Emotion Regulation in Detail –
Investigating the Predictors of Effective Cognitive Reappraisal

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für meine Oma, denn man lernt nie aus

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List of Abbreviations

ADS-L = Allgemeine Depressionsskala - Langform

CR = cognitive reappraisal

ECG = electrocardiogram

EEG = electroencephalogram

EMA = ecological momentary assessment

ER = emotion regulation

ERQ = Emotion Regulation Questionnaire

Fam = situational familiarity

fMRI = functional magnetic resonance imaging

GLM = general linear models

ICC = intraclass correlation coefficients

MABELLA = Mainz Behavioral and Experimental Laboratory

MIMIS = Mainz Inventory of Microstressors

ORSEE = Online Recruitment System for Economic Experiments

PANAS = Positive and Negative Affect Schedule

RE = reappraisal effectiveness

RI = reappraisal inventiveness

RIT = Reappraisal Inventiveness Test

SAM = Self-Assessment Manikins

SRT = Script-based Reappraisal Test

WEIRD = Western, Educated, Industrialized, Rich, and Democratic

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Zeier, P., Sandner, M., & Wessa, M. (2019). Script-based Reappraisal Test – Introducing a new paradigm to investigate the effect of reappraisal inventiveness on reappraisal effectiveness. *Cognition & Emotion, 34*(4), 793-799. doi:10.1080/02699931.2019.1663153

II. Manuscript

Zeier, P., Meine, L. E., & Wessa, M. (submitted). It's worth the trouble – Stressor exposure is related to increased cognitive reappraisal ability. *Stress and Health.*

III. Manuscript

Zeier, P., Sandner, M., & Wessa, M. (submitted). Regulating emotions with experience – The effectiveness of reappraisal variability depends on situational familiarity. *Affective Science.*

Abstract

Although emotions provide us with vital information, they sometimes also hinder us from achieving important goals, which in turn can result in reduced psychological well-being. Among a set of strategies to regulate such unwanted emotions, cognitive reappraisal, defined as the reinterpretation of an event to alter its emotional impact, received much attention in emotion regulation research. Cognitive reappraisal has been associated with various benefits for mental health and interpersonal functioning. However, this acclaimed emotion regulation strategy also comes with some pitfalls. For example, the frequent but ineffective use of cognitive reappraisal has been connected to more symptoms of depression. Therefore, recent theoretical models mostly dismiss normative concepts of emotion regulation and rather suggest a person- and situation-specific approach. In the light of these contextual influences, I aim at identifying predictors of cognitive reappraisal effectiveness. Specifically, this dissertation investigates whether the generation of multiple categorically different reappraisal thoughts and the experience with stressors influence the effective downregulation of negative emotions.

Study #1 introduces and validates a new emotion regulation paradigm – the Script-based Reappraisal Test (SRT) – to overcome methodological shortcomings of previous emotion regulation tasks. Primarily, the SRT provides valuable information on the generation process of cognitive reappraisal, as participants' reappraisal ideas are recorded. In a first attempt, we investigated the relationship between reappraisal inventiveness, i.e., the general ability to create multiple and differing reappraisals, and reappraisal effectiveness. The results indicated overall successful emotion regulation via cognitive reappraisal but no significant correlation between reappraisal inventiveness and reappraisal effectiveness. Thus, the generation of various reappraisal thoughts may not be adaptive in every situation.

Study #2 expands the focus of our research by including person-specific variables. Multiple theories on human resilience suggest that a certain degree of stressor exposure enables individuals to practice and improve emotion regulation strategies. Accordingly, we investigated whether a moderate (compared to a small or high) degree of exposure to daily hassles increases reappraisal inventiveness and reappraisal effectiveness in the SRT. Multiple regression analyses revealed the frequency of daily hassles as a significant and positive predictor of reappraisal effectiveness and reappraisal inventiveness. Contrary to our hypothesis, these relationships were rather linear than quadratic. Although this positive main effect of stressor exposure on cognitive reappraisal abilities may be overestimated due to a homogeneous sample, the results

indicate that the harmful effects of stressful situations may be inverted by practicing emotion regulation strategies.

Study #3 follows up on the results of study #1 by proposing that the effectiveness of generating various reappraisal thoughts depends on contextual characteristics. Specifically, we hypothesized that individuals who are familiar with emotional situations would unnecessarily use up cognitive resources by generating multiple reappraisal ideas and consequently experience impaired reappraisal effectiveness. In contrast, individuals who exhibit low situational familiarity would profit from a more extensive reappraisal generation by increasing the probability to find an effective reappraisal thought in the first place. Based on theories of emotion regulation flexibility, we introduced the concept of reappraisal variability, defined as the uninstructed generation of categorically different reappraisal thoughts, to adequately investigate this proposed moderation in an adapted version of the SRT. The results revealed the interaction term between reappraisal variability and situational familiarity as significant predictor of reappraisal effectiveness regarding affective valence. As expected, individuals with overall high situational familiarity experienced a detrimental effect of high reappraisal variability. Contrary to our hypothesis, reappraisal variability and reappraisal effectiveness were unrelated for individuals with low situational familiarity.

The findings of this dissertation underline the heterogeneity within families of emotion regulation strategies. Regarding cognitive reappraisal, individuals substantially differed with respect to the instructed or spontaneous generation of multiple categorically different reappraisal thoughts. This variation significantly influenced the effective downregulation of negative affect in certain contexts. On a theoretical level, this dissertation thus illustrates the importance of including person-, situation-, and strategy-specific variables in emotion regulation research. On a practical level, the results of this dissertation may support tailored interventions by providing individuals with information on how to select suitable reappraisal thoughts and pay attention to relevant contextual cues. Such theoretical and practical implications may only arise from a detailed investigation of emotion regulation strategies. The methodology and results of this dissertation pave new ways for this field of study.

Zusammenfassung

Auch wenn Emotionen uns häufig lebensnotwendige Informationen liefern, können sie uns in manchen Situationen an der Erreichung unserer Ziele hindern, was wiederum zu einem verminderten psychischen Wohlbefinden führen kann. Unter einer Reihe von Strategien zur Regulation solch unerwünschter Emotionen hat das kognitive Umbewerten, definiert als die Neuinterpretation eines Ereignisses zur Veränderung dessen emotionaler Auswirkungen, in der Emotionsregulationsforschung viel Aufmerksamkeit erhalten. Kognitives Umbewerten wurde mit verschiedenen Vorteilen für die psychische Gesundheit und das zwischenmenschliche Funktionieren in Verbindung gebracht. Allerdings birgt diese anerkannte Emotionsregulationsstrategie auch einige Fallstricke. Zum Beispiel wurde das häufige, aber ineffektive Anwenden von kognitivem Umbewerten mit einer erhöhten depressiven Symptomatik in Verbindung gebracht. Aktuelle theoretische Modelle lehnen daher normative Konzepte der Emotionsregulation überwiegend ab und schlagen stattdessen einen personen- und situationsspezifischen Ansatz vor. In Hinblick auf kontextuelle Einflüsse zielt diese Arbeit darauf ab, Prädiktoren für die Effektivität von kognitivem Umbewerten zu identifizieren. Konkret wird in dieser Dissertation untersucht, ob die Generierung mehrerer kategorial unterschiedlicher Umbewertungsgedanken und die Erfahrung mit Stressoren die effektive Herunterregulation negativer Emotionen beeinflussen.

In Studie #1 wird ein neues Emotionsregulationsparadigma – der Script-based Reappraisal-Test (SRT) – vorgestellt und validiert, um methodische Mängel bisheriger Emotionsregulationstests zu überwinden. In erster Linie liefert der SRT wertvolle Informationen über den Generierungsprozess des kognitiven Umbewertens, da die Umbewertungsideen der Versuchspersonen abgebildet werden. In einem ersten Versuch untersuchten wir den Zusammenhang zwischen dem Umbewertungseinfallsreichtum, d.h. der allgemeinen Fähigkeit, möglichst viele und unterschiedliche Umbewertungsgedanken zu erzeugen, und der Umbewertungseffektivität. Die Ergebnisse zeigten eine insgesamt erfolgreiche Emotionsregulation durch kognitives Umbewerten, aber keine signifikante Korrelation zwischen Umbewertungseinfallsreichtum und Umbewertungseffektivität. Somit ist die Generierung verschiedener Umbewertungsgedanken möglicherweise nicht in jeder Situation adaptiv.

Studie #2 erweitert den Fokus unserer Forschung, indem personenspezifische Variablen einbezogen wurden. Resilienztheorien legen nahe, dass ein gewisses Maß an Stressbelastung das Üben und Verbessern von Emotionsregulationsstrategien ermöglicht. Dementsprechend

untersuchten wir, ob ein moderates (im Vergleich zu einem geringen oder hohen) Ausmaß an Kontakt mit alltäglichen Stressoren den Umbewertungseinfallsreichtum und die Umbewertungseffektivität im SRT erhöht. Multiple Regressionen ergaben, dass die Häufigkeit der alltäglichen Stressoren einen signifikanten positiven Prädiktor für die Umbewertungseffektivität und die Umbewertungseinfallsreichtum darstellt. Entgegen unserer Hypothese waren diese Beziehungen eher linear als quadratisch. Obwohl dieser positive Haupteffekt der Stressbelastung auf die kognitiven Umbewertungsfähigkeiten aufgrund einer homogenen Stichprobe möglicherweise überschätzt wird, deuten die Ergebnisse darauf hin, dass die schädlichen Effekte von Stresssituationen durch das Üben von Emotionsregulationsstrategien umgekehrt werden können.

Studie #3 knüpft an die Ergebnisse von Studie #1 an, indem untersucht wurde, ob die Effektivität der Generierung verschiedener Umbewertungsgedanken von kontextuellen Merkmalen abhängt. Konkret formulierten wir die Hypothese, dass Personen, die mit emotionalen Situationen vertraut sind, unnötig kognitive Ressourcen verbrauchen, wenn sie verschiedene Umbewertungsgedanken generieren und folglich eine verminderte Umbewertungseffektivität erleben. Im Gegensatz dazu würden Personen, die eine geringe situative Vertrautheit aufweisen, von einer umfangreicheren Umbewertungsgenerierung profitieren, da diese die Wahrscheinlichkeit erhöht, überhaupt einen effektiven Umbewertungsgedanken zu finden. Basierend auf Theorien der Emotionsregulationsflexibilität führten wir das Konzept der Umbewertungsvariabilität ein, definiert als die nicht instruierte Generierung von kategorial unterschiedlichen Umbewertungsgedanken, um diese vorgeschlagene Moderation in einer adaptierten Version des SRT adäquat zu untersuchen. Die Ergebnisse zeigten, dass der Interaktionsterm zwischen Umbewertungsvariabilität und situativer Vertrautheit einen signifikanten Prädiktor der Umbewertungseffektivität hinsichtlich der affektiven Valenz darstellte. Wie erwartet hatten Personen mit insgesamt hoher situativer Vertrautheit einen nachteiligen Effekt einer hohen Umbewertungsvariabilität. Entgegen unserer Hypothese waren Umbewertungsvariabilität und Umbewertungseffektivität bei Personen mit niedriger situativer Vertrautheit nicht signifikant miteinander korreliert.

Die Ergebnisse dieser Dissertation betonen die Heterogenität innerhalb der Familien von Emotionsregulationsstrategien. Hinsichtlich des kognitiven Umbewertens unterschieden sich Personen erheblich bei der instruierten oder spontanen Generierung mehrerer kategorial unterschiedlicher Umbewertungsgedanken. Diese Unterschiede beeinflussten signifikant die effektive Herunterregulierung von negativem Affekt in bestimmten Kontexten. Auf

theoretischer Ebene verdeutlicht diese Dissertation somit die Wichtigkeit des Einbeziehens personen-, situations- und strategiespezifischer Variablen in die Emotionsregulationsforschung. Auf praktischer Ebene können die Ergebnisse dieser Dissertation maßgeschneiderte Interventionen unterstützen, indem Personen Informationen erhalten, wie sie geeignete Umbewertungsgedanken auswählen und auf relevante kontextuelle Hinweise achten können. Solche theoretischen und praktischen Implikationen können sich nur aus einer detaillierten Untersuchung von Emotionsregulationsstrategien ergeben. Die Methodik und die Ergebnisse dieser Dissertation ebnen neue Wege für dieses Forschungsgebiet.

1

General Introduction

1. Introduction: Emotions in need of regulation

Imagine a life without emotions in academia: no more fear of missing a deadline, no more rage against the frozen computer screen, nor sadness over your rejected manuscript. But also: no more joy and relief after successful publication in your favorite high impact journal. Most likely, an annihilation of all emotions would result in meaninglessness and apathy. Accordingly, emotions have been found to trigger specific action tendencies and as such to be highly adaptive (Frijda, Kuipers, & Terschure, 1989; Smith & Lazarus, 1993). For example, the experience of fear in the presence of danger leads to avoidance behavior, whereas feelings of enjoyment motivate approach behavior. From an evolutionary perspective, these informative properties of emotions are considered essential for survival (Ekman, 1992). However, an emotional state that persists longer than necessary or overgeneralizes across various situations can be harmful by motivating dysfunctional behavior. These pitfalls are clearly reflected in multiple mental disorders, e.g., fear transitioning into generalized anxiety disorder, or sadness into persistent complex bereavement disorder (as listed in The Diagnostic and Statistical Manual of Mental Disorders 5th ed.; American Psychiatric Association, 2013). As emotions can interfere with the achievement of important personal goals, we are well advised to consider regulation strategies.

1.1 Concepts of emotion regulation

1.1.1 The process model of emotion regulation

Emotion regulation (ER) has been defined as "(...) the ways individuals influence which emotions they have, when they have them, and how they experience and express these emotions" (Gross, 1999, p. 557). Accordingly, the starting point of ER is a discrepancy between the momentary emotional state and the desired emotional state, i.e., the *ER goal* (McRae, Ciesielski, & Gross, 2012). ER goals include the down- or upregulation of specific emotions. For example, an individual experiencing stage fright on the day before a presentation might want to decrease anxiety and at the same time increase feelings of excitement. Past research identified a plethora of strategies that are used to achieve these ER goals. The process model of emotion regulation (Gross, 2015; McRae & Gross, 2020) provides a useful schematic to organize the various ER strategies into five categories depending on the temporal stage of the emotion generation process (see Figure 1.1). In an early stage, individuals can try to avoid, approach, or modify situations depending on the ER goal. When already confronted with the

situation, individuals can choose to either focus on or distract from emotional stimuli. Cognitive change includes the strategy of *cognitive reappraisal* (CR), i.e., the reinterpretation of a situation to modify its emotional impact. Finally, individuals in need of ER may target the emotional response, e.g., by suppressing their facial expression.

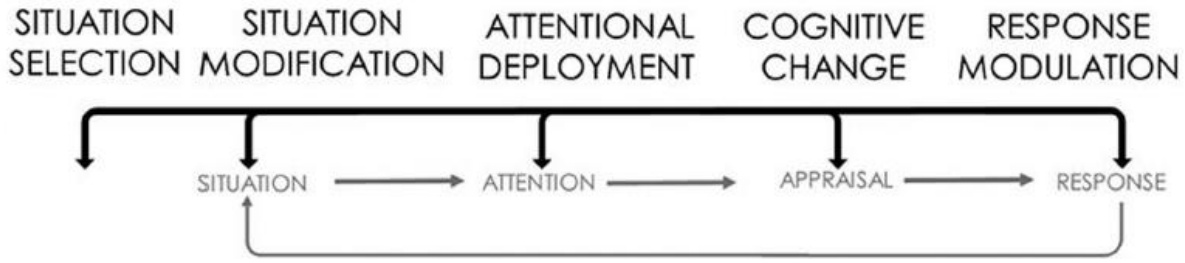

Figure 1.1. Process Model of Emotion Regulation Depicting Five Sets of Emotion Regulation Strategies Depending on the Stage of Emotion Generation. *Note.* Adapted from "Introduction: Emotion Regulation", by McRae, K. and Gross, J. J., 2020, *Emotion, 20*(1), 1-9. Copyright 2020 by American Psychiatric Association.

1.1.2 The alleged dichotomy of emotion regulation strategies

A magnitude of studies on ER implicitly or explicitly leans towards a dichotomization of ER strategies. Thus, strategies are labeled as either per se *healthy/adaptive* or *unhealthy/maladaptive* (Aldao & Nolen-Hoeksema, 2010; John & Gross, 2004). This distinction is largely based on positive or negative correlations of using a respective ER strategy and selected health outcomes. For example, the frequent use of CR is often considered adaptive due to associations with increased psychological well-being (Gross & John, 2003), fewer psychopathological symptoms (Cludius, Mennin, & Ehring, 2020), and decreased cardiovascular disease risk (Appleton, Loucks, Buka, & Kubzansky, 2014) to name but a few. The beneficial consequences of CR are often contrasted by the supposedly maladaptive strategy of suppressing emotional thoughts or expressions. The habitual use of emotion suppression has been associated with less social well-being (Chervonsky & Hunt, 2017), higher levels of depression (Cameron & Overall, 2018), and higher levels of inflammation (Appleton, Buka, Loucks, Gilman, & Kubzansky, 2013).

