how emotional experiences of more compared to less resilient individuals take its turn after emotionally loaded events. As Tugade and Fredrickson (2007) put it, " [...] ESM can reveal, rather than assume, behavioral patterns that are true for resilient individuals" (p. 326), expressing the focus of the current study.

The present study aims to answer two overarching questions. First, effects of reappraising on negative affect in daily life will be investigated by assessing if the relationship between stressful events and negative affect changed significantly due to the use of CR. As it is assumed that negatively perceived events are positively associated with negative affect, the use of momentary cognitive reappraisal is hypothesized to negatively moderate this relationship due to the resulting perspective change towards the stressful situation and the positive emotional alterations that come with it (Chen & Wang, 2014; Southward et al., 2021). Another aim of the current study is to examine how groups differing in trait resilience make use of reappraisal in daily life, in terms of frequency. Due to the hypothesized beneficial effects of reappraisal on affective states, it is assumed that the ability to deal with stressful situations is facilitated by reappraising more frequently. As previous studies expressed a positive relationship between resilience and cognitive reappraisal (Hong et al., 2018; Karreman & Vingerhoets, 2012; Mestre et al., 2017) it was hypothesized that more trait resilient individuals would make significantly more use of cognitive reappraisal in daily life compared to less trait resilient individuals.

*R1: Is cognitive reappraisal moderating the relationship between momentary stressful events and negative affect?*

*R2: Are there differences between less and more trait resilient individuals in the frequency of reappraisal in daily life?*

## Method

### Participants

A total of 114 participants was recruited with selective convenience sampling. Van Berkel et al. (2017) indicated that an average of 53 participants have been used in previous studies employing Experience Sampling Methodology which is significantly outnumbered in the current study. However, due to the burden on the participants that comes with the frequency of data collection points during the day it was expected that the initial number of participants would be noticeably reduced after excluding participants with low compliance rates. As data collection in ESM studies requires a high time investment (Yearick, 2017) it was decided to collect participants with a type of non-probability sampling. Selective convenience sampling makes it possible to invite personal contacts for participation which aids in gaining access to timely available and possibly motivated participants (Etikan, Musa, & Alkassim, 2016). To

increase the sample size additionally, the study was published on SONA (sona-systems.com), an internal recruitment platform of the University of Twente that provides SONA credits to psychology students in return for participating in studies. As SONA credits are a requirement for successful completion of the psychology program, such credits thus serve as an incentive for participation. Eligibility criteria consisted of a minimum age of 18 and a sufficient level of English. Additionally, a smartphone was of need to self-report the data.

**Materials**

*Baseline questionnaire*

The 6-item Brief Resilience scale (BRS) was used to measure trait resilience on a 5-point Likert scale with lower mean scores indicating lower trait resilience and higher mean scores representing higher resilience. The questionnaire was chosen for its psychometric qualities, characterized by good internal consistency ($a = 0.7$ to $0.9$; Smith et al., 2013) and superior construct validity, when compared to other resilience scales, such as the Resilient Coping Scale (Fung, 2020). Furthermore, the BRS is a relatively short questionnaire, making it suitable for ESM studies. In the current study, a reliability estimate ($a = 0.82$) expressing good internal-consistency was measured.

Trait cognitive reappraisal was measured with the corresponding subscale of the Emotion Regulation Questionnaire (Gross & John, 2003) which is composed of 6 items. Within the scale, cognitive reappraisal is measured on a 7-point Likert scale with 1 (strongly disagree) being the lowest and 7 (strongly agree) the highest score (Gross & John, 2003). Internal consistency values of trait reappraisal ($a=0.89$-$90$) express excellent reliability (Preece et al., 2018). The measured reliability estimate as measured in the current study ($a=0.92$) equally expresses excellent internal consistency.

To measure emotional, psychological, and social well-being, the Mental Health Continuum Short Form (MHC-SF) scale was incorporated, measuring overall well-being. The instrument consists of 14 items, with answering options ranging from 1 (never) to 6 (every day) which assess the frequency of positive mental health symptoms (Lamers et al., 2011). Items are summed and range from 0-70 with higher scores representing higher levels of positive well-being (Lamers et al., 2011). The questionnaire yields excellent internal consistency ($a=0.91$) as measured by Luijten et al. (2019). In addition, convergent and divergent validity were supported in a Dutch sample (Luijten et al., 2019). Similarly, the reliability estimate measured in the current study ($a =0.92$) expressed excellent internal consistency.

Lastly, to measure symptoms of depression, the Patient Health Questionnaire (PHQ-9) was included. Participants were asked about several depressive symptoms such as *'feeling tired or having little energy'* or *'little interest or pleasure in doing things'* they experienced in the last two weeks. The 9 items compromising the questionnaire can be answered from 1 (not at all) to 4 (nearly every day). The score is calculated by summing the values and are categorized into none-minimal-, mild- (5-9), moderate- (10-14), moderately severe- (15-19) and severe (20-27) depression severity. Internal consistency of the scale is classified as good (a=0.87; Kocalevent et al., 2013). In the current study, the reliability estimate was found to be similar ($a = 0.88$) as in the study by Kocalevent et al. (2013), expressing good reliability.

### *Daily questionnaires*

To measure momentary negative affect, 4 items were chosen from the ESM items created by Helmich et al. (2021). The items were created for the specific use in ESM studies, characterized by their brevity and have been incorporated in a previous ESM study (Schleich, 2022). Furthermore, they have been added to the ESM Item Repository, an ESM item database which offers open access to various questionnaire items that have been verified for the specific use in ESM studies (ESM Item Repository, n.d.). Participants were asked *"how 'anxious', 'irritable', 'down' and 'sad' do you feel right now?"*. Answering options were given on a 7-point Likert scale ranging from 1 (not at all) to 7 (very much) with higher mean scores indicating higher levels of momentary negative affect.

To measure cognitive reappraisal on the state level, two items of the Emotion Regulation Questionnaire (ERQ) were used. The first item stated *"In the last hour, I controlled negative feelings by changing the way I think about the situation I am in"* whereas the second item stated *"In the last hour, I tried to look at the cause of my negative feelings from a different perspective"*. The items were chosen based on their compatibility with the definition of cognitive reappraisal used in this paper, being an emotion regulation strategy that focuses on perspective change towards a given event, additionally to the initial event being perceived as negative by the individual. Again, answering options ranged from 1 (not at all) to 7 (very much) on a 7-point Likert scale with higher scores indicating higher cognitive reappraisal use on the state level.

Lastly, to assess stressful events, the item *"Think of the most striking event or activity in the last hour. How stressful was this event or activity?"* was added. The answering options range from –3 (very stressful) to 3 (not stressful). Anew, the item was found in the ESM item repository (esmitemrepository.com) and was used in a previous ESM study (Schleich, 2022).

**Design and Procedure**

After approval of the study (request nr: 220285) by the Ethics Committee of Behavioural, Management and Social Sciences of the University of Twente it was set up for the pilot test in the online platform Ethica Data (https://ethicadata.com/). The pilot test was run for three days to ensure that triggered questionnaires run timely. Participants were asked to download the Ethica Data app and could sign up with the study code provided by the researchers. After enrolling with the code, participants gained access to the informed consent form (see Appendix A). Once consent was given, the 20 minute baseline questionnaire was triggered on the first day of the study at 9 am and in case of non-completion, reminders were sent out after 8, 24 and 72 hours (see Appendix B). The baseline questionnaire did not expire throughout the study period, making it possible to complete the trait data from day 1 to day 14 and needed to be filled out once. Daily questionnaires were composed of 4 items measuring negative affect, one item measuring stressful events and lastly two items measuring cognitive reappraisal on the state level (see Appendix C). Daily questionnaires were estimated to take 3 minutes and were triggered using the semi-structured sampling scheme. This sampling scheme implies that questionnaires are randomly prompted within a preset time interval (Myin-Germeys & Kuppens, 2021). Such intervals were prefixed to morning (10-11 am), midday (1.30-2.30 pm), afternoon (5-6 pm) and evening (8.30-9.30 pm) and thus could ideally be filled out four times a day. One advantage of such a sampling scheme is the relatively high ecological validity when comparing it to a fixed sampling scheme, which is limited due to its high predictability (Myin-Germeys & Kuppens, 2021). Furthermore, fixed intervals are beneficial for the compliance rate when comparing it to a random interval scheme, where triggered questionnaires occur at unpredictable timepoints (Myin-Germeys & Kuppens, 2021). If questionnaires were not completed within the time frame, these questionnaires would expire after 60 minutes. Other subscales and questionnaires were included as well to serve the purpose of answering other research questions within the context of emotion regulation and mental health.

**Data analysis**

To analyze the data, the distinct questionnaires were downloaded from the Ethica website and inserted into the statistical program IBM SPSS Statistics 28. The data sets were prepared by deleting participants without a completed baseline assessment and a compliance rate lower than 50%, as employed in previous ESM literature (Conner & Lehman, 2012). Subsequently, it was assessed if trait and state measurements were positively correlated and would therefore

measure the same latent construct. This was done by calculating the mean score of every participant for state reappraisal and negative affect as well as the corresponding trait measures which were correlated against each other using the bivariate correlation function. Positive, significant correlations would then indicate that the items on the state as well as trait level would measure the same underlying construct.

ESM data is characterized by its repeated measures per individual due to the longitudinal design it is composed of. Since Fixed Effects models do not take this nested structure into account, more complex statistical models such as multilevel models are suitable for analyses incorporating such clustered data (Palmier-Claus et al., 2019). The Linear Mixed Model (LMM) for instance, takes random errors, missing data at random as well as the nested structure of the data into account, making it suitable for the analysis of the given data (Magezi, 2015). Within this model, individuals (ID) were inserted in the *subjects* box and the variable time was allocated to the box *repeated* to indicate that repeated measures were nested within individuals. Furthermore, the Covariance Type First–order Autoregressive AR(1) was used as it assumes that measurements that are time-wise further away from each other are less correlated (Kincaid, n.d.).

First, it was measured if negative events are positively associated with negative affect. Accordingly, the variable stressful events was dichotomized into either stressful event (scores –3 to –1 being recoded into 2) or non-stressful event (scores 0 to 3 being recoded into 1). Afterwards, a LMM was run with the aforementioned settings and the total score of negative affect as the dependent variable and stressful events as the independent variable. Further, to measure the moderation effect of cognitive reappraisal, a LMM was run, keeping the total score of negative affect as the dependent variable and inserting both, stressful events as well as the total score of cognitive reappraisal as fixed covariates. Cognitive reappraisal as well as stressful events were selected as multifactorial variables in the settings next to including an interaction effect of both for the output. Additionally, for all aforementioned variables a standardized version, hence the respective z scores, were created with the aim of replicating the analyses to gain standardized estimates which aid in interpreting effect sizes. To classify the strength of the relationships employing standardized scores the classification system applied by Cohen (1988) was used. Relationships are respectively classified as weak: ß <0.3; moderate: ß = 0.3-0.5 or strong: ß >0.5.0.5.

To explore the differences between higher and lower trait resilient individuals and the frequency of reappraisal use in daily life an independent samples t-test was conducted. To achieve groups of equal size the sample was divided by the median of the mean resilience score.