This division of ER strategies is also apparent in laboratory studies investigating *ER effectiveness*, i.e., the degree of achieving an ER goal by using a specific strategy (also *ER success* or *ability*, cf McRae, Ciesielski et al., 2012; Troy, Wilhelm, Shallcross, & Mauss, 2010). These kinds of studies usually make use of experimental tasks, in which participants are

instructed to either actively apply an ER strategy or passively react to various emotional stimuli presented in multiple trials (e.g., Ochsner et al., 2004; Schonfelder, Kanske, Heissler, & Wessa, 2014). ER effectiveness is then operationalized as difference in emotional responses between both types of trials. A meta-analysis (Webb, Miles, & Sheeran, 2012) including 190 experimental studies on ER effectiveness suggests small to medium effect sizes (d = 0.36) when participants were instructed to apply CR. In contrast, suppressing thoughts of the emotional event was paradoxically associated with slightly increased emotional responses (d = -0.12). This advantage of CR over suppression was found on multiple measures of emotional response: with lower negative affect ratings via single item measure on a subjective level (Kalokerinos, Greenaway, & Denson, 2015), decreased amygdala activation via functional magnetic resonance imaging (fMRI) on a neural level (Goldin, McRae, Ramel, & Gross, 2008), and less increase in heart rate via electrocardiogram (ECG) on a physiological level (S. G. Hofmann, Heering, Sawyer, & Asnaani, 2009). Recently, these findings gained support by studies capturing daily affect and use of ER strategies via daily diary methodology or ecological momentary assessment (EMA; for an overview, see Colombo et al., 2020). For example, the use of CR as a reaction to daily stressors was negatively correlated with negative affect while the use of suppression yielded zero correlations with affect ratings (Troy, Saquib, Thal, & Ciuk, 2019).

1.1.3 Adding context and personality to emotion regulation research

If we stop here, the message is simple: avoid maladaptive strategies, such as suppression, and instead, rely on adaptive strategies, such as CR, to effectively regulate your emotional state. However, by adding more recent findings, the picture of seemingly dichotomous effectiveness of various ER strategies starts to dissolve. For example, the ability to use CR was associated with in fact higher levels of depression for individuals facing controllable stressors (Troy, Shallcross, & Mauss, 2013). Likewise, high CR ability did not lead to reduced depression levels in individuals of high socioeconomic status (Troy, Ford, McRae, Zarolia, & Mauss, 2017). The authors attribute these findings to increased passivity in apt CR users by undermining the motivation to act on the (controllable) problem at hand and consequently suggest to rather "change the things you can" (Troy et al., 2017, p. 141). Furthermore, when confronted with stimuli of high emotional intensity, individuals prefer and more effectively implement attention focused ER strategies compared to CR (Shafir, Schwartz, Blechert, & Sheppes, 2015).

Conversely, allegedly unhealthy ER strategies seem more adaptive when factoring in the motivation for changing an emotional state in the first place. According to Tamir (2016; see also Tamir, Vishkin, & Gutentag, 2020), ER goals entail hedonistic motives, i.e., wanting to immediately feel better, but also instrumental motives, i.e., wanting to feel different to achieve a more distal goal. Especially in social contexts, instrumental motives may deviate from hedonistic motives. For example, individuals are more likely to increase their anger before entering a negotiation, which in turn leads to more successful enforcement of their demands (Tamir & Ford, 2012). In the light of instrumental motives, the use of suppressing the emotional expression has been found beneficial. A series of experiments revealed that participants expressed more affection for individuals who were less expressive in their positive emotions after winning a competition (Kalokerinos, Greenaway, Pedder, & Margetts, 2014). Here, expressive suppression served the instrumental goal to appear humble and protect the loser's feelings. Furthermore, the open expression of negative emotions can cause group disharmony, which, depending on culture, may result in varying social sanctions. To this effect, the habitual use of expressive suppression was unrelated to depression and life satisfaction in a Hong Kong Chinese in contrast to a European American sample (Soto, Perez, Kim, Lee, & Minnick, 2011). Finally, the effects of ER strategies depend on age and developmental factors. The use of expressive suppression in early childhood, for example, was associated with increased school readiness and better grades in elementary school (Harrington, Trevino, Lopez, & Giuliani, 2020).

A dichotomous categorization of ER strategies into adaptive or maladaptive does not adequately capture the complexities of dealing with everyday emotions. As suggested by numerous theoretical accounts (Aldao, 2013; Dore, Silvers, & Ochsner, 2016; Kobylinska & Kusev, 2019; Troy et al., 2013), a more refined research on ER should therefore consider person-, situation-, and strategy-specific factors. Consequently, ER effectiveness would be the result of not only the main but also the interaction effects of these three variables yielding seven possible predictors (three main effects, three two-way interactions, one three-way interaction; see Figure 1.2). With this complexity in mind, let us return to the example of a person experiencing stage fright the day before a presentation: A seasoned professor (person variable) having to talk in front of students (situation variable) may effectively regulate feelings of anxiety by relying on the reappraisal thought "I did this about a million times" (strategy variable). Yet, a PhD student facing the thesis defense in front of the dissertation committee may rather gain confidence by going through the presentation slides one last time. By extending the focus of ER research from simple main effects of strategy (adaptive vs. maladaptive) to a

more person- and situation-sensitive approach, new questions arise. Specifically, we require further information on how individuals select and implement an appropriate ER strategy in a specific context.

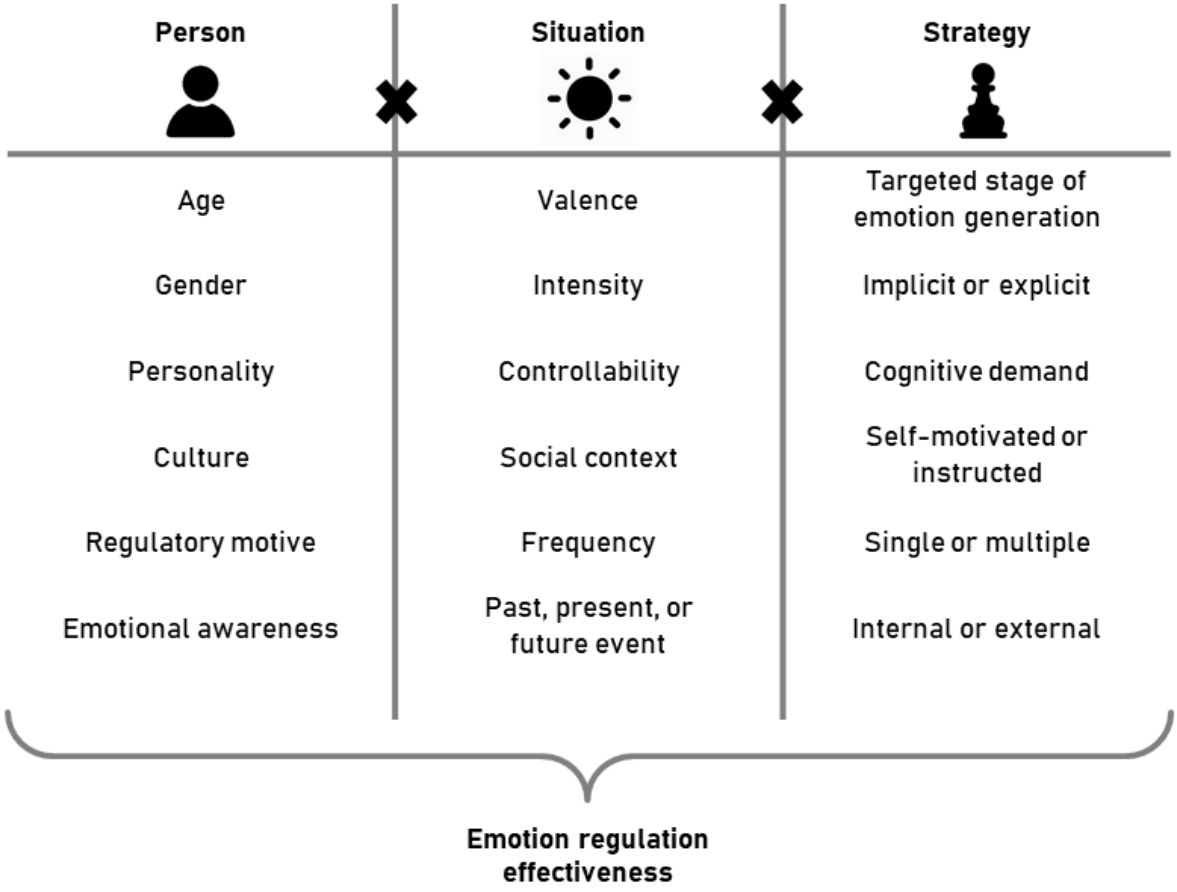

Figure 1.2. Emotion Regulation Effectiveness as a Result of the Main and Interaction Effects of Person-, Situation-, and Strategy-specific Factors with Exemplary Variables to be Considered.
Note. Adapted from "Toward a Personalized Science of Emotion Regulation", by Doré, B. P., Silvers, J. A., and Ochsner, K. N., 2016, *Social and Personality Psychology Compass, 10*(4), 171-187. Copyright 2016 by John Wiley & Sons Ltd.

1.1.4 Considering emotion regulation flexibility

The deployment of different ER strategies depending on the contextual demands has been referred to as ER *flexibility* (Aldao, Sheppes, & Gross, 2015; Bonanno & Burton, 2013; Pruessner, Barnow, Holt, Joormann, & Schulze, 2020). Some authors (e.g., Bonanno & Burton, 2013) consider the flexible use of various ER strategies to be adaptive in general. This notion gained support by a set of studies indicating lower levels of psychopathology in individuals with high ER flexibility (Aldao, Jazaieri, Goldin, & Gross, 2014; Aldao & Nolen-Hoeksema,

2012; Conroy et al., 2020). Other theoretical accounts hypothesize a certain degree of ER flexibility to be adaptive (Pruessner et al., 2020) or choose to stay agnostic regarding adaptiveness altogether (Aldao et al., 2015). Bonanno and Burton (2013) provided a framework for ER flexibility suggesting three sequential key components for effective ER. First, individuals need a certain degree of *context sensitivity*, defined as "(...) the ability to perceive impinging demands and opportunities from the situational context as they emerge over and above the normative background of ongoing regulatory concerns and processes and to determine the most appropriate regulatory strategy in response to those demands or opportunities" (p. 594). Second, individuals need access to an ample ER *repertoire* by being able to apply a range of ER strategies. Third, after having chosen and executed an ER strategy, individuals need to make use of *feedback* by constantly reassessing the effectiveness of the chosen ER strategy and adjust the course of action, if necessary.

Gross (2015) acknowledged these processes by suggesting an extended process model of emotion regulation. Similar to the theory of ER flexibility provided by Bonanno and Burton (2013), the extended process model of ER outlines the temporal sequence of the ER process, in which individuals identify upcoming regulatory needs, then select and implement an appropriate strategy, and finally monitor the ER progress (see Figure 1.3). These components iterate within a feedback loop until the ER goal is attained. As problems can occur in every stage of the process, effective ER appears more delicate than expected. Accordingly, ER flexibility relies on various cognitive control abilities (Pruessner et al., 2020). In the identification and selection stage, for example, individuals would profit from the shifting aspect of executive functioning (W. Hofmann, Schmeichel, & Baddeley, 2012; Schmeichel & Tang, 2015) to effectively switch to another ER strategy or stop the process altogether. Maintaining an ER strategy would additionally depend on an individual's ability to inhibit interfering action tendencies. For example, participants' abilities to inhibit negative stimuli in an experimental priming task was found to be positively correlated with the habitual use of CR (Joormann & Gotlib, 2010). The monitoring stage of ER is expected to rely heavily on working memory updating, as changing contextual and regulatory demands need to be mentally represented (Schmeichel & Tang, 2015).

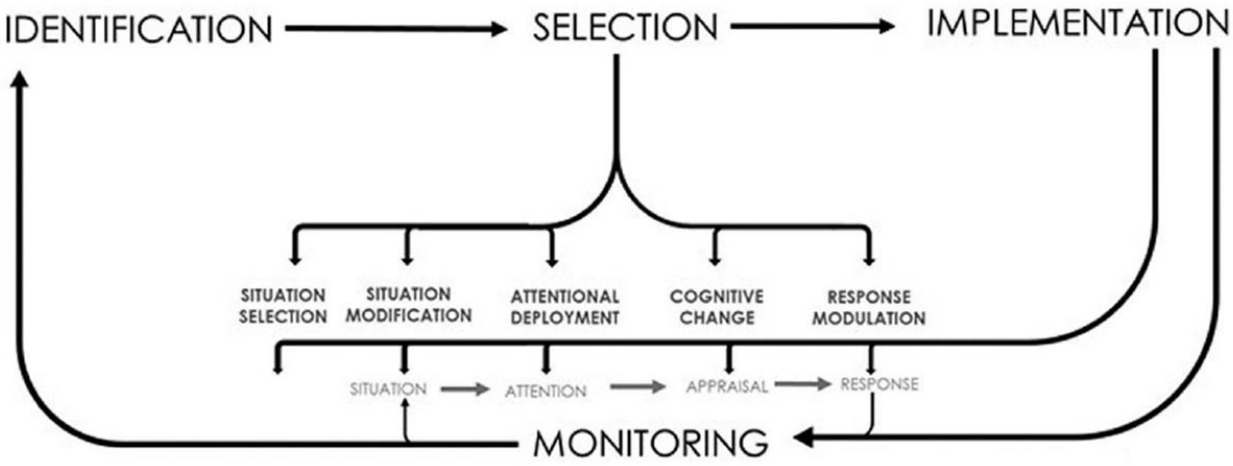

Figure 1.3. The Extended Process Model of Emotion Regulation Depicting the Four Stages of the Emotion Regulation Process in Temporal Order as well as the Five Sets of Emotion Regulation Strategies Depending on the Stage of Emotion Generation.
Note. Adapted from "Introduction: Emotion Regulation", by McRae, K. and Gross, J. J., 2020, *Emotion, 20*(1), 1-9. Copyright 2020 by American Psychiatric Association.

1.1.5 Considering emotion regulation variability

In addition to theoretical assumptions about the subcomponents of the ER process, Aldao, Sheppes, and Gross (2015) suggest a distinction to be made between ER *flexibility* and ER *variability*. According to this terminology, ER variability refers to "the variation in the use of one or more ER strategies across a number of situations" (Aldao et al., 2015, p. 265). ER flexibility in turn is achieved, if ER variability does not occur haphazardly but rather corresponds with changing demands of the environment. Thus, ER variability is necessary but not sufficient for ER flexibility. For example, an anxious PhD student who would at random sometimes employ CR, sometimes expressive suppression, and sometimes problem solving before important presentations would exhibit high ER variability but not ER flexibility (assuming stable regulatory demands across situations).

Furthermore, Aldao and colleagues (2015) suggest a division of ER variability into *within-strategy* variability and *between-strategy* variability. On the one hand, within-strategy variability refers to the frequency of using a specific ER strategy across different time points. In other words, high within-strategy variability is the result of employing a strategy in some situations but not in others (as exemplified above). On the other hand, between-strategy variability occurs if an individual uses multiple ER strategies with different intensities at a given

point in time. Two studies that explicitly investigated the relationship of both types of ER variability with mental health outcomes based on EMA data yielded ambiguous findings. While in one study (Wang, Blain, Meng, Liu, & Qiu, 2020) high ER variability was generally related to decreased depression and negative affect, in another study (Blanke et al., 2020), only between-strategy variability significantly predicted negative affect ratings. Within-strategy variability, in contrast, was unrelated to negative affect and even slightly positively associated with depressive symptoms. A cautious interpretation of the latter findings suggests two conclusions: First, having a set of different ER strategies at one's disposal in an emotional situation (high between-strategy variability) might ease the downregulation of negative emotions. Second, too much inconsistency in the use of specific ER strategies across various emotional situations (high within-strategy variability) might result in less effective ER and worse mental health.

1.2 The details matter

1.2.1 The many facets of single emotion regulation strategies

Individuals not only show variability in terms of *which* ER strategies they use but also *how* they execute a given ER strategy. Along these lines, past research revealed a remarkable heterogeneity regarding the focus, intensity, and subjective quality within a single ER strategy. In their comprehensive meta-analysis, Webb and colleagues (2012) dissected the families of ER strategies proposed by the extended process model of ER (Gross, 2015) yielding seven types of *attentional deployment*, four types of *cognitive change*, and four types of *response modulatio*n. According to this taxonomy, attentional deployment includes strategies to either distract from or concentrate on emotional content. Distraction in turn is further divided into four subtypes depending on the generation mode (active vs. passive) and valence (positive vs. neutral) of the distracting stimulus. Individuals who apply concentration, on the other hand, can focus their attention on the emotional experience itself or on the causes and implications of their emotions. Similarly, CR varies depending on the focus of the reinterpretation. As a means of CR, individuals may reappraise the emotional response, the cause or context of the emotional stimulus, or adopt a different perspective. Finally, suppression can take on many forms, including the suppression of the emotional experience, the emotional expression, or thoughts of the emotion-eliciting event.