Lastly, explorative work on individual cases regarding reappraisal use over the study period was aimed for. In total, three individuals of varying mean resilience scores and with relatively high compliance rates were selected. Subsequently, the mean scores of state cognitive reappraisal, state negative affect and stressful events per selected individual were plotted with Excel.

# Results

## Descriptive statistics

After clearing the data, a sample of 60 participants was left, composed of 35 females and 25 males (58% female, 42% male). Within this sample, respondents had a compliance rate of 76,6%. Participants age span ranged from 18 to 65  with a mean age of 23.38 ($SD = 8.03$). Characteristic about the sample was that most participants were students and reported that the highest level of education achieved compromised a High School degree. More details regarding relevant characteristics of the sample can be found in Table 1.

**Table 1**

*Sample characteristics (n=60)*

|  |  | n | % |
|---|---|---|---|
| Gender | Female | 35 | 58.3% |
|  | Male | 25 | 41.7% |
| Nationality | Dutch | 11 | 18.3% |
|  | German | 41 | 68.3% |
|  | Other | 8 | 13.3% |
| Occupation | Student | 34 | 56.7% |
|  | Student and working | 18 | 30% |
|  | Working | 5 | 8.3% |
|  | Self-employed | 0 | 0% |
|  | Other | 3 | 5% |
| Highest level education | High school | 52 | 86.7% |
|  | Bachelor | 4 | 6.7% |
|  | Master | 3 | 5.0% |
|  | Other | 1 | 1.7% |

The mean score of trait reappraisal as assessed in the ERQ in the current sample ($M= 4.4$, $SD= 1.09$) scored comparably to the mean of the undergraduate, non-clinical samples (samples A-

D, *n*=1483) in the study by Gross and John (2003) (*M*=4.6 [*SD*=.94] for men; *M*=4.61 [*SD*= 1.02] for women). For the PHQ-9 (*M*=8.5, *SD*= 5.88) the mean value contrasts the estimate for the general population found in the paper of Hinz et al. (2016) (*M*=3.3, *SD*= 3.65). Based on this comparison, it can be concluded that the current sample experiences a heightened amount of depressive symptoms. As for the BRS, the assessed mean score for trait resilience in the current sample (*M*=3.1, *SD*=0.3) expresses a lower level of trait resilience when compared to the findings of Smith et al. (2013) where the sample was composed of healthy, patient and at-risk participants (*M*= 3.7, *SD*=0.68). Lastly, as for the MHC-SF, the sample of the current study displayed a lower mean (*M*=2.6, *SD*= 0.89) for mental health than the reported level of mental health in the Dutch general population assessed by Lamers et al. (2011) *(M*= 3.98, *SD*=0.85), expressing relatively low levels of mental health.

**Associations among state variables**

When plotting the person mean scores of standardized cognitive reappraisal and standardized negative affect on the state level an inconsistent pattern emerges (see Figure 1). While for some participants negative affect scores seem to coincide with state cognitive reappraisal (participant 2, 14, 19) for others the two variables lie in opposite directions (participant 9, 32, 55). Correlating standardized reappraisal per measurement point with standardized negative affect on the state level, expressed a significant, weak association (*r*=-.096, *p* <.001) which is negative.

**Figure 1**

*Line plot depicting standardized person mean scores of state cognitive reappraisal and state negative affect per participant (n=60)*
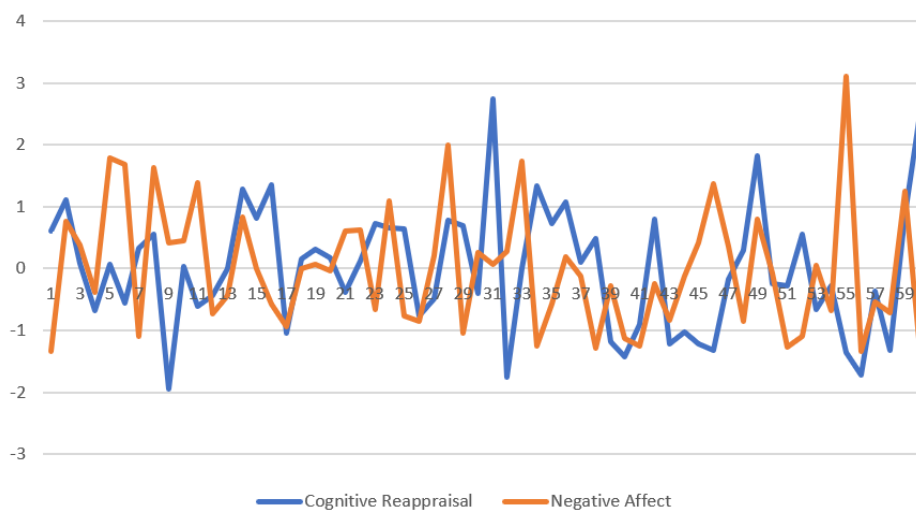
Correlations among state and trait measurements were furthermore run to assess convergent validity. Relevant correlations have been shown to go in the expected directions (see Table 2). The correlation between state cognitive reappraisal and trait reappraisal as assessed in the subscale of the Emotion Regulation Questionnaire has been shown to be positive, however, did not express a significant association ($r$=.227, $p$= 0.08). This finding expresses relevant implications in regards to convergent validity, indicating that the items measuring state reappraisal potentially did not fully represent the full concept of reappraisal.