I argue that the examination of variation in a single ER strategy does not merely provide anecdotal or taxonomic information, but rather enables predictions of emotional experiences in everyday life. Accordingly, Webb and colleagues (2012) found that subtypes of specific ER strategies differed in their effectiveness. For example, suppressing the emotional expression (d = 0.32), in contrast to the emotional experience (d = -0.04) or thoughts of the emotion-eliciting event (d = -0.12), was the only effective subtype of response modulation. Regarding CR, perspective taking (d = 0.45) was most effective, followed by reappraising the emotional stimulus (d = 0.36) or the emotional response (d = 0.23). Such distinctions indicate valuable practical implications. Most importantly, ineffective ER is considered to contribute to the etiology and maintenance of various mental disorders (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Berking & Wupperman, 2012). Therefore, a detailed description of how to execute a specific ER strategy offers the opportunity to enhance mental health interventions. This seems to apply especially to CR in the context of psychotherapy. Although CR has been an integral part of cognitive behavioral therapy for more than four decades, respective therapeutic interventions are still being optimized based on current research (Beck, 1976, 2019; Ouimet & Ferguson, 2019). Thus, practitioners as well as patients may profit from more refined instructions on how to effectively execute CR.

This dissertation is dedicated to the intricacies of CR due to a perceived imbalance in the scientific literature on this ER strategy: while a multitude of previous research focused on the outcomes of habitual or experimentally instructed CR (McRae & Gross, 2020), only a few studies to date captured the individual reappraisal generation process (e.g., the content and variability of reappraisal ideas). In behavioristic terms (Watson, 1994), the lack of procedural information represents a *black box* phenomenon in CR research. Largely, this circumstance may be attributed to the methodology used in most experimental ER studies that include specific inputs (e.g., the instruction to apply CR) and outputs (e.g., affective ratings), but neglect process-related measures. The black box phenomenon appears problematic in at least two ways. First, most studies on CR are unable to reliably assess to what extent participants adhered to the ER instructions. In these experiments, an unknown number of participants may resort to ER strategies other than CR due to difficulties in understanding the instructions or personal preference. This notion is supported by the fact that participants simultaneously make use of multiple ER strategies when confronted with emotional stimuli (Aldao & Nolen-Hoeksema, 2013). Second, as mentioned before, we know little about how to apply CR to be most effective. This is surprising given the prominence of CR in affective science and cognitive behavioral therapy. Therefore, it appears worth taking a closer look at the details of CR.

1.2.2 The many facets of cognitive reappraisal

In addition to Webb and colleagues' (2012) seminal investigation of ER strategies, further studies revealed even more nuances of CR. In an experimental investigation of reappraisal goals, tactics, and outcomes (McRae, Ciesielski, et al., 2012), for example, participants were instructed to reappraise affective pictures to either upregulate positive or downregulate negative emotions. The authors distinguished eight categories of reappraisal tactics, i.e., (1) conceiving the event as explicitly positive, (2) changing the impact of current circumstances, (3) challenging the authenticity of the depicted event, (4) imagining alternate consequences of the event, (5) expecting another person to change the situation, (6) creating psychological or physical distance, (7) analyzing the situation to initiate problem solving, and (8) accepting and normalizing the event. The results indicated mostly comparable ER effectiveness between the reappraisal tactics (except for reality challenge being less effective for increasing positive affect). Although participants most frequently tried to mentally change the circumstances of the event and least frequently applied distancing, they exhibited a rather heterogeneous execution of CR by using four different tactics on average.

Due to such findings, Weber, de Assunção, Martin, Westmeyer, and Geisler (2014) introduced the concept of *reappraisal inventiveness* as a measure of reappraisal ability. Reappraisal inventiveness is defined as an individual's maximum performance in generating multiple, categorically different reappraisal thoughts as a reaction to emotional situations. In accordance with Guilford's (1967) theory on divergent thinking, reappraisal inventiveness is construed as a rather stable trait. To assess this facet of reappraisal ability, Weber and colleagues (2014) invented the R*eappraisal Inventiveness Test* (RIT). In the RIT, participants encounter anger-eliciting situations presented in textual and pictorial form and are instructed to generate as many categorically different reappraisal ideas as possible within three minutes. Similar to widely-used tests for divergent thinking, e.g., the Alternate Uses Task (Guilford, 1967) or the Berlin Intelligence-Structure Test (Jäger, Süß, & Beauducel, 1997), the RIT yields separate scores for reappraisal *fluency*, i.e., the total number of valid reappraisal ideas, and reappraisal *flexibility*, i.e., the total number of categorically different reappraisal ideas. Both measures of reappraisal inventiveness are determined via a rating system that seizes and further differentiates the reappraisal tactics reported in previous research (McRae, Ciesielski, et al., 2012) resulting in 17 distinct categories.

1.2.3 Reappraisal inventiveness: What we know so far

It seems evident that individuals make use of a variety of reappraisal tactics, but more uncertainty prevails to what extent and under which conditions high reappraisal inventiveness would translate into more ER effectiveness. According to Weber and colleagues (2014, p. 348), reappraisal inventiveness is considered adaptive, as it "(...) enables individuals to come up with a variety of different perspectives with regard to critical situations rather than being fixed to one or only a few perspectives". Having access to multiple reappraisal ideas would in turn result in a less negatively biased perception of a situation. However, in their first set of studies, high reappraisal inventiveness was positively related to the personality trait openness to experience but unrelated to neuroticism and trait anger. Since the latter two constructs were included as indicators of ineffective ER, the authors deduced, aside from methodological concerns, that the motivation to regulate emotions is a necessary condition for reappraisal inventiveness to contribute to higher ER effectiveness. In other words, although people may be able to generate multiple reappraisal ideas, they may not be motivated to do so in everyday life.

Aside from individual motivational differences, the outcomes of reappraisal inventiveness have been found to depend on gender: while women and men did not significantly differ in their ability to generate multiple reappraisal ideas, high reappraisal inventiveness was associated with less depressive daily life experiences only in men (Perchtold et al., 2019). As men also reported higher levels of self-efficacy regarding the use of ER strategies, this finding was conceived as a first indicator that individuals need not only motivation but also confidence in their ER skills to profit from high reappraisal inventiveness. Furthermore, a series of electroencephalogram (EEG) studies provided indirect evidence for beneficial outcomes of an inventive reappraisal style. Accordingly, individuals with high reappraisal inventiveness showed more left-lateralized prefrontal brain activity during reappraisal generation (Papousek et al., 2017). A follow-up study in turn revealed associations between more activity in the left prefrontal cortex during the RIT and lower ratings of chronic stress in women (Perchtold et al., 2018).

1.2.4 Adding context and personality to cognitive reappraisal research

Although previous research revealed first indications of positive outcomes due to high reappraisal inventiveness, the effects seemed to be strongly influenced by person- and situation-specific variables. These findings are in line with recent theoretical considerations (Ford &

Troy, 2019) that expose CR as a particular context sensitive ER strategy. Accordingly, as mentioned in section 1.1.3, CR may be ineffective due to person- and situation-specific factors, which in the end can result in mental health issues. Regarding person-specific variables, for example, an individual's ability to implement CR was found to be relevant for the ER outcome. In a daily diary study, the frequent but not successful use of CR was associated with in fact higher levels of depression in individuals with elevated life stress (Ford, Karnilowicz, & Mauss, 2017). Regarding situation-specific variables, CR is rather ineffective when confronted with stimuli of high emotional intensity (Sheppes & Gross, 2011). Based on these findings, it seems consequent to also examine the variation within CR (e.g., reappraisal inventiveness, use of specific tactics) in the light of contextual factors. In parallel with theoretical models on variables moderating ER effectiveness (see Figure 1.2), I propose reappraisal effectiveness to be a product of the interaction between person-, situation-, and reappraisal-specific variables. For example, a certain reappraisal tactic may only be effective in some situations and for some people. Hence, the PhD student on the day before the thesis defense may derive more comfort from the reappraisal thought "Great opportunity to show off my hard work!" (i.e., conceiving the event as explicitly positive) than by the thought "This is just a dream!" (i.e., challenging the authenticity of the event). Similar contextual dependencies may exist regarding the more or less variable generation of reappraisal thoughts.

Before we try to unravel possible contextual factors, let us reconsider the dynamics of CR to better understand how reappraisal inventiveness would come into effect in the first place. Based on a meta-analyses of neuroimaging studies on CR, Kalisch (2009) outlined the implementation-maintenance model of cognitive reappraisal. Accordingly, in an early stage, the reappraisal process starts with the generation and implementation of a reappraisal thought. Later stages are instead characterized by monitoring the effectiveness and maintaining the reappraisal thought in working memory while inhibiting competing negative thoughts. As preliminary support for these differential stages, the meta-analysis of Kalisch (2009) revealed a shift of activations in the lateral frontal cortex from left posterior to right anterior regions in the temporal progression of CR. Figure 1.4 depicts a simplified sequence of the reappraisal process based on these findings. Accordingly, individuals initiate CR by generating a first reappraisal thought as a reaction to a stressor. Next, individuals monitor the effectiveness of the selected reappraisal thought. If the thought proves effective, individuals proceed to the maintenance phase. If the thought proves ineffective, individuals need to generate a different reappraisal thought. This cycle is repeated until a suitable reappraisal thought is found.

In accordance with the theoretical considerations of Weber and colleagues (2014), I hypothesize reappraisal inventiveness to be a relevant ability especially in the early implementation stage of CR. Similar to the concept of ER repertoire (Bonanno & Burton, 2013; see section 1.1.4), individuals with high reappraisal inventiveness would benefit from having a variety of reappraisal thoughts at their disposal. Specifically, high reappraisal inventiveness would enable more iterations of the outlined reappraisal cycle and in turn increase the probability to arrive at an effective reappraisal thought. However, the *shielding-shifting* dilemma of cognitive control (Dreisbach & Frober, 2019; Pruessner et al., 2020) suggests a trade-off between the implementation and the maintenance process of CR. Accordingly, goal-directed behavior (e.g., CR) is a product of the ideal balance between stability mechanisms that shield the behavior against distraction (e.g., negative thoughts) and flexibility mechanisms that help adjust to changing situational demands (e.g., by generating various reappraisal thoughts). Therefore, an abundance of variable reappraisal thoughts may in some situations and for some people even undermine effectiveness by inviting distractions and impairing the maintenance stage. Consequently, effective CR would require individuals to pass through as many iterations in the cycle of generating and monitoring reappraisal thoughts as necessary but proceed to the maintenance stage as soon as possible.

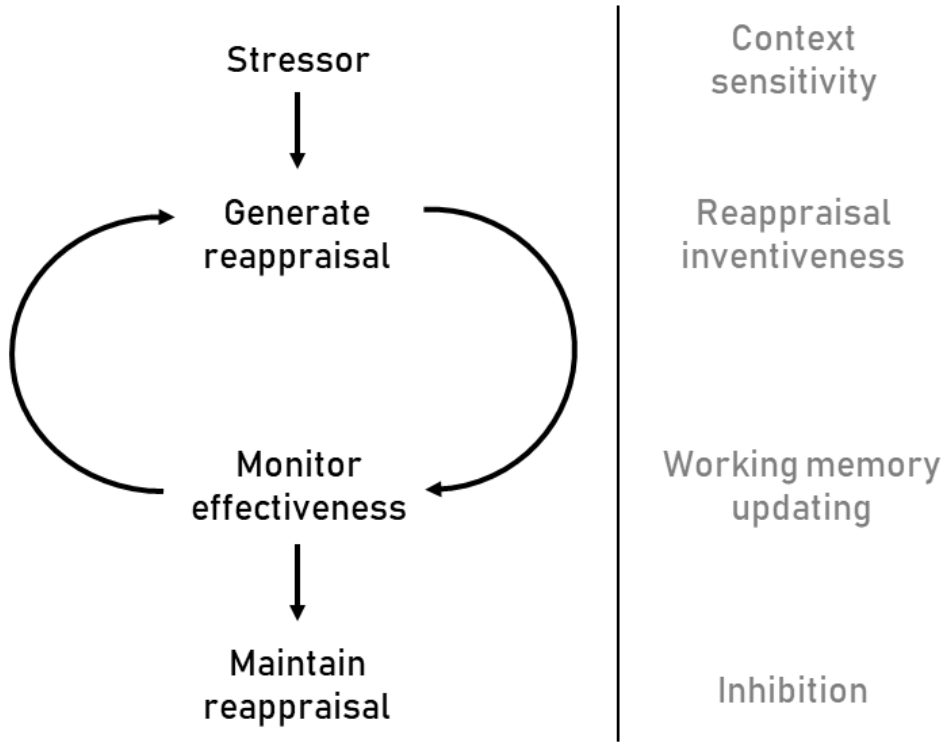

Figure 1.4. A Process Model of Cognitive Reappraisal Including the Stages of Generating, Monitoring, and Maintaining Reappraisal Thoughts (left) and Examples of Abilities Supporting the Execution of Each Stage (right).

Reappraisal inventiveness, however, would most likely not capture these proposed context sensitive effects, as it is operationalized as an individual's rather stable ability to generate multiple categorically different reappraisal thoughts. However, as outlined above, what individuals *are able* to do may differ from what they *should* do in a given situation. Therefore, I propose a distinction between reappraisal *inventiveness* and reappraisal *variability*. Following conventions of psychological testing (Cronbach, 1970), reappraisal variability describes the *typical performance* in generating categorically different reappraisal thoughts, while reappraisal inventiveness assesses *maximum performance*. Consequently, individuals with high reappraisal variability chose to (rather than being instructed to) generate various reappraisal thoughts in a given situation. This choice rather reflects motivation than ability and is therefore more closely related to contextual variables (Beus & Whitman, 2012). Similar to the concept of ER variability (see section 1.1.5) and in line with the shielding-shifting dilemma, high reappraisal variability irrespective of contextual demands is not expected to increase reappraisal effectiveness. Thus, context sensitivity (Bonanno & Burton, 2013) may be necessary to wisely choose whether to be variable in the generation stage of CR.

1.2.5 The role of experience in the reappraisal process

In this dissertation, I aim to work towards a more context appropriate research of CR by investigating the differential implications of an individual's experience with emotion-eliciting situations for reappraisal inventiveness and reappraisal variability, respectively. Considering an individual's prior experience with stressors as context variable seems especially relevant for ER, as it evidently relates to mental health outcomes. Specifically, a moderate exposure to stressors has been found to increase human *resilience*, i.e., the ability to maintain or regain health in the face of adversity (Kalisch, Muller, & Tuscher, 2015; Seery & Quinton, 2016). For example, individuals with moderate levels of lifetime adversity reported higher life satisfaction (Seery, Holman, & Silver, 2010) and increased pain tolerance in a stress test (Seery, Leo, Lupien, Kondrak, & Almonte, 2013). Resilience theories argue that individuals who experience a certain number of stressful events benefit from having more opportunities to acquire and train ER strategies, especially CR (Crane, Searle, Kangas, & Nwiran, 2019; Rutter, 2012; Seery & Quinton, 2016). This learning effect is absent if individuals are confronted with no or too many stressors. Regarding the CR process, a certain degree of exposure to emotion-eliciting events may result among other effects in more frequent iterations in the proposed generation-

monitoring cycle (Figure 1.4). This would eventually increase an individual's repertoire of reappraisal thoughts (i.e., higher reappraisal inventiveness), which in turn facilitates CR in upcoming situations (as described in Section 1.2.4).

However, as discussed before, variable reappraisal is most likely not helpful for every person in every situation. In contrast, spending too many resources on the generation process can invite distractions and impair the maintenance stage of CR. Regarding effects of personal experience, I argue that the reappraisal dynamics change with repeated exposure to a certain emotional stimulus. Specifically, models of psychological flexibility (Dreisbach & Frober, 2019) suggest a shift in the shielding-shifting balance from flexibility to stability with increasing experience. This progression likely transfers to the CR dynamics. Hence, new situations require multiple iterations of the generation-monitoring cycle (high reappraisal variability) until an effective reappraisal thought is found. With more frequent exposure to similar situations, less iterations of the generation-monitoring cycle (low reappraisal variability) become necessary. Instead, previously generated reappraisal thoughts can be retrieved from memory, which in turn leaves more resources for maintenance processes. Consequently, maximum reappraisal effectiveness would require high context sensitivity (Bonanno & Burton, 2013), as individuals need to recognize the familiarity with the present situation and accordingly adapt the degree of reappraisal variability. Conversely, individuals who apply CR irrespective of contextual demands are more prone to ineffective ER, for example, by reappraising too rigidly in new situations or too variable in familiar situations. In summary, I therefore propose that, while a moderate degree of experience with emotion-eliciting situations increases overall reappraisal inventiveness, frequently experienced situations require less reappraisal variability.

1.3 Research Questions

The focus of the present dissertation is the investigation of variables predicting individual differences in reappraisal effectiveness. Therefore, in study #1, I introduce a new experimental paradigm, the Script-based Reappraisal Test (SRT), which combines elements of previous reappraisal tasks (Ochsner et al., 2004; Weber et al., 2014) to overcome the black box phenomenon in ER research. Specifically, the SRT enables a more detailed investigation of the CR process by offering process-related (reappraisal inventiveness and variability) and outcome-related (reappraisal effectiveness) measures. Studies #2 and #3 are dedicated to the effects of an individual's prior experience with emotional stimuli on CR. More precisely, in study #2, I

hypothesize that a moderate degree of exposure to daily hassles increases reappraisal inventiveness and effectiveness measured via SRT. Study #3 makes use of an adapted version of the SRT that assesses reappraisal variability rather than reappraisal inventiveness. To illustrate the pitfalls of variable reappraisal generation, I propose that reappraisal effectiveness is predicted by the interaction between reappraisal variability and the familiarity with the situations presented in the SRT. Accordingly, individuals with high (in contrast to low) situational familiarity would exhibit negative relationships between reappraisal variability and reappraisal effectiveness.

2

Script-based Reappraisal Test

Introducing a new paradigm to investigate the effect of reappraisal inventiveness on reappraisal effectiveness

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2.1 Summary of study #1

Objectives: The ability to regulate emotions is essential for psychological well-being. Therefore, it is particularly important to investigate the specific dynamics of emotion regulation. In a new approach, we developed a novel paradigm – the Script-based Reappraisal Test (SRT) – to measure the processes involved in reappraisal, especially reappraisal inventiveness, i.e., the ability to create multiple and differing reappraisals. The aim of this study was twofold: (1) experimentally validate the SRT and (2) investigate whether reappraisal inventiveness increases reappraisal effectiveness.

Methods: Healthy students (N = 143) completed the SRT. In this task, we presented everyday emotional situations in textual form and instructed participants to either decrease negative emotions by generating different reappraisals (reappraisal-trials) or react naturally (control-trials) to the situations. After each trial, participants indicated their affective state (SAM) and typed in their reappraisal thoughts.

Results: Within-subjects analyses showed significantly less negative affect and arousal in reappraisal-trials compared to control-trials, indicating a successful emotion regulation through reappraisal. Contrary to our hypothesis, reappraisal inventiveness and reappraisal effectiveness were not related.

Discussion: The theoretical and practical implications are discussed in the light of a person-by-situation approach.

Keywords: emotion regulation; cognitive reappraisal; reappraisal inventiveness

2.2 Introduction

When in a heated situation, the way of thinking can determine whether you lose your temper or keep your cool. Along these lines, cognitive reappraisal, i.e., reinterpreting a situation to alter its emotional impact, is one of the most prominent strategies in emotion regulation research (Gross, 1999; Gross & Thompson, 2007), largely due to its beneficial effects. Reframing events in a more positive manner is associated with increased psychological well-being (Gross & John, 2003) and less symptoms of depression and anxiety in adolescents and adults (Garnefski, Legerstee, Kraaij, Van Den Kommer, & Teerds, 2002). Moreover, better cognitive reappraisal ability attenuates the positive relationship between stress and depression (Troy et al., 2010).

However, recent research suggests that the effectiveness of cognitive reappraisal depends on situational and person-specific factors (Troy et al., 2013). For example, cognitive reappraisal was found to be maladaptive in the context of controllable stress and less effective for people of high socioeconomic status (Troy et al., 2017). Beyond contextual factors, effective cognitive reappraisal also relies on an individual's cognitive control abilities (McRae, Jacobs, Ray, John, & Gross, 2012). According to McRae et al., the reappraisal process consists of subcomponents, i.e., inhibiting negative appraisals, generating alternative interpretations, selecting and implementing a new appraisal, maintaining the reappraisal thought in mind, and monitoring the emotional change. Regarding the implementation and maintenance process, McRae et al. identified working memory and set shifting as predictors of reappraisal ability. Verbal ability was hypothesized to contribute to the generation process but did not correlate with reappraisal ability. It therefore remains unclear how individual differences in the reappraisal generation influence effective downregulation of negative affect.

A central component of the generation process may be reappraisal inventiveness, i.e., the ability to create multiple and differing reappraisals (Weber et al., 2014). Weber et al. defined emotional situations as problems that can be solved by a variety of reappraisal styles and inventive individuals may be more likely to find effective reappraisal thoughts while being less susceptible to a biased negative perspective. An inventive reappraisal style may also promote the adaption to a series of alternating emotional situations.

To investigate their proposition, Weber et al. (2014) developed the Reappraisal Inventiveness Test (RIT), whereby participants imagine anger-eliciting situations by reading four short texts presented with pictures. Afterwards, they generate and write down as many

different reappraisals as possible. Independent judges assess the participants' reappraisal inventiveness in terms of fluency (total number of reappraisals) and flexibility (diversity of reappraisals). Results indicated a positive relationship between reappraisal inventiveness and openness. However, reappraisal inventiveness measures did not correlate with neuroticism nor with trait anger, both supposedly indicating individual differences in effective emotion regulation. The authors attributed this finding to the effectiveness measures being too unspecific and influenced by other emotion regulation strategies. Additionally, participants may not have been genuinely motivated to take anger-diminishing perspectives, as hostile appraisals are sometimes perceived as useful and appropriate in interpersonal situations (Weber, 2004).

In another study to identify the role of creativity in reappraisal effectiveness, Wu, Guo, Tang, Shi, and Luo (2017) instructed participants to reappraise negative affective pictures more positively and subsequently indicate the creativity as well as the effectiveness of their reappraisals in regulating negative emotions. Additionally, independent experts rated the reappraisals in terms of creativity. The results indicated a positive correlation between reappraisal effectiveness and self-reported creativity, but not with creativity scores of the independent judges. Self-report bias was discussed as a reason for this ambivalent finding, as participants might have exaggerated the creativity of their appraisals. Therefore, a more objective measure of creativity might be more suitable to identify the role of inventiveness in the reappraisal process.

In this study, we offer a new methodology based on the RIT to investigate the relationship between reappraisal inventiveness and effectiveness, which directly addresses the concerns raised by previous research (Weber et al., 2014; Wu et al., 2017), i.e., unspecific effectiveness measures, anger-eliciting stimulus material, and self-reported creativity. Therefore, we introduce an emotion regulation task – the Script-based Reappraisal Test (SRT) –, which combines the objective and elaborate assessment of reappraisal inventiveness as proposed by the RIT with an experimental effectiveness measure. In accordance with other emotion regulation tasks (e.g., Ochsner et al., 2004), the SRT comprises trials, in which participants apply reappraisal to downregulate negative emotions (reappraisal-trials) and trials, in which participants do not actively regulate emotions (control-trials). As after each trial participants rate their emotional state, reappraisal effectiveness is measured as the difference between the emotional responses during reappraisal- and control-trials. Thus, the SRT provides an effectiveness measure that is directly linked to the reappraisal process and more accurate than effectiveness derived from unspecific questionnaires.

Similar to the RIT, we present scripts, i.e., short texts describing everyday situations associated with negative emotions (see Appendix I). We aimed at extending the stimulus selection of the RIT to account for motivational ambivalence regarding the regulation of anger directed at others (Weber, 2004) and to enhance generalizability of our results. The SRT therefore also includes scripts that induce frequent emotions (Scherer, Wranik, Sangsue, Tran, & Scherer, 2004) with a different focus (self-anger) and quality (fear). Finally, the scripts seem well-suited to capture the dynamic nature of emotional experiences, as participants imagine themselves being in the described situations.

The first aim of this study is to examine the SRT in terms of successful experimental manipulation. We expect participants to indicate less negative affect in reappraisal-trials than in control-trials. The second aim of this study is to identify the role of reappraisal inventiveness in the reappraisal process. In line with previous research (Weber et al., 2014; Wu et al., 2017), we hypothesize reappraisal fluency and flexibility to be positively related to reappraisal effectiveness. Furthermore, the habitual use of reappraisal serves as a parameter to assess the construct validity of reappraisal inventiveness and effectiveness. Although studies linking habitual reappraisal to reappraisal ability (Kanske, Schönfelder, Forneck, & Wessa, 2015; Weber et al., 2014) are inconclusive, we expect habitual reappraisal to be positively related to a more fluent, flexible, and effective reappraisal style by facilitating the retrieval of past reappraisal thoughts.

2.3 Method

2.3.1 Participants

A total of 143 students participated in this study and were recruited through the online recruitment system ORSEE (Greiner, 2015). Sample size was determined a priori via power analysis using G*Power, yielding a minimum sample size of $N = 122$ based on an effect size of $d = .30$ (Webb et al., 2012), an alpha error set to .05, and a statistical power of .95 for paired t-tests. We excluded 14 participants from the study because more than 50% of their answers in all trials did not comply with the experimental instructions. The final sample consisted of $N = 129$ (88 females; age: $M = 23.1$, $SD = 3.8$). Participants received reimbursement of 13.50 Euro.

2.3.2 Measures

Script-based Reappraisal Test

The Script-based Reappraisal Test (SRT) is a computerized task, which contains 30 written short texts (scripts) describing everyday situations, 10 each associated with one of three emotions: anger directed at oneself (self-anger), anger directed at others (other-anger), or fear. In each trial, participants are presented with a script (20 s) and asked to imagine the situation happening to them as vividly as possible. After script presentation, they proceed to an ideation phase (60 s) linked to one of two instructions (derived from the "Look" and "Decrease" trials in Ochsner et al., 2004): in 10 reappraisal-trials, participants are instructed to decrease negative emotions by generating as many different reappraisals ("think about the situation in a less negative way") as possible. In 10 control-trials, participants are instructed to "react naturally to the situation without actively trying to change your emotion". Participants click on a button every time a new reappraisal (reappraisal-trials) or negative thought (control-trials) emerges.

After each ideation phase, participants indicate affective valence and arousal on a nine-point scale using the Self-Assessment Manikins (SAM; Bradley & Lang, 1994); high scores represent negative valence and high arousal, respectively. Each trial concludes with a recording phase (90 s) where participants are instructed to "enter all thoughts that occurred during the ideation phases in input boxes". In contrast to the RIT, we separate the ideation from the recording process to ensure that the typing itself does not influence affective ratings. The button clicks serve to check whether the number of thoughts indicated in the ideation and recording phases match. Participants work on two practice trials before the main experiment starts.

Script characteristics and display timing. The scripts describe everyday experiences of harm carelessly caused by oneself (self-anger), willingly caused by another person (other-anger), or impending danger (fear). Two preliminary validation studies were conducted to ensure sufficient emotional intensity and specificity of the scripts as well as appropriate durations of the experimental phases (for an overview of the validation studies, see Appendix II). With respect to both studies, we matched the scripts in the reappraisal- and control-trials in the main study regarding intensities and set the duration of the presentation and ideation phase to 20 s and 60 s, respectively.

Scoring. Three graduate students independently rated the participants' reappraisal ideas regarding (1) the total number of appropriate reappraisals (*SRT-fluency*) and (2) the number of substantially distinct reappraisals (*SRT-flexibility*). We adapted the categorical rating system of the RIT to facilitate the scoring of SRT-flexibility. Depending on emotion, the rating system

offered 16 (self-anger), 22 (other-anger), and 17 (fear) categories.[1] Adequate reappraisals that did not fit any category were rated as "other". Furthermore, judges assessed the total number of negative appraisals in control-trials (*SRT-negatives*), i.e., thoughts that potentially increase or maintain negative affect (Smith & Lazarus, 1993). Answers that did not comply with the instructions, i.e., negative interpretations in reappraisal-trials and reappraisals in control-trials were rated as "invalid". Finally, resulting intraclass correlation coefficients (ICC) for SRT-fluency (.97, .99, .99 for self-anger, other-anger, and fear, respectively) and SRT-flexibility (.93, .94, .92) indicated high inter-rater reliability and thus a valid scoring system.

Self-report measures

We assessed habitual use of reappraisal via the German translation of the Emotion Regulation Questionnaire (ERQ; Abler & Kessler, 2009; Gross & John, 2003). The ERQ contains six items measuring habitual use of reappraisal and four items measuring suppression. To control for pre-experimental affect, we administered the German version of the Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996; Watson, Clark, & Tellegen, 1988), which includes 10 items each for positive and negative affect.

2.3.3 Procedure

The study was conducted in the Mainz Behavioral and Experimental Laboratory (MABELLA) in groups of 20 to 25 participants. The SRT and the questionnaires were implemented in SoSci Survey software and conducted on computers with 24-inch monitors. Upon arrival, participants provided written informed consent and completed the PANAS. To keep the duration of the SRT as short as possible, we randomly assigned participants to one of three versions of the SRT, each containing 20 trials with scripts associated to only two emotions: self-anger/other-anger (n = 38 participants), self-anger/fear, (n = 41 participants), other-anger/fear, (n = 50 participants). Participants worked on the SRT for 60 to 65 minutes followed by the ERQ and a demographical questionnaire adding up to a total duration of approximately 75 minutes.

[1] Categories included appraising the harm/danger as reducible, de-emphasizing the meaning of the harm/danger, focusing on positive aspects of the situation, or reflecting the functionality of the negative emotion. For an overview of all categories, see Appendix III.

2.4 Results

2.4.1 Descriptive statistics and preliminary analyses

Cronbach's alpha for SRT-fluency (self-anger: .78, other-anger: .86, fear: .84) and SRT-flexibility scores (.70, .81, .79) indicated acceptable to good internal consistencies across scripts for each emotion. The responses in the recording phase were significantly related to the ideation process, indicated by a high correlation ($r = .82$, $p < .001$) between total number of button clicks ($M = 86.45$, $SD = 37.11$) and typed in thoughts ($M = 82.72$, $SD = 26.92$). As the small sample size for each questionnaire did not warrant reliable analyses of differences between specific emotions, general mean SRT-scores were calculated across all scripts for further analyses. Furthermore, we computed individual reappraisal effectiveness (RE) scores by calculating the difference between mean SAM-ratings from reappraisal- and control-trials for valence and arousal. High RE-scores indicate more positive valence and less arousal in reappraisal-trials compared with control-trials. Table 2.1 shows descriptive statistics and correlations between all main variables.

Table 2.1

Mean, Standard Deviation, Range, and Inter-Correlations of Main Variables.

	Correlation coefficients (*r*)							
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) SRT-fluency	1							
(2) SRT-flexibility	.93**	1						
(3) SRT-negatives	.70**	.68**	1					
(4) RE-valence	.07	.04	.07	1				
(5) RE-arousal	.03	.00	.10	.68**	1			
(6) ERQ-reappraisal	.24*	.27*	.06	.00	-.01	1		
(7) PANAS-positive	.03	.03	.11	-.14	-.03	.06	1	
(8) PANAS-negative	-.04	-.02	-.07	-.05	-.15	-.11	-.12	1
	Descriptive Statistics							
M	33.32	27.33	34.70	0.68	0.62	4.59	3.09	1.36
SD	10.92	8.23	12.73	0.79	0.87	1.14	0.66	0.53
Min	10	6	10	-1.10	-1.50	1.67	1.20	1.00
Max	69	54	81	3.00	3.20	6.67	4.30	4.80

Note. $N = 129$. *$p < .05$; **$p < .01$. SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness; ERQ = Emotion Regulation Questionnaire; PANAS = Positive and Negative Affect Schedule.

2.4.2 Analyses of experimental manipulation and construct validity

In a first step, one-sample t-tests indicated successful emotion induction via scripts, as valence ratings in control-trials were significantly higher than 5 (*neutral*), $t(128) = 9.3$, $p < .001$, $d = .82$, and arousal ratings in control-trials significantly higher than 0 (*relaxed*), $t(128) = 33.5$, $p < .001$, $d = 2.95$ (see Figure 2.1). In a second step, we conducted within-subjects t-tests to evaluate the reappraisal manipulation and observed significantly stronger affective responses in control- than in reappraisal-trials (valence: $t(128) = 9.75$, $p < .001$, $d = .51$; arousal: $t(128) = 8.09$, $p < .001$, $d = .35$). Furthermore, using Bonferroni adjusted alpha levels of .0125 per test (.05/4), we found a significant correlation between habitual reappraisal as measured with the ERQ with SRT-flexibility but not with SRT fluency nor RE-scores (see Table 2.1). Regarding the ideation in reappraisal- and control-trials, SRT-fluency correlated highly with SRT-negatives.