**Table 2**

*Mean, standard deviations, and inter-correlations among trait and state measures*

|  | Mean | SD | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 1 ERQ | 4.4 | 1.09 | | | | | |
| 2 PHQ-9 | 8.5 | 5.88 | -.38** | | | | |
| 3 MHC-SF | 2.6 | .89 | .49** | -.63** | | | |
| 4 State c. reappraisal | 3.0 | .95 | .23 | -.24 | .35** | | |
| 5 State negative affect | 2.18 | .78 | -.41** | .53** | -.31* | -.04 | |

**. Correlation is significant on the level of 0.01 (two-sided)

*. Correlation is significant on the level of 0.05 (two-sided)

**Moderation of Cognitive Reappraisal on Stressful Events and Negative Affect**

When running the LMM for the association between the dichotomous variable of stressful events on standardized negative affect a significant positive relationship was found ($\beta$= 0.46, $p$<.001). As the standardized estimate lies between 0.3 and 0.5 the association can be classified as moderate (Cohen, 1988). Furthermore, the moderating effect of cognitive reappraisal on the relationship between stressful events and negative affect showed to be significant and negative ($b$ = -.12 , $p$ < .001) (see Table 3).

**Table 3**

*Estimates of fixed effects of stressful event and cognitive reappraisal on negative affect as dependent variable*

| Parameter | *B* | *ß* | *SE* | *df* | *t* | Sig | 95% Confidence Interval Lower bound | 95% Confidence Interval Upper bound |
|---|---|---|---|---|---|---|---|---|
| Intercept | 1.33 | -.50 | .14 | 2327.72 | 9.89 | <.001 | 1.07 | 1.59 |
| stressful event | .89 | .46 | .10 | 1980.82 | 8.73 | <.001 | .69 | 1.09 |
| reappraisal | .09 | .12 | .04 | 2037.92 | 2.24 | .025 | .011 | .16 |
| stressful event*reappraisal | -.12 | -.17 | .03 | 1920.97 | -4.13 | <.001 | -.18 | -.07 |

**Cognitive reappraisal use in less and more resilient groups**

As the median of the overall sample resulted in 3.17 this number was set as the cut-off score to classify individuals as less (<3.17) or more resilient ($\geq$ 3.17). The results of the independent samples t-test indicated that there was no significant difference in the mean scores of state reappraisal in the lower resilient (*M*=2.88, *SD*=1.01) and higher resilient (*M*=3.12, *SD*=.89) group; $t(58)=1$, *p*=.42. Concludingly, the frequency of momentary cognitive reappraisal use does not significantly differ between groups of less versus more resilience.

**Table 4**

*Independent samples t-test results comparing means of less and more trait resilient individuals on state cognitive reappraisal*

| Group | n | Mean | SD | t | df | *p* |
|---|---|---|---|---|---|---|
| More resilient | 32 | 3.12 | .89 | 1 | 58 | .42 |
| Less resilient | 28 | 2.88 | 1.01 | | | |

**Exploration of individuals with different resilience scores**

Starting with the less resilient group, participant 52712 expressed a mean trait resilience score of 2.00 and displayed a rather inconsistent pattern between stressful events and state negative affect (see Figure 2). At some measurement points (i.e. 12, 15, 23, 48) stressful events correlate with state negative affect. In these time points, the scores for state cognitive reappraisal are relatively low, indicating a low usage of the emotion regulation strategy. Conversely, in other timepoints (i.e. 7, 27, 40) in moments of a stressful event, both state negative affect as well as cognitive reappraisal are relatively low. This suggests that the individual does not consistently experience negative affect when being confronted with stressful events and that the use of cognitive reappraisal remains relatively low when experiencing stressful events.

**Figure 2**

*Line plot depicting standardized state cognitive reappraisal, state negative affect and stressful event per measurement point for participant 52712*
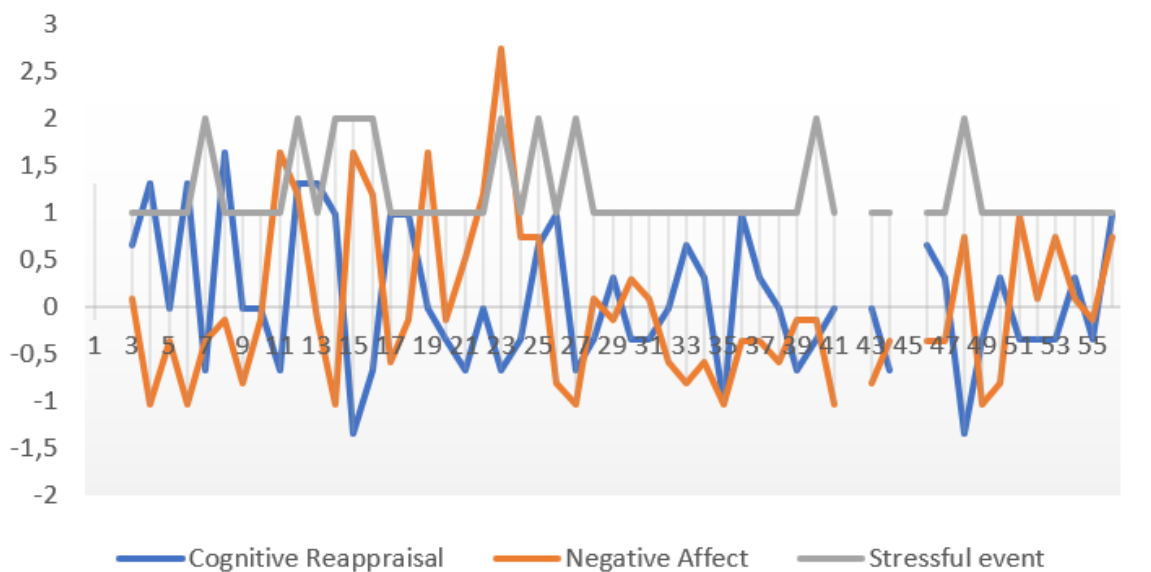


*Note:* Stressful events were coded as 1= not stressful and 2=stressful.