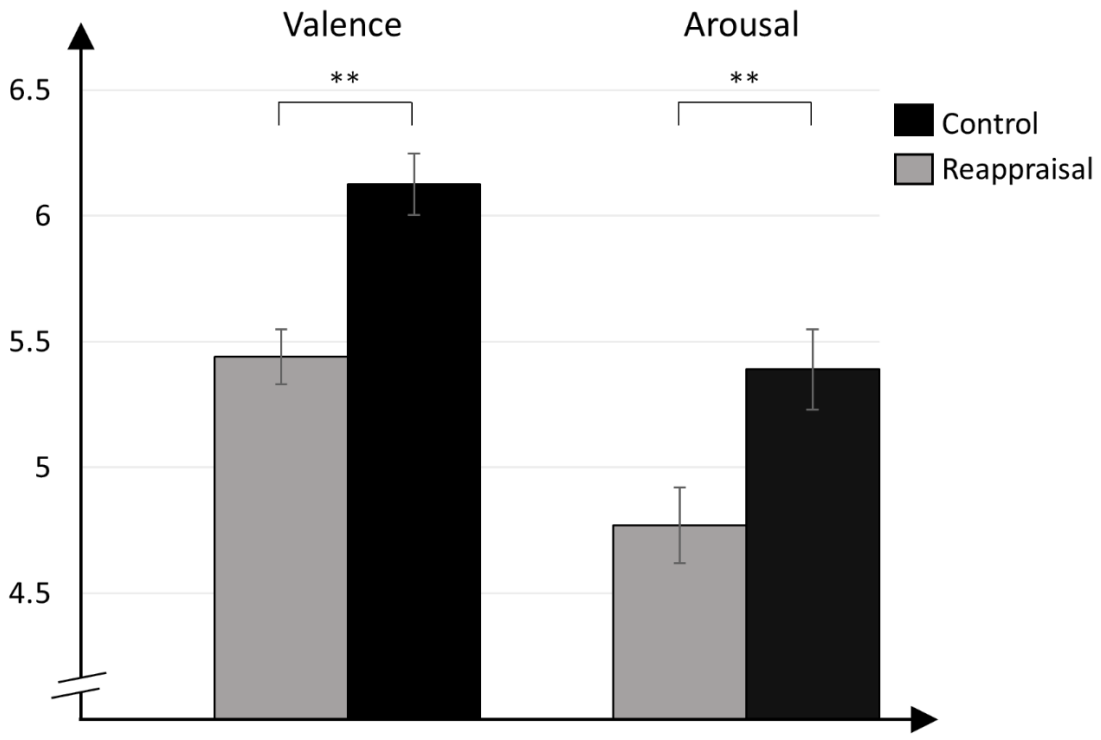

Figure 2.1. Mean SAM-ratings in Control- and Reappraisal-trials. Error Bars Represent Standard Error of the Mean. $N = 129$. $^{**}p < .01$, Repeated Measures t-test.

2.4.3 Relationship between reappraisal inventiveness and reappraisal effectiveness

To examine the effects of reappraisal inventiveness on reappraisal effectiveness, we conducted a multivariate regression using the GLM procedure in SPSS (version 23) with the dependent variables RE-valence and RE-arousal. As SRT-fluency and SRT-flexibility were highly correlated (see Table 2.1), we excluded SRT-flexibility from the regression model to avoid multicollinearity. Furthermore, we added SRT-negatives and both PANAS scores as covariates to our model, to control for variance in the generation of negative thoughts and pre-experimental affect. Using Pillai's trace, the analysis indicted a non-significant regression equation ($V = 0.05$, $F(6, 248) = 1.02$, $p = .42$) with neither SRT-fluency nor any of the covariates significantly predicting RE-scores (all ps > .10). Exchanging SRT-fluency for SRT-flexibility revealed similar results ($V = 0.05$, $F(6, 248) = 1.10$, $p = .36$; for a detailed overview of all univariate regression coefficients, see Appendix IV).

2.5 Discussion

The aim of this study was twofold: (1) to validate the SRT as a new emotion regulation paradigm and (2) to investigate the role of reappraisal inventiveness for reappraisal effectiveness.

First, the emotional scripts in the SRT were useful in eliciting negative affect and arousal. As simulated emotions are highly correlated with the online experience of emotions (Robinson & Clore, 2001), the text-based methodology of the SRT seems well-suited for emotion regulation research. Furthermore, participants successfully regulated their emotional response to the scripts, indicated by less arousal and negative affect in the reappraisal-trials compared with the control-trials. This finding coincides with previous research (Webb et al., 2012) establishing cognitive reappraisal as an effective strategy to handle emotional situations. The size of the reappraisal effect in this study might be overestimated due to demand characteristics of the task, as we instructed participants to downregulate negative emotions. However, studies using similar instructions in an fMRI setting (Kanske et al., 2015; Ochsner et al., 2004) showed significant reductions of amygdala activity due to reappraisal, which would be less influenced by demand effects.

Regarding construct validity, habitual reappraisal was correlated with reappraisal flexibility but not with fluency nor effectiveness. This finding is in line with previous research (McRae, Jacobs, et al., 2012; Troy et al., 2010; Weber et al., 2014) and emphasizes that self-reported use of reappraisal and reappraisal ability measures are two distinct constructs that

independently relate to subjective well-being. Furthermore, the number of thoughts generated in the reappraisal- and control-trials were highly correlated. A main effect of general divergent thinking ability is likely to account for this relationship. Although we did not explicitly instruct participants to generate a multitude of negative thoughts in the control-trials, creative participants would presumably not only generate more reappraisal ideas (Weber et al., 2014) but also more negative thoughts.

The second focus of our study was the investigation of an enhancing effect of reappraisal inventiveness on reappraisal effectiveness. The SRT was developed to address methodological concerns raised by previous research (Weber et al., 2014; Wu et al., 2017), by including a direct effectiveness measure, more diverse stimulus material, and an objective assessment of inventiveness. Despite these adaptations, our results did not support a positive relationship between an inventive and an effective reappraisal style. Generating a multitude of alternative perspectives may therefore not be inherently beneficial for the reappraisal process. For example, high inventiveness scores may result from creative but unrealistic reappraisal thoughts. Consequently, effective reappraisal would depend on the quality rather than the quantity of reappraisal ideas.

Contextual factors are also likely to influence the effectiveness of an inventive reappraisal style. In familiar situations, for example, people may rely on more frugal and implicit emotion regulation strategies rather than spending resources on the explicit generation of multiple reappraisal thoughts (Gyurak, Gross, & Etkin, 2011). In novel situations, however, an explicit and inventive reappraisal style may be necessary to implement effective reappraisal thoughts. The scripts in the SRT reflect very common everyday situations. Forthcoming studies should include scripts that are more heterogeneous to identify moderating effects of contextual factors, as a person-by-situation approach seems to be especially relevant for the effectiveness of emotion regulation strategies (Troy et al., 2013).

Methodological shortcomings could limit the interpretation of our results. First, the rather homogeneous sample of healthy students in this study might exhibit low variance in reappraisal inventiveness, thus limiting regression analyses. Future studies should increase variance by investigating subclinical or clinical samples associated with impaired emotion regulation (Joormann & Gotlib, 2010), potentially using a shorter version of the SRT to avoid fatigue. Secondly, we instructed participants to reappraise or react naturally after the script presentation in each trial. Therefore, participants might have pre-emptively generated reappraisal thoughts in the presentation phases of the control-trials and consequently experienced less negative affect. However, we conducted a follow-up study with a modified

version of the SRT, in which instructions preceded each presentation phase and trials were arranged in randomized blocks. A similar pattern of results (see Appendix V) suggests that pre-emptive reappraisal did not account for our findings. Thirdly, participants might have omitted invalid responses in both trials due to task compliance. Future studies using a think-aloud protocol or physiological measures could help exclude this possibility.

Overall, the current study introduces an emotion regulation paradigm that successfully assesses reappraisal effects and provides detailed information on the reappraisal process. This information seems especially relevant for the development of targeted interventions. Regarding our results, for example, people may as well rely on a frugal reappraisal style rather than spending resources on generating a multitude of reappraisal thoughts.

Conflict of interest statement

The authors declare no conflict of interest.

Funding details

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Data Availability Statement

The data that support the findings of this study are openly available in Open Science Framework at http://doi.org/10.17605/OSF.IO/4ZS8Y.

2.6 Appendix

Appendix I

Sample of translated scripts for each emotion:

"You want to take the bus to get to an important meeting. As you approach the bus stop, you see the bus already waiting with doors closed. You go to the bus driver's door to signal that you want to board, but instead he laughs at you and drives away." (Other-Anger)

"You want to leave the apartment to take a walk. As you open the door to your apartment, you meet your neighbor and start a conversation. After your neighbor says goodbye, you close the door to your apartment to go outside. Suddenly you realize that you left your keys in the hallway of your apartment." (Self-Anger)

"You go home alone at night after being at a party. As you are new to this part of the city, you get lost. While looking for a way home, you cross a grim park in a remote area. You keep on walking through the park, as you suddenly see a group of inebriated young men approaching in the distance." (Fear)

Overview of all scripts in German:

Other-Anger

1. *"Sie haben in Ihrem Vorgarten ein großes Blumenbeet angelegt. Nach mühsamer monatelanger Pflege kommen endlich die ersten Blüten zu Tage. Als Sie an einem Sonntagmorgen das Haus verlassen, laufen Sie an Ihrem Garten vorbei. Sie finden mehrere leere Bierflaschen und ein verwüstetes Blumenbeet vor."*

2. *"Sie wollen mit dem Bus zu einem wichtigen Termin fahren. Kurz vor der Bushaltestelle sehen Sie, dass der Bus bereits da ist und die Türen geschlossen sind. Als Sie zur Fahrertür gehen, um dem Fahrer zu signalisieren, dass Sie gerne noch mitfahren möchten, lacht er Sie aus und fährt weg."*

3. *"Sie schlendern durch die Fußgängerzone, als Sie bemerken, dass sich eine Gruppe Jugendlicher über einen Menschen mit körperlicher Behinderung lustig macht. Sie gehen auf die Jugendlichen zu und konfrontieren sie mit deren Verhalten. Daraufhin sagen diese: "Jetzt stell dich mal nicht so an, das ist doch witzig!""*

4. *“Sie sitzen im Kino und schauen einen spannenden Film als zwei weitere Zuschauer direkt hinter Ihnen anfangen, sich lautstark zu unterhalten. Als Sie die beiden schließlich fragen, ob sie sich leiser unterhalten können, grinsen diese verächtlich, sagen "Zieh Leine, du Spießer!" und bewerfen Sie mit Popcorn.”*

5. *“Sie haben einen Stand auf dem Flohmarkt und unterhalten sich mit dem Inhaber des Standes neben Ihnen. Als er sich Ihre Waren ansieht, verschüttet er seinen Kaffee auf Ihrem Stand und beschädigt auf unwiederbringliche Weise ein sehr seltenes und wertvolles Buch. Er wendet sich ab mit den Worten: "Das war doch sowieso nur Schrott."”*

6. *“Sie befinden sich in einem Supermarkt am Weinregal. Ein Kunde neben Ihnen greift nach einer Flasche Rotwein und lässt diese fallen. Die Flasche zerbricht und einige Spritzer landen auf Ihrer Kleidung. Als ein Supermarktangestellter vorbeikommt und fragt, wie das passiert sei, zeigt der Kunde auf Sie und behauptet: "Ich wurde angerempelt!"”*

7. *“Sie sind im Skiurlaub und fahren die Skipisten hinunter. Ein anderer Skifahrer kommt hinter Ihnen angerast und stürzt auf Sie, sodass Sie sich das Bein verstauchen und den Rest der Woche nicht mehr Ski fahren können. Als Sie den Skifahrer auf sein Verhalten ansprechen, sagt dieser: "Bummler wie Sie gehören auf die Anfängerpiste!"”*

8. *“Sie sind am Bahnhof und wollen an Ihr Gleis. Als Sie die Treppe hinunterlaufen, werden Sie angerempelt, wodurch Ihnen Ihre Laptoptasche aus der Hand entgleitet und die Treppe hinunterfällt. Als Sie den Passanten nach dessen Versicherung fragen, antwortet dieser: "Pass' halt besser auf!" und steigt in den nächsten Zug.”*

9. *“Sie nehmen die Straßenbahn zusammen mit einem Kollegen, um ein wichtiges Projekt abzugeben. Plötzlich fällt Ihnen auf, dass Ihr Kollege den Ordner an der Haltestelle vergessen hat, woraufhin das Projekt scheitert. Nach dem Vorfall spricht Sie Ihr Vorgesetzter an: "Das darf nicht noch einmal passieren, dass Sie den Ordner vergessen!" Ihr Kollege schweigt.”*

10. *“Sie wollen an einem Projekt arbeiten, dass Sie morgen einreichen müssen. Da sich zwei Ihrer Kollegen nebenan lautstark unterhalten, fällt es Ihnen schwer, konzentriert weiterzuarbeiten. Als Sie die beiden fragen, ob sie sich etwas leiser unterhalten können, entgegnet Ihnen einer der Kollegen: "Von dir lasse ich mir nicht den Mund verbieten!"”*

Self-Anger

1. *"Sie spielen seit langem immer mit denselben Zahlen - Ihren Glückszahlen - Lotto. Während der Kaffeepause informieren Sie sich zusammen mit Ihrem Kollegen über die aktuellen Lottozahlen. Begeistert erkennen Sie, dass Ihre Glückszahlen gezogen worden sind, bis Ihnen plötzlich einfällt, dass Sie dieses Mal vergessen haben, sich ein Los zu kaufen."*

2. *"Sie sind am Strand. Sie möchten sich auf den Heimweg machen und packen Ihre Sachen zusammen. Zu Hause angekommen suchen Sie vergeblich Ihren Schlüssel. Als Sie überlegen, wo er sein könnte, erinnern Sie sich, dass Sie ihn auf dem Handtuch abgelegt hatten und er beim Ausschütteln des Handtuchs vermutlich verloren gegangen ist."*

3. *"Sie haben den Tag mit Shopping verbracht. Nachdem Sie zwei Taschen voll Kleider erworben haben, nehmen Sie die Straßenbahn, um nach Hause zu fahren. An Ihrer Haltestelle steigen sie aus. Als Sie merken, dass Sie Ihre Taschen in der Straßenbahn vergessen haben, sehen Sie diese bereits in der Ferne wegfahren".*

4. *"Sie fahren mit dem Auto zum Flughafen, um in den Urlaub zu fliegen. Auf dem Weg halten Sie an, um zu tanken. Statt Diesel zu tanken, tanken Sie versehentlich Benzin. Als Sie Ihren Fehler bemerken, müssen Sie den Pannendienst rufen, damit dieser den Tank auspumpt. Sie verpassen den Flug."*

5. *"Sie erhalten eine E-Mail, die Sie über einen vermeintlichen Millionengewinn informiert. Sie öffnen die E-Mail und werden aufgefordert, einen Link anzuklicken. Da Sie neugierig werden, klicken Sie auf den Link. Daraufhin stürzt Ihr Computer ab und Sie sind anschließend nicht mehr in der Lage, diesen hochzufahren."*

6. *"Sie renovieren gerade Ihre Wohnung. Zufällig treffen Sie Ihren Nachbarn und kommen mit ihm ins Gespräch. Da er auch kürzlich renoviert hat, fragt er Sie, wie Sie vorankämen. Als Sie ihm Ihre Fortschritte zeigen möchten, stoßen Sie einen Eimer Tapetenkleister um und ruinieren damit Ihren neuen Teppichboden."*

7. *"Nach einem langen Arbeitstag kommen Sie abends nach Hause. Sie öffnen die Tür Ihrer Wohnung und bemerken beim Eintreten, dass der gesamte Teppichboden nass geworden ist. Als Sie in die Küche gehen, sehen Sie noch mehr Wasser auf dem Boden. Sie bemerken, dass Sie morgens vergessen haben, den Wasserhahn zuzudrehen."*

8. *"Sie räumen auf und haben geplant, Ihre Akten abzulegen. Sie bilden hierfür einen Stapel mit wichtigen und einen mit unwichtigen Dokumenten. Anschließend schreddern Sie den gesamten Stapel mit unwichtigen Dokumenten. Als Sie Ihre wichtigen Dokumente in Ordner abheften wollen, bemerken Sie, dass Sie beide Stapel vertauscht haben."*

9. *"Sie haben ein seltenes Buch ersteigert. Voller Stolz präsentieren Sie es Ihren Freunden. Zur Feier des Tages möchten Sie mit ihnen auf diesen Erfolg anstoßen. Sie nehmen eine Flasche Sekt und öffnen sie vorsichtig. Der Korken schießt heraus und der Sekt beginnt, zu schäumen. Einiges an Schaum durchnässt das neue Buch."*

10. *"Sie wollen Ihre Wohnung verlassen, um spazieren zu gehen. Sie öffnen die Wohnungstür und treffen Ihren Nachbarn, woraufhin ein Gespräch entsteht. Nachdem Ihr Nachbar sich von Ihnen verabschiedet, schließen Sie die Tür und wollen hinausgehen, als Sie feststellen, dass Sie Ihre Schlüssel im Flur auf der Kommode haben liegen lassen."*

Fear

1. *"Sie haben bereits seit einigen Tagen Zahnschmerzen und entscheiden sich, einen Zahnarzt aufzusuchen. Nachdem der Arzt Ihre Zähne untersucht hat, erklärt er, dass aufgrund einer fortgeschrittenen Entzündung dringend eine Wurzelbehandlung nötig sei. Diese werde ca. zwei Stunden dauern und sei häufig mit Schmerzen verbunden, da man durch den Zahn bis zur Wurzel bohren müsse."*

2. *"Sie gehen nachts alleine von einer Feier nach Hause. Da Sie sich zum ersten Mal in diesem Stadtteil befinden, verlaufen Sie sich. Auf der Suche nach einem Weg nach Hause durchqueren Sie einen dunklen Park in einer abgelegenen Gegend. Als Sie einige Meter gehen, sehen Sie eine Gruppe alkoholisierter junger Männer auf Sie zukommen."*

3. *"Sie haben sich beim Kochen tief in den Finger geschnitten. Im Krankenhaus warten Sie, nachdem der Krankenpfleger schon einen Blick auf ihren Finger geworfen hat, auf einen Arzt. Sie hören, wie der Krankenpfleger dem Arzt die Situation schildert und dass dieser etwas von einer Amputation murmelt."*

4. *"Sie fahren alleine mit dem Fahrstuhl in den sechsten Stock eines Hochhauses. Auf einmal hören Sie einen lauten Knall und stellen fest, dass der Fahrstuhl zwischen den Stockwerken stehen geblieben ist. Daraufhin flackert das Licht kurz und geht schließlich aus. Sie befinden sich in vollkommener Dunkelheit als Sie einen ohrenbetäubenden Alarm hören."*

5. *"Sie machen einen Spaziergang durch einen belebten Park. Auf Ihrem Weg sehen Sie eine Bulldogge und ihren Besitzer beim Spielen. Als Sie an den beiden vorbeilaufen, rennt die Dogge plötzlich auf Sie zu. Sie bleibt vor Ihnen stehen, bellt und fletscht die Zähne. Auf die Zurufe des Herrchens scheint sie nicht zu reagieren."*

6. *"Sie schwimmen in einem Badesee. Als Sie schon einen beträchtlichen Weg zurückgelegt haben und ungefähr in der Mitte des Sees angekommen sind, erfasst Sie an den Beinen eine Wasserpflanze und hindert sie daran, sich zu bewegen. Je stärker Sie strampeln, desto höher wird der Widerstand."*

7. *"Sie befinden sich in einem Flugzeug auf einem Langstreckenflug. Nach einigen Stunden spüren Sie plötzlich starke Turbulenzen und Sauerstoffmasken fallen aus den*

Klappen der Kabinendecke. Das Kabinenlicht beginnt zu flackern und das Flugzeug begibt sich in einen Sturzflug. Es ertönt eine Durchsage: "Eines unserer Triebwerke ist ausgefallen. Wir müssen notlanden!"”