When exploring a participant of the higher resilience group (#52961), with a mean resilience score of 3.83, negative affect and stressful events repeatedly show an inconsistent pattern over time (see Figure 3). At some points the aforementioned variables visibly coincide (i.e. 22, 23) whereas at other time points the pattern does not continue (i.e. 45, 50, 53) and the variables are rather in opposite directions. For cognitive reappraisal and negative affect on the other hand the line plot suggests a weak positive association expressing that the individual might employ

the emotion regulation strategy in times of negative affective states, regardless of the presence of a stressful event.

**Figure 3**

*Line plot depicting standardized state cognitive reappraisal, state negative affect and stressful event per measurement point for participant 52961*
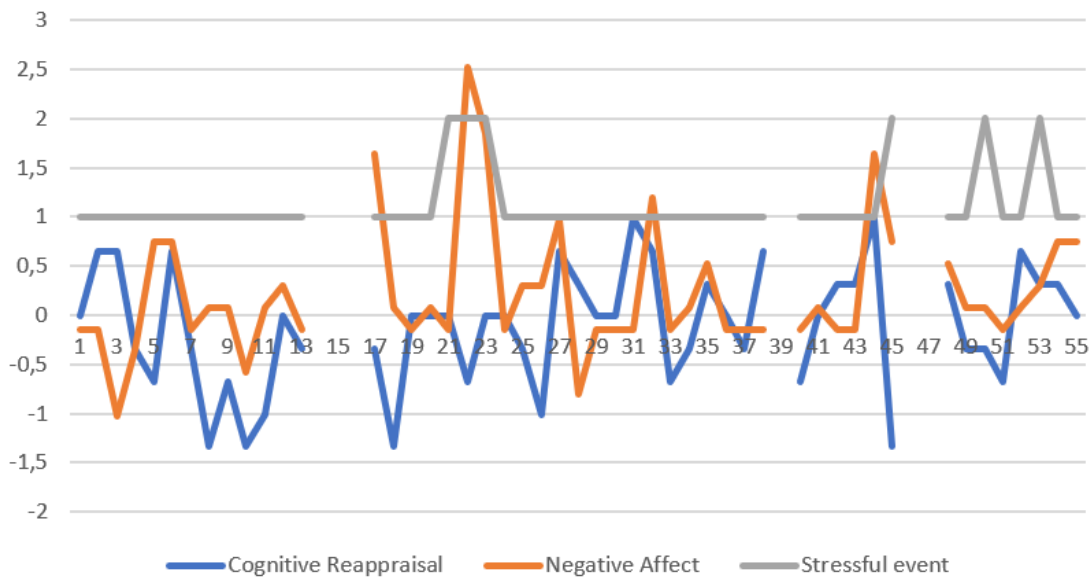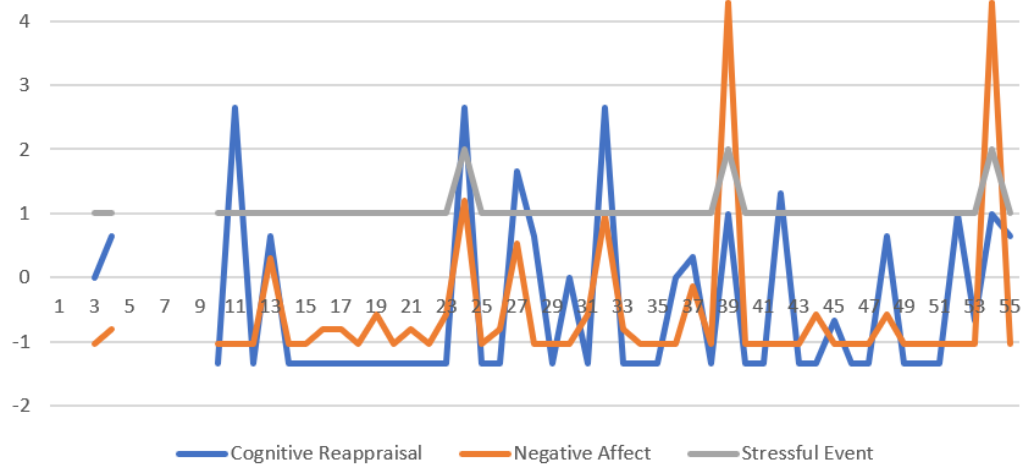


*Note:* Stressful events were coded as 1= not stressful and 2=stressful.

When plotting one of the highest resilient individuals of the sample (#52829) with a mean resilience score of 4.0, a clear pattern for all three variables over time emerges (see Figure 4). Timepoints characterized by stressful events (i.e. 24, 39, 54) express peaks in negative affect as well as medium to high usage of state cognitive reappraisal. Remarkably, the positive association between negative affect and cognitive reappraisal does not only occur in instances of stressful events, but also in timepoints that were initially reported as either neutral or positive events (i.e.13, 27, 32).

**Figure 4**

*Line plot depicting standardized state cognitive reappraisal, state negative affect and stressful event per measurement point for participant 52829*



*Note:* Stressful events were coded as 1= not stressful and 2=stressful.