8. *“Sie sind in einem Freizeitpark und haben sich entschlossen, eine neue Achterbahn zu fahren. Nachdem Sie kurze Zeit anstehen, steigen Sie in den Wagen ein und fahren los. Als die Bahn langsam den höchsten Punkt der Steigung erreicht, bemerken Sie, dass der Sicherungsbügel nicht richtig befestigt wurde und sich zunehmend lockert.”*

9. *“Sie sind in einer Bank und wollen Geld abheben. Hierfür stehen Sie in der Schlange vor dem Geldautomaten an. Kurz bevor Sie an der Reihe sind, stürmen zwei maskierte und bewaffnete Männer in die Bank. Sie feuern einen Warnschuss, gehen zum Schalter und bedrohen die Bankangestellte mit einer Pistole.”*

10. *“Sie fliegen in den Urlaub und kommen nach mehrstündigem Flug am Flughafen an. Um zu Ihrem Hotel zu gelangen, nehmen Sie vom Flughafen aus ein Taxi. Sie fahren eine Weile bis Sie merken, dass der Taxifahrer in einer abgelegenen Gegend hält. Nachdem Sie halten, kommen drei kräftige Männer auf Sie zu.”*

Appendix II

Validation study 1:

To ensure sufficient emotional intensity and specificity of the scripts, an independent sample of 90 students (67 female; age: M = 23.57, SD = 3.97) rated their emotional reactions to 90 scripts. Specifically, participants read the scripts and selected among eleven emotions (including self-anger, other-anger, and fear) the one that would best describe their emotional reactions. Subsequently, participants indicated the intensity of all eleven emotions on 7-point scales ranging from 1 = *not at all* to 7 = *very intense*. For the main experiment, we selected those scripts that participants associated most frequently with the target emotions (mean percentage across scripts for self-anger: M = 74.3%, other-anger: M = 79.1%, and fear: M = 81.4%) and indicated the highest intensities (intensity ratings across scripts for self-anger: M = 6.18, SD = 1.29, other-anger: M = 6.31, SD = 1.14, and fear: M = 6.17, SD = 1.45).

Validation study 2:

We conducted a second validation step to determine adequate duration of the phases by instructing another independent sample of 24 students (13 female, age: M = 25.2, SD = 4.6) to work on 15 reappraisal-trials with an extended presentation (25 s) and ideation phase (180 s). Participants indicated the duration of imagining the situations via button click, yielding mean imagination durations of M = 12.47 s, SD = 2.45 s. Concerning the duration of the ideation phase, we found that 84% of all reappraisals were generated during the first 60 s. Regarding these results, we shortened the duration of the presentation and ideation phase in the main experiment to 20 s and 60 s, respectively.

Appendix III

Auswertungskategorien – Ärger auf sich selbst

HANDLUNGSMÖGLICHKEITEN: eine Handlung gedanklich planen, in Erwägung ziehen oder initiieren
01 Schadensbegrenzung (*Handlung planen, um Schaden einzugrenzen, rückgängig zu machen oder zu kompensieren*)
02 Hilfe einfordern (*andere aktiv um Unterstützung bitten*)
SCHADEN UMBEWERTEN: Bedeutung des Schadens relativieren oder bagatellisieren
03 Worst-Case-Vergleich (*Das Ereignis im direkten Vergleich zu einem anderen, schlimmeren Ereignis weniger negativ bewerten*)
04 Externe Hilfe erwarten (*Unterstützung durch andere, z.B. Mitmenschen, Institutionen, Entitäten, erwarten, aber nicht aktiv einfordern*)
05 Bagatellisieren (*Bedeutung oder Ausmaß des Schadens als gering bewerten*)
06 Optimismus (*pos. Ausgang der Situation erwarten, ohne eigenes Handeln oder externe Hilfe zu erwähnen*)
07 Ressourcen betonen (*vorhandene Ressourcen betonen, durch die die Bedeutung des Schadens verringert wird*)
08 Selbstwirksamkeit (*sich zureden, die Situation bewältigen zu können, ohne spez. Handlungsplan; vorhandene Fähigkeiten betonen*)
PROFITIEREN: Vorteile/Nutzen hervorheben, die ohne das Eintreten der Situation nicht entstanden wären
09 Nachteil als Vorteil interpretieren (*In der Situation einen Vorteil sehen*)
10 Lernerfahrung betonen (*Sich vornehmen, beim nächsten Mal etwas anders zu machen, um zukünftigen Schaden zu vermeiden*)
FOKUS AUF EMOTION: Emotion und deren Konsequenzen kritisch reflektieren, alternative Emotion betonen
11 Konsequenzen einer Emotion betonen (*Neg. Konsequenzen der neg. Emotion/ bzw. pos. Konsequenzen einer alternativen Emotion betonen*)
12 Selbstverbalisation (*Neg. Emotion weg- bzw. alternative Emotion herbeireden*)
URSACHENZUSCHREIBUNG: Alternative Erklärung für eigenes Verhalten/Schaden generieren
13 Sich selbst entschuldigen (*Ereignis zumindest teilweise auf externale Faktoren attribuieren; betonen, dass es auch anderen passiert*)
14 Akzeptanz (*Ereignis wird als unausweichlich akzeptiert*)
FOKUS AUF POSITIVES: Betonen von positiven Elementen, die weder direkt mit dem Schaden noch mit der Ursache verbunden sind
15 Pos. Aspekte der Situation betonen (*Aspekte betonen, die trotz des Schadens positiv sind*)
16 Belohnung antizipieren (*Für das Durchstehen der Situation von sich, anderen oder äußeren Umständen belohnt werden*)
17 Sonstiges (*eine korrekte Antwort, die in keine der anderen Kategorien eingeordnet werden kann*)

Auswertungskategorien – Ärger auf andere

HANDLUNGSMÖGLICHKEITEN: eine Handlung gedanklich planen, in Erwägung ziehen oder initiieren
01 Schadensbegrenzung (*Handlung planen, um selbst Schaden einzugrenzen, rückgängig zu machen oder zu kompensieren*)
02 Hilfe einfordern (*andere aktiv um Unterstützung bitten*)
03 Klärung planen (*direkte Klärung mit Übeltäter planen*)
SCHADEN UMBEWERTEN: Bedeutung des Schadens oder des Übeltäters relativieren oder bagatellisieren
04 Worst-Case-Vergleich (*Das Ereignis im direkten Vergleich zu einem anderen, schlimmeren Ereignis weniger negativ bewerten*)
05 Externe Hilfe erwarten (*Unterstützung/Entschädigung durch andere erwarten, aber nicht aktiv einfordern*)
06 Bagatellisieren (*Bedeutung oder Ausmaß des Schadens als gering bewerten*)
07 Optimismus (*pos. Ausgang der Situation erwarten, ohne eigenes Handeln oder externe Hilfe zu erwähnen*)
08 Distanzierung vom Übeltäter (*Bedeutung des Übeltäters abwerten, z.B. dahingehend, dass die Person den Ärger nicht Wert ist*)
09 Ressourcen betonen (*vorhandene Ressourcen betonen, durch die die Bedeutung des Schadens verringert wird*)
10 Selbstwirksamkeit (*sich zureden, die Situation bewältigen zu können, ohne spez. Handlungsplan; vorhandene Fähigkeiten betonen*)
PROFITIEREN: Vorteile/Nutzen hervorheben, die ohne das Eintreten der Situation nicht entstanden wären
11 Nachteil als Vorteil interpretieren (*In der Situation einen Vorteil sehen*)
12 Lernerfahrung betonen (*Sich vornehmen, beim nächsten Mal etwas anders zu machen, um künftigen Schaden zu vermeiden*)
13 Altruismus (*in der Situation einen Vorteil für den Übeltäter sehen*)
FOKUS AUF EMOTION: Emotion und deren Konsequenzen kritisch reflektieren, alternative Emotion betonen
14 Konsequenzen einer Emotion betonen (*Neg. Konsequenzen der neg. Emotion bzw. pos. Konsequenzen einer alternativen Emotion betonen*)
15 Selbstverbalisation (*Neg. Emotion weg- bzw. alternative Emotion herbeireden*)
URSACHENZUSCHREIBUNG: Erklärung für Ereignis/Verhalten des Übeltäters generieren oder suchen
16 Erklärung für Verhalten des Übeltäters generieren (*eine Ursache benennen oder suchen, die die Absicht zu schaden relativiert*)
17 Verständnis mit dem Übeltäter (*Eingestehen, dass man sich in einer ähnlichen Situation ähnlich verhalten hätte; Verständnis äußern*)
18 Akzeptanz (*Ereignis wird als unausweichlich akzeptiert*)
19 Normalisieren (*Ereignis/Verhalten des Übeltäters wird als gewöhnlich/häufig bewertet*)
20 Schuldzuweisung (*eigene Unschuld, Schuld des Übeltäters betonen, aber auch eigenen Schuldanteil einräumen*)
FOKUS AUF POSITIVES: Betonen von positiven Elementen, die weder direkt mit dem Schaden noch mit der Ursache verbunden sind
21 Pos. Aspekte der Situation betonen (*Aspekte betonen, die trotz des Schadens positiv sind*)
KONSEQUENZEN FÜR DEN ÜBELTÄTER: Konsequenzen, die sich für den Übeltäter ergeben betonen oder erwarten
22 Neg. Konsequenzen für den Übeltäter betonen (*entstandene oder zukünftige neg. Folgen für den Übeltäter betonen; nicht aktiv herbeiführen*)
23 Sonstiges (*eine korrekte Antwort, die in keine der anderen Kategorien eingeordnet werden kann*)

Auswertungskategorien – Angst

HANDLUNGSMÖGLICHKEITEN: eine Handlung gedanklich planen, in Erwägung ziehen oder initiieren
01 Bedrohung minimieren (*Handlung planen, um bedrohlichen Reiz zu kontrollieren, zu reduzieren oder zu beseitigen*)
02 Hilfe einfordern (*andere aktiv um Unterstützung bitten*)
BEDROHUNG UMBEWERTEN: Bedeutung der Bedrohung relativieren oder bagatellisieren
03 Worst-Case-Vergleich (*Das Ereignis im direkten Vergleich zu einem anderen, schlimmeren Ereignis weniger negativ bewerten*)
04 Externe Hilfe erwarten (*Unterstützung durch andere, z.B. Mitmenschen, Institutionen, Entitäten, erwarten, aber nicht aktiv einfordern*)
05 Bagatellisieren (*Bedeutung oder Ausmaß der Bedrohung als gering bewerten*)
06 Optimismus (*pos. Ausgang der Situation erwarten, ohne eigenes Handeln oder externe Hilfe zu erwähnen*)
07 Ressourcen betonen (*vorhandene Ressourcen betonen, durch die die Bedeutung der Bedrohung verringert wird*)
08 Selbstwirksamkeit (*sich zureden, die Situation bewältigen zu können, ohne spez. Handlungsplan; vorhandene Fähigkeiten betonen*)
PROFITIEREN: Vorteile/Nutzen hervorheben, die ohne das Eintreten der Situation nicht entstanden wären
09 Nachteil als Vorteil interpretieren (*In der Situation einen Vorteil sehen*)
10 Lernerfahrung betonen (*Sich vornehmen, beim nächsten Mal etwas anders zu machen, um zukünftige Bedrohungssituationen zu vermeiden*)
FOKUS AUF EMOTION: Emotion und deren Konsequenzen kritisch reflektieren, alternative Emotion betonen
11 Konsequenzen einer Emotion betonen (*Neg. Konsequenzen der neg. Emotion/des Handlungsimpulses bzw. pos. Konsequenzen einer alternativen Emotion betonen*)
12 Selbstverbalisation (*Neg. Emotion weg- bzw. alternative Emotion herbeireden*)
URSACHENZUSCHREIBUNG: Alternative Erklärung für eigenes Verhalten/Schaden generieren oder suchen
13 Erklärung für Bedrohung generieren (*Eine andere, weniger bedrohliche Ursache für das Ereignis generieren*)
14 Akzeptanz (*Ereignis wird als unausweichlich akzeptiert*)
15 Normalisieren (*Ereignis wird als gewöhnlich/häufig bewertet*)
FOKUS AUF POSITIVES: Betonen von positiven Elementen, die nicht direkt mit der Bedrohung verbunden sind
16 Pos. Aspekte der Situation betonen (*Aspekte betonen, die trotz der Bedrohung positiv sind*)
17 Belohnung antizipieren (*Für das Durchstehen der Situation von sich, anderen oder äußeren Umständen belohnt werden*)
18 Sonstiges (*eine korrekte Antwort, die in keine der anderen Kategorien eingeordnet werden kann*)

Appendix IV

Table A.1a

Summary of Simple Regression Analyses for SRT-fluency and Covariates Predicting RE-valence and RE-arousal.

	RE-valence					RE-arousal				
Variable	*B*	*SE B*	*β*	*t*	*p*	*B*	*SE B*	*β*	*t*	*p*
Constant	1.17*	0.45		2.59	.011	1.09*	0.50		2.19	.030
SRT-fluency	0.00	0.01	.03	0.23	.818	-0.01	0.01	-.09	-0.73	.468
SRT-negatives	0.00	0.01	.07	0.56	.576	0.01	0.01	.16	1.32	.190
PANAS-positive	-0.19	0.11	-.16	-1.78	.078	-0.09	0.12	-.07	-0.77	.445
PANAS-negative	-0.10	0.13	-.07	-0.73	.466	-0.25	0.15	-.15	-1.73	.086
R^2			.03					.04		
F			1.08		.371			1.31		.268

Note. $N = 129$. *$p < .05$. SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness; PANAS = Positive and Negative Affect Schedule.

Table A.1b

Summary of Simple Regression Analyses for SRT-flexibility and Covariates Predicting RE-valence and RE-arousal.

	RE-valence					RE-arousal				
Variable	*B*	*SE B*	*β*	*t*	*p*	*B*	*SE B*	*β*	*t*	*p*
Constant	1.23*	0.46		2.68	.008	1.17*	0.50		2.34	.021
SRT-flexibility	0.00	0.01	-.02	-0.18	.859	-0.02	0.01	-.14	-1.16	.249
SRT-negatives	0.01	0.01	.11	0.86	.390	0.01	0.01	.20	1.62	.108
PANAS-positive	-0.19	0.11	-.16	-1.80	.074	-0.09	0.12	-.07	-0.79	.433
PANAS-negative	-0.10	0.13	-.07	-0.72	.471	-0.25	0.15	-.15	-1.70	.091
R^2			.03					.05		
F			1.07		.371			1.52		.199

Note. $N = 129$. *$p < .05$. SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness; PANAS = Positive and Negative Affect Schedule.