## Discussion

The current study aimed to investigate the relationship between cognitive reappraisal and negative affect while also exploring possible differences in reappraisal use for more versus less resilient individuals. The current research was led by the hypothesis that cognitive reappraisal is moderating the relationship between momentary negative affect and stressful events with the expectation of a negative moderation effect. This hypothesis was based on the theoretical notion (Polizzi & Lynn, 2021) that reappraisal would promote the ability to differentiate between positive and negative affect, prompting its use when identifying negative affect which the aim of cognitively reducing the intensity of an emotion-eliciting event (Johnson et al., 2016, Tugade & Fredrickson, 2007). In line with this expectation, results showed a significant negative moderation effect of cognitive reappraisal on the aforementioned variables. Thus, current findings support the previously held adaptive characteristics of reappraisal on affective states as found in correlational and experimental research (Gross & John, 2003; Johnson et al., 2016; Southward et al., 2021) while acknowledging the narrow context in which reappraisal has been shown to display such adaptive features, namely stressful events. According to the contextual view on emotion regulation as proposed by Gross (2015), individual, situational as well as goal-related details determine the adaptive or maladaptive outcome of emotion regulation. Current results express that even when not taking individual or goal-oriented characteristics into account, reappraisal expresses an adaptive tendency in stressful situations,

suggesting that such adaptive characteristics could potentially show even higher effectiveness when further taking individual and goal-oriented details into account.

Another aim of the study was to explore cognitive reappraisal in the context of resilience. Here, research was led by the question of how less resilient individuals differ from more resilient ones when it comes to the daily use of reappraisal. As literature suggested a repeatedly observed positive association between trait resilience and reappraisal (Hong et al., 2018; Karreman & Vingerhoets, 2012; Mestre et al., 2017) it was expected to see a higher reappraisal use in the group classified as more resilient. A significant difference in mean scores between the less and the more resilient group could not be observed, hence discounting the assumption that higher resilient individuals reappraise more often in the current sample. In regards to this finding it stays relevant to mention that the present sample differed significantly in the mean score for trait resilience compared to the sample in a previous study (Smith et al., 2013). More specifically, the present sample expressed a lower mean in trait resilience which impacts the distribution of lower and higher resilient individuals. As Smith et al. (2013) statistically established a trait resilience mean of 4.3 to be classified as high, this threshold was solely achieved by a small fraction (5%) of the current sample and thus indicates that low, average and some high scoring individuals compromised the group that should represent more resilience. While this group indeed expressed marginally more resilience than the less resilient group, it stays questionable to what degree these groups significantly differed in trait resilience hence suggesting that the possibility of assessing meaningful differences in reappraisal use was hardly achievable.

Furthermore, the more resilient group only reappraised less than half as much on the state level as the sample in the study by Brockman et al. (2016) expressing that the reappraisal frequency was remarkably low. A main difference in the samples here was the ethnic composition, characterized by a majority of Caucasian individuals (53.1%) for the study by Brockman et al. (2016) compared to a mainly German sample (68.3%) in the present study, suggesting that cultural differences possibly affect reappraisal frequency. In alignment with the contextual view on emotion regulation (Gross, 2015), psychologist Vygotsky (1978) highlighted the shaping role of the environment on the regulation of emotions, as the social context determines which emotions are seen as appropriate and which ones require regulation (Haga et al., 2009). Hence, a tentative explanation of the given findings could be that in the German culture, negative affective states in stressful contexts are socially accepted and thus

are signaled to not require extensive regulation through cognitive reappraisal as possibly required in other socio-cultural contexts. Another distinguishing characteristic of the sample was that the majority of participants were students. Research on well-being has previously emphasized that students face amounts of stress that have the potential to impair physical and mental health (Shankar & Park, 2016). The low mental health scores in combination with low reappraisal use and resilience as seen in the current study suggest that students might not be familiar with ways in which they can support their mental health, hindering them from building resilience. Connected to that, the findings of Brockman et al. (2016) express that age moderates the relationship between reappraisal and negative affect, showing that younger participants (aged 17-19) report increased negative affect when reappraising, as opposed to older participants. This finding accentuates that cognitive reappraisal and its adaptive outcomes for affective states cannot be generalized to all contexts and individuals while also emphasizing that especially for the target group of students there is an apparent need for resilience-promoting interventions to support mental health.

Moreover, on the within-person level, the exploration of individuals in varying resilience showed that the manner in which stressful events, negative affect and cognitive reappraisal are associated does not show to be consistent. For the displayed participants (Figure 2,3) the association between state reappraisal and negative affect did not show to be positive. Only for one of the highest resilient participants of the sample (#52829) the expected positive association of the aforementioned variables could be clearly observed. This insight expresses that while being able to observe adaptive functions of reappraisal on the between-person level, this assumption cannot be equally transferred onto the individual level (Curran & Bauer, 2011). A previous study with the aim of displaying variability in associations behind average estimates (Kraiss et al., 2022) demonstrated that even though regression lines based on averaged estimates might show to have a clear positive or negative correlation, individual slopes can visibly and substantially deviate by for instance, not showing a correlation at all. The current findings are thus embedded in the view that the effects of reappraisal on mental health are of differing magnitude for individuals with differing characteristics i.e. resilience. Lastly, the line plots illustrate that reappraisal is not only employed in stressful moments but also when events are reported as positive or neutral (see Figure 4), suggesting that reappraisal is used to regulate emotions in many different situational contexts for less as well as more resilient individuals. Thus, cognitive reappraisal and its potential for building resilience and the maintenance of

mental health can be concluded to be a process that is dependent on different intrapersonal, interpersonal and contextual influences and possibly also their interaction.

**Strengths and limitations**

An advancement of the current study was the ecologically valid design. Since the majority of research on emotion regulation and resilience was based on cross-sectional, retrospective designs (Polizzi & Lynn, 2021), the usage of ESM designs was scarce until now. However, ESM studies hold the potential to reduce recall bias (Scollon et al., 2009) and make the data collection process more accessible for participants, possibly increasing individual's motivation to participate and improving the accuracy of the given data (Etikan, Musa, & Alkassim, 2016; Schleich, 2022). Further, the frequency of data collection moments per day was higher than in previous longitudinal studies (Brockman et al., 2016; Johnson et al., 2016) which has the potential to capture more moments of emotion regulation during the day, giving a more detailed insight into these processes and how they unfold. Lastly, employing a semi-random sampling scheme is another strength as the time points for data collection can be anticipated and thus benefit the compliance rate, but are not completely predictable due to the random triggering within certain time intervals (Myin-Germeys & Kuppens, 2021).

Despite the mentioned advancements, there were some limitations to the present study. First, explicitly focusing on reappraisal use and not incorporating reappraisal quality limits the understanding of the emotion regulation strategy. Southward et al. (2012) discovered that the quality with which reappraisal is used serves as an explanatory mechanism on how the strategy impacts affective outcomes. It could be theorized that resilient individuals do not differ in frequency of reappraisal but in quality, signaling that they might have collected insights into how to use the strategy most effectively compared to less resilient individuals.

Second, the focus on self-report measures has previously been criticized in the field of emotion regulation. Self-report measures only enable individuals to report emotion regulation processes that are consciously experienced while excluding unconscious regulatory processes and hence limiting the understanding of the exact usage of a given strategy (Johnson et al., 2016). Moreover, self-report measures are based on subjective experiences and are therefore inevitably restricted in measuring variables in an objective manner (Polizzi & Lynn, 2021).

Third, the generalizability of current findings has to be reflected on in regards to the sample which is rather homogeneous. Characterized by a similar ethnic background and

occupation, the current sample is hardly representative, making it difficult to transfer current findings onto populations with deviating characteristics. Connected to this aspect, the homogenous nature of the sample was most probably caused by the choice of convenience sampling, which only gives selected personal contacts of researchers the possibility to participate. Accordingly, such samples are preferably avoided in quantitative research, as the generalizability of results is significantly reduced compared to probability samples (Jager et al., 2017).

Fourth, in the present study the possibility to establish causally relevant results remains unattainable (Myin-Germeys & Kuppens, 2021). The employment of ESM is suitable to uncover how variables of interest interact in the same moment, yet the assessment of temporal precedence is not possible. Thus, it stays a matter of interpretation if the variables interact with each other in the directional manner as currently suggested which possibly leaves opportunity for alternative explanations.

Lastly, the current findings have to be evaluated in consideration with the results of the correlation matrix which expressed that the ERQ and the state items of cognitive reappraisal did not show a significant correlation. This finding is crucial to acknowledge as the state items originated from the ERQ. This suggests that the selection of items for reappraisal was not fully representative of the whole concept of it as established in the ERQ but rather depicts one specific form of reappraisal, namely positive reappraisal (Nowlan et al., 2016). Here, the strategy is used for rephrasing a negatively valanced situation into a more positive one. Yet, this fails to incorporate the general nature of reappraisal, which is primarily focused on the aspect of reformulation (Gross & John, 2003). While this finding does not discard the adaptive function that reappraisal expresses, it accentuates that specifically positive reappraisal as assessed in the current study seems to serve adaptive purposes for mental health in stressful contexts.

**Implications and future directions**

Approaches aiming at establishing resilience-promoting interventions (Peng et al., 2014) have incorporated reappraisal as one among several factors in the program which is further recommended and supported by current results. Even though no differences in reappraisal use in groups of differing resilience levels could be established, the adaptive function of reappraisal in stressful contexts should not be overlooked. The strategy shows relevance for populations facing stressful events in daily life, and especially students seem to be in urgent need of

interventions that aim at improving resilience for the maintenance of mental health (Shankar & Park, 2016). Similar to the design of ESM studies, the suggestion of using Ecological Momentary Interventions (EMI), essentially understood as momentary psychological interventions, has emerged in literature (Myin-Germeys & Kuppens, 2021) which aim to support participants' mental health in daily life through technological devices. EMI can either be independently used, in form of a preventive self-help tool or can be employed as an addition next to regular therapeutic sessions, making psychoeducational content and practices more accessible, thus promoting mental health on a cost-effective and daily basis (Myin-Germeys & Kuppens, 2021). For instance, by incorporating gratitude tasks in such Ecological Momentary Interventions the act of reappraisal could be fostered, as deliberately and positively reframing daily activities as done in gratitude tasks seems to resemble the nature of reappraisal, yielding possible positive outcomes for mental health. Previous gratitude interventions have shown to promote mental health (Bohlmeijer et al., 2020) as the feeling of gratitude has been found to mediate the effects of gratitude interventions on mental well-being (Bohlmeijer et al., 2021) which in turn can positively influence resilience through positive emotions (Tugade & Fredrickson, 2007). Resilience constitutes a skill that can be learned (Peng et al., 2014; Tugade & Fredrickson, 2007) and the rapid advancement of technology suggests that the implementation of Ecological Momentary Interventions could be more accessible and effective than ever before.