Appendix V

Follow-up study:

To investigate whether pre-emptive emotion regulation during the presentation phases of the SRT accounted for the independence between reappraisal inventiveness and effectiveness in the main experiment, an independent sample of 72 students (48 female; age: $M = 22.25$, $SD = 3.74$) worked on a modified version of the SRT. Specifically, we instructed participants before the script presentation of each trial to reappraise or react naturally. Additionally, we implemented randomised blocks of three consecutive trials of the same type (reappraise or control). Apart from these modifications, the procedure of the SRT coincided with the methodology of the main experiment. In accordance with the statistical analysis of the main study, we conducted a multivariate regression with RE-valence and RE-arousal as dependent variables. SRT-fluency, SRT-negatives, and both PANAS scores were included as covariates. Using Pillai's trace, the analysis indicted a non-significant regression equation ($V = 0.12$, $F(8, 134) = 1.05$, $p = .40$) with neither SRT-fluency nor any of the covariates significantly predicting reappraisal effectiveness scores (all ps > .10). The coefficients of the univariate regression models are shown in Table A.2. As the follow-up study yielded a pattern of results similar to the main study, pre-emptive reappraisal generation during the presentation phases of the SRT is unlikely to explain the absence of reappraisal inventiveness effects on reappraisal effectiveness.

Table A.2

Summary of Simple Regression Analyses for Variables Predicting RE-valence and RE-arousal in follow-up study.

	RE-valence					RE-arousal				
Variable	*B*	*SE B*	*β*	*t*	*p*	*B*	*SE B*	*β*	*t*	*p*
Constant	-0.34	0.66		-0.52	.606	0.64	0.91		0.71	.482
SRT-fluency	-0.01	0.01	-.08	-0.50	.622	0.01	0.02	.05	0.30	.767
SRT-negatives	0.01	0.01	.24	1.60	.116	0.01	0.01	.19	1.26	.213
PANAS-positive	0.14	0.16	.12	0.91	.369	-0.08	0.21	-.05	-0.39	.700
PANAS-negative	0.15	0.19	.10	0.80	.424	-0.09	0.26	-.04	-0.34	.733
R^2			.05					.05		
F			0.91		.463			0.91		.466

Note. *N* = 72. SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness; PANAS = Positive and Negative Affect Schedule.

3

It's worth the trouble

Stressor exposure is related to increased cognitive reappraisal ability

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Zeier, P., Meine, L. E., & Wessa, M. (submitted). It's worth the trouble – Stressor exposure is related to increased cognitive reappraisal ability. *Stress and Health.*

3.1 Summary of study #2

Objectives: Research on human resilience revealed individuals with a history of moderate stressor exposure to report higher life satisfaction and well-being than individuals with no stressor exposure. However, the mechanisms underlying this relationship remain unclear. In line with recent theoretical considerations, we propose moderate stressor exposure to promote emotion regulation capacities. More precisely, we expect an inverted U-shaped relationship between exposure to daily hassles and performance in a cognitive reappraisal task, i.e., best reappraisal ability in individuals with a history of moderate (compared to low or high) stressor exposure.

Methods: Participants (N = 165) reported the number of daily hassles during the last week as indicator of stressor exposure and completed the Script-based Reappraisal Test (SRT). In the SRT, participants are presented with fear-eliciting scripts and instructed to either downregulate negative affect via reappraisal (reappraisal-trials) or react naturally (control-trials). Two measures indicate cognitive reappraisal ability: (1) reappraisal effectiveness, i.e., the difference between affective ratings in reappraisal- and control-trials and (2) reappraisal inventiveness, i.e., the number of categorically different reappraisal thoughts.

Results: Multiple regression analyses with stressor exposure as predictor of reappraisal effectiveness and reappraisal inventiveness revealed significant regression models: exposure to daily hassles showed positive linear, but not quadratic, relationships to both indicators of cognitive reappraisal ability.

Discussion: Our findings emphasize the potential of exposure to daily hassles to strengthen resilience mechanisms such as emotion regulation.

Keywords: stressor exposure; emotion regulation; cognitive reappraisal; resilience; daily hassles

3.2 Introduction

While excessive exposure to psychological stressors can be highly toxic for mental health, recent research suggests that the dose makes the poison. More precisely, the relationship between stressor exposure and resilience, i.e., the dynamic capacity to maintain or regain mental health in the face of adversity (Kalisch et al., 2017), has been described as an inverted U-shaped function (for an overview, see Seery & Quinton, 2016). Accordingly, a moderate exposure to lifetime adversity, in contrast to no and high exposure, was found to be related to higher life satisfaction, fewer stress-related symptoms (Seery et al., 2010), and increased pain endurance in an experimental stress test (Seery et al., 2013). Additionally, moderate stressor exposure in childhood has been shown to protect adults from developing depressive symptoms in reaction to current stressful events (Shapero et al., 2015). As stressor frequency and intensity further increase, the detrimental effects of stressor exposure on mental health however predominate, e.g., by increasing depression (Hammen, 2005).

How does moderate stressor exposure increase resilience? Numerous resilience theories (Crane et al., 2019; Kalisch et al., 2015; Seery & Quinton, 2016) suggest that resilience is not a stable attribute of an individual, rather resilience outcomes (e.g., life satisfaction, mental health) are influenced by resilience mechanisms. In addition to biological resilience mechanisms, previous research (Rutter, 2012) proposed that experiencing some stressful events would provide more opportunities to acquire coping strategies. More precisely, the Systematic Self-Reflection Model (Crane et al., 2019) implies that individuals learn from stressful events by applying self-reflective practices, e.g., self-awareness, the identification of situational triggers, and cognitive reappraisal, i.e., the regulation of emotions via reinterpretation of a situation (Gross & John, 2003). Similarly, cognitive reappraisal constitutes an integral resilience mechanism in the Positive Appraisal Style Theory of Resilience (Kalisch et al., 2015).

The prominence of cognitive reappraisal as a mechanism in resilience theories is hardly surprising, given its beneficial effects on mental health. For instance, individuals who frequently apply cognitive reappraisal report increased levels of interpersonal functioning and well-being (Gross & John, 2003). The use of reappraisal in response to daily stressors is also associated with increased positive and decreased negative affect (Troy et al., 2019). Similarly, coping via positive reappraisal in response to traumatic events was found to contribute to posttraumatic growth (Prati & Pietrantoni, 2009).

Resilience theories further suggest an inverted U-shaped relationship between stressor exposure and resilience mechanisms (e.g., cognitive reappraisal) similar to the effects of

stressor exposure on resilience outcomes (cf. Hypothesis 1 in Crane et al., 2019; Seery & Quinton, 2016). Accordingly, moderate prior stressor exposure in contrast to no stressor exposure would enhance the ability to reappraise current stressful situations as individuals had various opportunities to reflect and practice cognitive reappraisal. On the other hand, high levels of stressor exposure would rather lead to stress sensitization by depleting an individual's cognitive resources (Hammen, 2005). As a consequence, individuals might establish other emotion regulation strategies, e.g., distraction (Murphy & Young, 2018) or react with more dysfunctional cognitive processes, e.g., worry and rumination (Brosschot, Gerin, & Thayer, 2006).

However, previous research mainly revealed detrimental effects of chronic stressor exposure on cognitive reappraisal ability. For example, in a neuroimaging study (Kim et al., 2013), adults who experienced childhood poverty showed difficulties to decrease amygdala activation during an experimental reappraisal task. Similarly, women who were exposed to sexual trauma were less successful at deliberately downregulating affective responses to negative pictures than non-traumatized control subjects (New et al., 2009). To our knowledge, only one study (Schweizer et al., 2016) explicitly investigated enhancing effects of stressor exposure on cognitive reappraisal. Adolescents completed a questionnaire on childhood adversities and subsequently worked on a cognitive reappraisal test in the fMRI scanner. Results indicated that individuals with moderate exposure to childhood adversity were most effective at downregulating negative affect towards aversive film footage.

We argue that most of the previous studies did not find enhancing effects of stressor exposure on cognitive reappraisal due to a focus on extreme groups (e.g., traumatized vs. non-traumatized) or linear detrimental effects only. Based on the promising results provided by Schweizer and colleagues (2016), we propose that the investigation of potential resilience strengthening effects would require various degrees of stressor exposure and the inclusion of non-linear analyses. Furthermore, dynamic resilience theories (Crane et al., 2019; Seery & Quinton, 2016) suggest that the improvement of emotion regulation strategies would not be limited to childhood but also occur as a reaction to more recent mundane stress experiences, often referred to as daily hassles (Kanner, Coyne, Schaefer, & Lazarus, 1981). Consequently, we expect moderate exposure to daily hassles, compared to minimal exposure, to enhance cognitive reappraisal ability by offering more opportunities to practice. High levels of daily hassles, on the other hand, have been associated with the development of psychopathological symptoms (Asselmann, Wittchen, Lieb, & Beesdo-Baum, 2017) and therefore seem to overwhelm reappraisal capacities.

As a further extension of previous research, this study includes two measures of reappraisal ability: reappraisal *effectiveness* and reappraisal *inventiveness*. Reappraisal effectiveness, also referred to as reappraisal success (e.g., Ochsner et al., 2004), is mostly operationalized as the difference between affective responses after individuals either reappraise or passively perceive emotional stimuli. Reappraisal inventiveness, on the other hand, is defined as the ability to create multiple and categorically different reappraisal thoughts (Weber et al., 2014). While both, reappraisal effectiveness and inventiveness, have been associated with benefits for mental health (McRae, Jacobs, et al., 2012; Perchtold et al., 2019), each construct seems to independently contribute to the reappraisal process (Zeier, Sandner, & Wessa, 2019). This study includes both measures of reappraisal ability, thereby providing information on process-specific (reappraisal inventiveness) and outcome-specific (reappraisal effectiveness) effects of stressor exposure. We expect a similar enhancing effect of moderate exposure to daily hassles on both reappraisal measures, as increased practice opportunities would likely lead to a more versatile creation and implementation of reappraisal thoughts.

3.3 Method

3.3.1 Participants

Participants were recruited via flyers and letters in Mainz, Germany. We conducted telephone screenings with all prospective participants to assess and exclude individuals with acute or chronic disease as well as current or anamnestic mental disorders. Additionally, only individuals with German as first language were included. A total of 166 participants aged 18-30 completed the study. One participant had to be excluded from all analyses due to missing values in all questionnaires, yielding a final sample of 165 participants (51% female; age: $M = 24.8$, $SD = 3.3$).

3.3.2 Measures

Exposure to daily hassles

Participants completed the Mainz Inventory of Microstressors (MIMIS; Chmitorz et al., 2020) to indicate exposure to daily hassles. The MIMIS contains a list of 58 daily hassles (e.g., noisy environment, traffic jam, caretaking). For each stressor, participants are asked to retrospectively rate the frequency ("On how many days during the last week did the situation occur?") on an eight-point Likert scale (0-7 days) and severity ("To what extent did you find

the situation stressful?") on a five-point Likert scale (0 = "not at all stressful", 4 = "extremely stressful"). As stressor severity ratings are likely confounded with emotion regulation ability, we limited our analyses to the stressor frequency scale of the MIMIS. The sum of all 58 ratings served as indicator of total stressor exposure. In a validation study (Chmitorz et al., 2020), the frequency scale of the MIMIS was highly correlated with daily hassle counts measured via ecological momentary assessment (EMA; $r = 83$), indicating high external validity.

Reappraisal inventiveness and effectiveness

A shortened version of the Script-based Reappraisal Test (SRT; Zeier et al., 2019) was used to experimentally assess individual reappraisal inventiveness and reappraisal effectiveness (RE) scores. At the beginning of each trial of the SRT, participants are presented with a script describing a fear-eliciting situation for 20 seconds (for an overview of all scripts, see Appendix I). After participants imagine themselves being in the situation, they proceed to an ideation phase lasting 45 seconds. In this phase, participants are instructed to either "think about the situation in a less negative way" (reappraisal-trials) or to "react naturally without active emotion regulation" (control-trials). Concurrently, participants click on a button on the center of the screen with each novel thought. In a next step, participants indicate affective valence and arousal states on a nine-point scale (1 to 9) of the Self-Assessment Manikins (SAM; Bradley & Lang, 1994), with high scores indicating negative affect and high levels of arousal. Finally, participants type in all thoughts that occurred during the ideation phase in a recording phase lasting 90 seconds.

In this study, the SRT included five reappraisal- and five control-trials presented in randomized order. Two practice trials preceded the main experiment. To check whether participants forgot reappraisal ideas within a trial, we correlated the number of button clicks during the ideation phases with the number of entries during the recording phase. Similar to our recent study (Zeier et al., 2019), a high correlation ($r(163) = .87$, $p < .001$) indicated only minimal memory effects.

Reappraisal inventiveness in the SRT is assessed via two measures: SRT-fluency, i.e., the total number of reappraisal thoughts, and SRT-flexibility, i.e., the total number of categorically different reappraisal thoughts in the reappraisal-trials. Two graduate students independently applied the categorical rating system established in our previous study to obtain reappraisal inventiveness scores from the participants' reappraisal ideas. Inter-rater reliability was high for both, SRT-fluency ($ICC = .99$) and SRT-flexibility ($ICC = .95$). RE-scores were calculated by subtracting the mean SAM-scores in the reappraisal-trials from the mean

SAM-scores in the control-trials for valence and arousal, respectively. Thus, high RE-scores denote less negative affect (*RE-valence*) and less arousal (*RE-arousal*) in reappraisal-trials compared with control-trials.

Covariates

As depressive symptoms have been shown to impair reappraisal (Greening, Osuch, Williamson, & Mitchell, 2014), we decided to control for variance of depressiveness in all analyses. Therefore, participants completed the German version of the Center for Epidemiologic Studies Depression Scale (ADS-L; Hautzinger, Bailer, Hofmeister, & Keller, 2012). For the ADS-L, participants are asked to rate 20 items based on how often they experienced depressive symptoms during the preceding seven days on 4-point Likert scales (0 = "rarely", 3 = "most of the time"), yielding sum scores of 0 to 60. Additionally, participants rated the degree of immersion during the SRT ("How well could you imagine yourself being in the situations?") on a 5-point Likert scale (1 = "very badly", 5 = "very well") after completing the experiment. The degree of immersion is also included as covariate in all regression analyses to ensure that variances in SRT measures are not merely a product of differences in the motivation or ability to imagine affective situations.

3.3.3 Procedure

This study was part of a bigger project within the Collaborative Research Centre 1193 "Neurobiology of resilience". Upon arrival, participants provided written informed consent and worked on a working memory and cognitive flexibility task for approximately 60 minutes, which are not in the scope of the present study. Subsequently, participants completed the SRT in approximately 30 minutes. Finally, participants filled in a battery of questionnaires, including the MIMIS and ADS-L, for approximately 60 minutes. All questionnaires and the SRT were presented on computers with 24-inch monitors. After complete participation in the project, which also included a second day of testing, participants received 50 Euro as reimbursement.

3.4 Results

3.4.1 Preliminary Analyses

All Analyses were conducted with SPSS version 27. Similar to our previous study (Zeier et al., 2019), SRT-fluency and SRT-flexibility were highly correlated ($r(163) = .89$, $p < .001$). To avoid redundancy, we only included SRT-flexibility in our main analyses (for results with SRT-fluency as dependent variable, see Appendix VI). Descriptive statistics and correlations of the main variables are presented in Table 3.1. As manipulation check regarding the instructions of the SRT, we conducted within-subjects t-tests for the affective ratings in both types of trials. Significantly less negative affect in reappraisal- ($M = 5.07$, $SD = 1.48$) compared to control-trials ($M = 5.55$, $SD = 1.48$), $t(164) = -6.09$, $p < .001$, $d = -.48$, 95% CI [-0.64, -0.32] and significantly less arousal in reappraisal- ($M = 4.54$, $SD = 1.82$) compared to control-trials ($M = 4.86$, $SD = 1.79$), $t(164) = -3.45$, $p = .001$, $d = -.28$, 95% CI [-0.49, -0.13], indicated overall effective emotion regulation.

Table 3.1

Mean, Standard Deviation, Range, and Inter-Correlations of Main Variables.

	Correlation coefficients (*r*)					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
(9) Stressor frequency (MIMIS)	1					
(10) Depressivity (ADS-L)	.12	1				
(11) Degree of immersion	.08	.03	1			
(12) SRT-flexibility	.21**	.01	.11	1		
(13) RE-valence	.13	-.23**	-.03	.03	1	
(14) RE-arousal	.16*	-.08	-.20*	.17*	.70**	1
	Descriptive Statistics					
M	78.79	9.11	3.50	13.28	0.48	0.31
SD	26.90	5.54	0.78	3.64	1.01	1.16
Min	16	0.00	1.00	5.00	-2.40	-3.40
Max	160	29.00	5.00	23.00	4.00	4.40

Note. $N = 165$. *$p < .05$. **$p < .01$. MIMIS = Mainz Inventory of Microstressors; SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness; ADS-L = Allgemeine Depressionsskala - Langform.