For future research it is first and foremost relevant to improve on the limitations posed in the current study such as not considering the aspect of reappraisal quality, next to other limitations. Moreover, it is advised to aim at achieving a sample that incorporates more highly resilient individuals, as the proportion of such in the present sample remained modest. As the current sample was rather young and previous research has documented that effective emotion regulation possibly increases with age (Brockman et al., 2016; Carstensen et al., 2000), older individuals are recommended to be included in future research. Furthermore it is encouraged to dive deeper into individual trajectories of emotion regulation of highly resilient individuals in a qualitative manner. As previously mentioned, there is substantial amount of variability in associations behind averaged estimates (Kraiss et al., 2022) which accentuates the necessity of examining independent moments of emotion regulation in more detail, potentially uncovering how possible patterns and deviations of such regulatory processes look like when disentangling them. Connected to this, conducting network analyses is recommended in order to uncover the interdependent nature of variables in the context of emotion regulation and resilience (Myin-Germeys & Kuppens, 2021). Here, several contextual factors could be included and observed

in relation to the use of cognitive reappraisal and its impact on resilience, further contributing to an increased understanding of how reappraising works most effectively when embedded in different situational or psycho-social contexts.

**Conclusion**

The present study expressed that reappraisal displays adaptive functions in stressful contexts by negatively moderating the relationship between stressful events and negative affect on the between-person level. Moreover, momentary reappraisal frequency does not show to be a factor distinguishing less from more trait resilient individuals, thus opening the possibility for alternative explanations of which daily emotion-regulation strategies promote resilience. For future research, it is encouraged to explore the interplay of relevant variables in network analyses or conduct qualitative work to understand how highly resilient individuals effectively regulate emotions while already implementing Ecological Momentary Interventions employing gratitude tasks to support vulnerable populations.

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**Appendix A**

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 mental health is related to the way you deal with feelings in daily life. 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 20 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.

**Contact information**

If you have any questions regarding this study, you can contact the researchers of this research project Jasmin Wallner (j.wallner@student.utwente.nl), Paula Oberle (p.v.oberle@student.utwente.nl), Natalie Koop (n.koop@student.utwente.nl), Caroline Dauer (v.c.dauer@student.utwente.nl), Kia Lemmen (k.r.lemmen@student.utwente.nl) and Jenny Schwabe (j.schwabe@student.utwente.nl).

**Consent**

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

**Appendix B**

Baseline Questionnaire

*Demographics*

- Age: How old are you?
- Gender: What gender do you identify as? Female, Male, Other, If you prefer to not specify, you can skip this question
- Nationality: What is your nationality? Dutch, German, Other
- Occupation: What is your current occupation? Working, Self-employed, Student, Studying and Working, Not working, Other
- Highest degree obtained: What is the highest degree or level of school that you have completed? *If currently enrolled, mark the highest degree already received.* Middle school (such as MBO, MTS, MEAO or Haupt- or Realschule), High school (such as HAVO, VWO, HBS or Gymnasium/Berufsschule/Berufskolleg), Bachelor, Master, PhD, Other
- SONA ID

*MHC-SF*

During the past month, how often did you feel...

1. Happy

2. Interested in life

3. Satisfied with life

4. That you had something important to contribute to society

5. That you belonged to a community

6. That our society is a good place or is becoming a better place, for all people

7. That people are basically good

8. That the way our society works makes sense to you

9. That you liked most parts of your personality

10. Good at managing the responsibilities of your daily life

11. That you had warm and trusting relationships with others

12. That you had experiences that challenged you to grow and become a better person

13. Confident to think or express your own ideas and opinions

14. That your life has a sense of direction or meaning to it

    a. Never

b. Once or twice

c. About once a week

d. About 2 or 3 times a week

e. Almost every day

f. Every day

*PHQ-9*

Over the last 2 weeks, how often have you been bothered by any of the following problems?

1. Little interest or pleasure in doing things

2. Feeling down, depressed, or hopeless

3. Trouble falling or staying asleep, or sleeping too much

4. Feeling tired or having little energy

5. Poor appetite or overeating

6. Feeling bad about yourself or that you are a failure or have let yourself or your family

down

7. Trouble concentrating on things, such as reading the newspaper or watching television

8. Moving or speaking so slowly that other people could have noticed. Or the opposite being

so fidgety or restless that you have been moving around a lot more than usual

9. Thoughts that you would be better off dead, or of hurting yourself

a. Not at all

b. Several days

c. More than half the days

d. Nearly every day

*BRS*

1. I tend to bounce back quickly after hard times.

2. I have a hard time making it through stressful events.

3. It does not take me long to recover from a stressful event.

4. It is hard for me to snap back when something bad happens.

5. I usually come through difficult times with little trouble.

6. I tend to take a long time to get over setbacks in my life.

a. Strongly disagree

b. Disagree

c. Neutral

d. Agree

e. Strongly agree

*ERQ*

1. When I want to feel a more positive emotion (such as joy or amusement) I change what I am thinking about.

2. When I want to feel less negative emotion (such as sadness or anger) I change what I am thinking about.

3. When I am faced with a stressful situation, I make myself think about it in a way that helps me stay calm.

4. When I want to feel more positive emotion, I change the way I am thinking about the situation.

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.

    a. Strongly agree

    b. Mostly disagree

    c. Somewhat disagree

    d. Neither disagree nor agree

    e. Somewhat agree

    f. Mostly agree

    g. Strongly disagree

**Appendix C**

Daily Questionnaire

*Positive and negative affect*

Below you can find several questions about your current feelings.

Please try to indicate how you felt right before you started to answer the questionnaire.

1. How cheerful do you feel right now?

2. How enthusiastic do you feel right now?

3. How satisfied do you feel right now?

4. How relaxed do you feel right now?

5. How anxious do you feel right now?

6. How irritable do you feel right now?

7. How down do you feel right now?

8. How sad do you feel right now?

      a. 1 (not at all) to 7 (very much)

*Cognitive reappraisal*

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

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

      a. (not at all) to 7 (very much)

*Stressful event*

1. Think of the most striking event or activity in the last hour. How stressful was this event or activity?

      a. 1 (not at all) to 7 (very much)