3.4.2 Regression Analyses

Next, we conducted stepwise regression analyses with only covariates (degree of immersion, depressiveness) at step 1 and covariates and stressor exposure at step 2 as predictors of SRT-flexibility, RE-valence, and RE-arousal to test for linear relationships (see Table 3.2). The inclusion of stressor exposure at step 2 contributed to a significant change in the explained variance of SRT-flexibility (R^2 change = .040, $p < .01$), RE-valence (R^2 change = .028, $p < .05$), and RE-arousal (R^2 change = .033, $p < .05$). To test for the proposed U-shaped relationships, we included the quadratic term of stressor exposure at step 3. Adding quadratic stressor exposure did not lead to a significant change in the explained variance of all three reappraisal variables, suggesting linear rather than quadratic relationships. A visual inspection of the scatter plots (see Appendix VII) further supported the results of the regression analyses, with linear effects of stressor exposure on all reappraisal ability measures.

Table 3.2a

Summary of Stepwise Regression Models Predicting SRT-flexibility with only Covariates at Step 1, including Stressor Exposure at Step 2, and Quadratic Stressor Exposure at Step 3.

		Step 1			Step 2			Step 3		
Outcome variable	Predictor variables	*ß*	*t*	*p*	*ß*	*t*	*p*	*ß*	*t*	*p*
SRT-flexibility	Depressivity	.01	0.13	.899	-.01	-0.18	.856	-.01	-0.15	.881
	Degree of immersion	.11	1.44	.151	.10	1.27	.205	.09	1.20	.233
	Stressor exposure	—	—	—	**.20**	**2.63**	**.009**	-.10	-0.30	.764
	Quadratic stressor exposure	—	—	—	—	—	—	.31	0.92	.357
	R^2		.013			**.053**			**.058**	
	F		1.05	.351		**3.03**	**.031**		**2.49**	**.046**

Note. N = 165. Significant effects ($p < .05$) highlighted in bold. Degrees of Freedom: df = 2, 162 (Step 1); df = 3, 161 (Step 2); df = 4, 160 (Step 3). SRT = Script-based Reappraisal Test.

Table 3.2b

Summary of Stepwise Regression Models Predicting RE-valence and RE-arousal with only Covariates at Step 1, including Stressor Exposure at Step 2, and Quadratic Stressor Exposure at Step 3.

		Step 1			Step 2			Step 3		
Outcome variable	Predictor variables	ß	*t*	*p*	ß	*t*	*p*	ß	*t*	*p*
RE-valence	Depressivity	**-.23**	**-3.06**	**.003**	**-.25**	**-3.33**	**.001**	**-.26**	**-3.35**	**.001**
	Degree of immersion	-.02	-0.27	.790	-.03	-0.43	.669	-.03	-0.37	.714
	Stressor exposure	—	—	—	**.17**	**2.19**	**.030**	.42	1.24	.217
	Quadratic stressor exposure	—	—	—	—	—	—	-.26	-0.76	.448
	R^2		**.055**			**.083**			**.086**	
	F		**4.74**	**.010**		**4.84**	**.003**		**3.76**	**.006**
RE-arousal	Depressivity	-.08	-1.01	.313	-.10	-1.30	.194	-.10	-1.31	.191
	Degree of immersion	**-.20**	**-2.57**	**.011**	**-.21**	**-2.77**	**.006**	**-.21**	**-2.72**	**.007**
	Stressor exposure	—	—	—	**.18**	**2.40**	**.018**	.32	0.95	.343
	Quadratic stressor exposure	—	—	—	—	—	—	-.14	-0.42	.676
	R^2		**.046**			**.079**			**.080**	
	F		**3.88**	**.023**		**4.58**	**.004**		**3.46**	**.010**

Note. N = 165. Significant effects ($p < .05$) highlighted in bold. Degrees of Freedom: df = 2, 162 (Step 1); df = 3, 161 (Step 2); df = 4, 160 (Step 3). SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness.

3.5 Discussion

This study aimed at identifying an inverted U-shaped relationship between stressor exposure and emotion regulation. We expand previous research by focusing on exposure to daily hassles and including process- and outcome-related indicators of reappraisal ability, i.e., reappraisal inventiveness and reappraisal effectiveness. Results revealed a linear, but not quadratic, relationship: increased levels of recent stressor exposure were significantly associated with better reappraisal ability. Furthermore, these findings could not be attributed to interindividual differences in depressiveness nor the degree of immersion during the reappraisal task.

Our findings partially fit the assumptions of previous resilience research (Crane et al., 2019; Seery & Quinton, 2016), indicating that exposure to stressors can strengthen important resilience mechanisms, e.g., reappraisal ability. When confronted with daily hassles, individuals might have more opportunities to practice cognitive reappraisal, thereby leading to a more extensive repertoire of reappraisal thoughts and more effective downregulation of negative affect. Successful regulation of negative emotion in turn enables increased self-efficacy (Goldin et al., 2012), which might account for early findings on daily hassles that revealed individuals to report better mood on days following a stressful day than on other days (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982). To support the causal inference of stressor exposure leading to training effects of cognitive reappraisal, future studies should assess daily hassles as well as the respective emotion regulation strategies applied via EMA.

Our results did not suggest a drop in reappraisal performance at high levels of stressor exposure. The sample characteristics might help explain the linear increase in reappraisal ability, as only healthy individuals who are less likely to encounter high levels of stressor exposure than individuals who suffer from mental disorders (Asselmann et al., 2017) took part in the current investigation. To reveal a potential downward progression of the inverted U-shaped function, future studies might investigate a more heterogeneous sample regarding stressor exposure. Furthermore, specific types of daily hassles (e.g., interpersonal tensions) have been found to be more detrimental for mental health than others (Almeida, 2005). Similarly, certain stressor properties might have different effects on reappraisal ability, with some stressors enabling individuals to practice cognitive reappraisal and others providing little opportunity for improvement. Although we assessed multiple types of stressors in this study, the sample size was not sufficient for such detailed analyses.

While the causal inferences regarding the main variables is limited by the cross-sectional design of this study, it seems less plausible that increased reappraisal ability would lead to more frequent daily hassles. However, individuals with high reappraisal ability were shown to have a better memory for stressful events due to more active coping (Mikolajczak, Roy, Verstrynge, & Luminet, 2009). Although the frequency scale of the MIMIS was highly correlated with daily hassles counts measured via EMA in previous studies (Chmitorz et al., 2020), a systematic recall bias for daily hassles in individuals with high reappraisal ability is possible. Connecting reappraisal ability to daily hassles measured via EMA in future studies would prevent potential retrospective effects.

In summary, stressor exposure might have a beneficial effect on resilience outcomes by strengthening resilience mechanisms such as reappraisal ability. An important next step would be to further uncover moderating person- and stressor-specific characteristics that either enable or impede the improvement of reappraisal ability during and after stressor exposure. A better understanding of the differential effects of daily hassles on emotion regulation capacities seems especially important for psychological intervention such as the Stress Inoculation Training (Meichenbaum & Deffenbacher, 1988). Thus, daily hassles can be turned into daily practice opportunities, in which individuals can learn how to regulate negative emotions more effectively. It seems like stressor exposure does not have to be toxic after all.

Conflict of interest statement

The authors declare no conflict of interest.

Funding details

The current study received funding from the German Research Foundation (Deutsche Forschungsgemeinschaft) as part of the CRC1193 on the “Neurobiology of resilience” (Project C07).

Data Availability Statement

The data that support the findings of this study are openly available in Open Science Framework at https://doi.org/10.17605/OSF.IO/UJVNH.

3.6 Appendices

Appendix VI

Table A.3

Summary of Stepwise Regression Models Predicting SRT-fluency with only Covariates at Step 1, including Stressor Exposure at Step 2, and Quadratic Stressor Exposure at Step 3.

		Step 1			Step 2			Step 3		
utcome variable	Predictor variables	ß	*t*	*p*	ß	*t*	*p*	ß	*t*	*p*
SRT-fluency	Depressivity	-.05	-0.60	.552	-.07	-0.88	.383	-.07	-0.84	.401
	Degree of immersion	.15	1.09	.059	.14	1.75	.081	.13	1.67	.097
	Stressor exposure	—	—	—	.18	2.34	.021	-.15	-0.43	.671
	Quadratic stressor exposure	—	—	—	—	—	—	.33	0.98	.327
	R^2		.024			**.056**			**.061**	
	F		1.96	.144		**3.16**	**.026**		**2.61**	**.037**

Note. $N = 165$. Significant effects ($p < .05$) highlighted in bold. Degrees of Freedom: df = 2, 162 (Step 1); df = 3, 161 (Step 2); df = 4, 160 (Step 3). SRT = Script-based Reappraisal Test.

Appendix VII

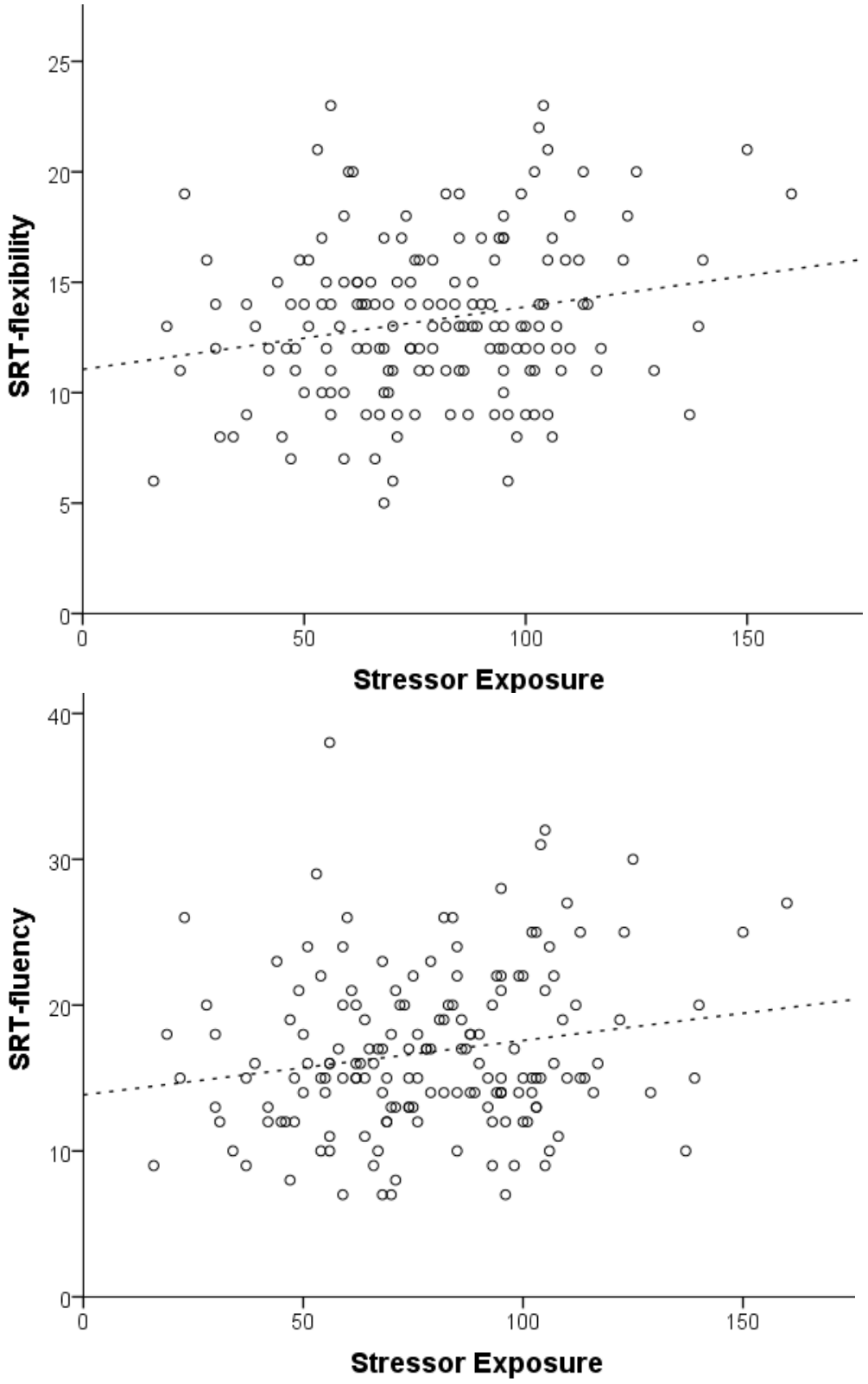

Figure A.1a. Relations Between Stressor Exposure Measured via Frequency Scale of the Mainz Inventory of Microstressors and Reappraisal Flexibility (above) as well as Reappraisal Fluency (below) in the Script-based Reappraisal Test (SRT). For SRT-flexibility: $r(163) = .21$, $p < .01$; for SRT-fluency: $r(163) = .18$, $p < .05$.

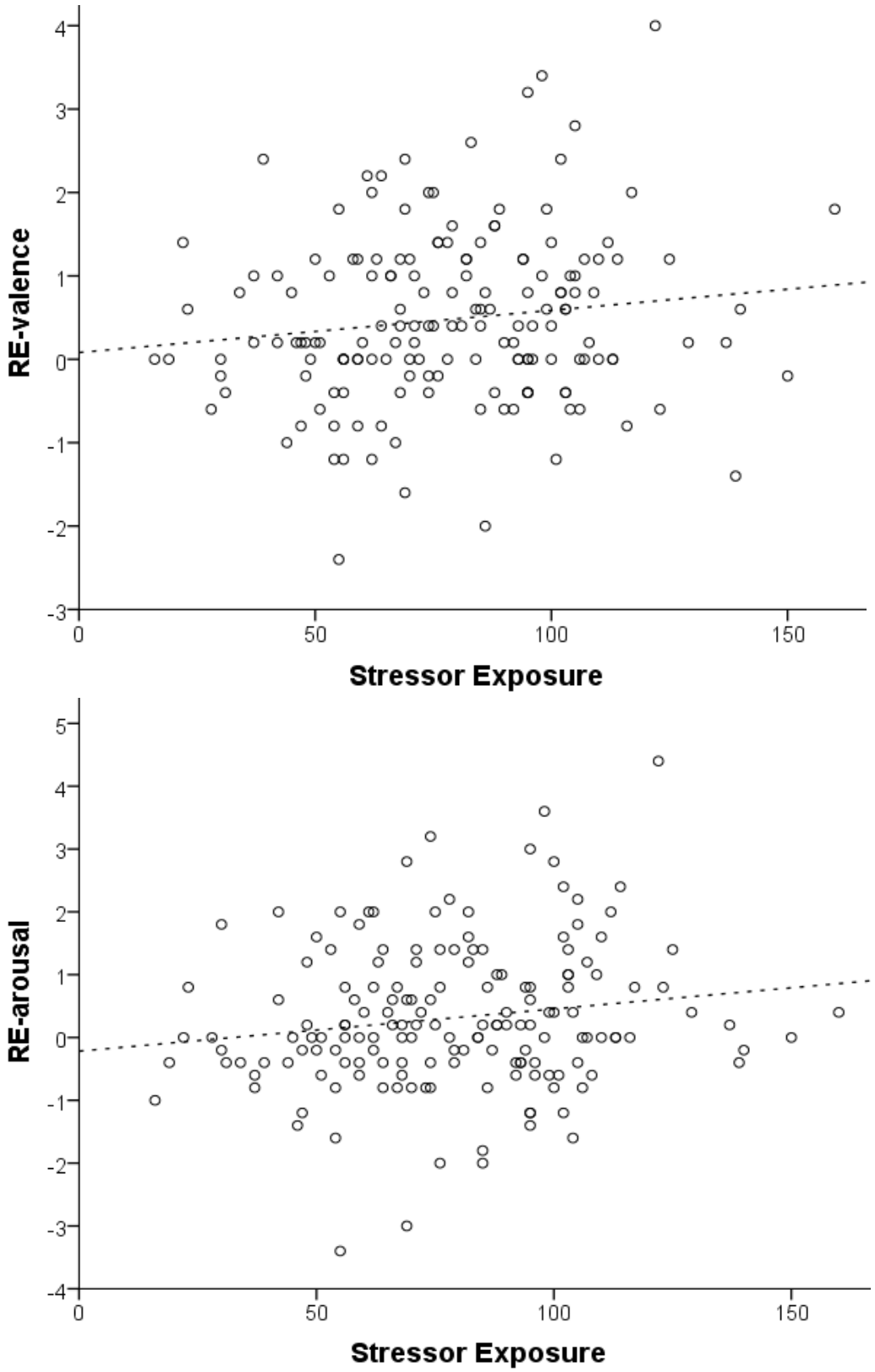

Figure A.1b. Relations Between Stressor Exposure Measured via Frequency Scale of the Mainz Inventory of Microstressors and Reappraisal Effectiveness (RE) on a Valence Level (above) as well as on an Arousal Level (below) in the Script-based Reappraisal Test (SRT). For RE-valence: $r(163) = .13$, $p = .08$; for RE-arousal: $r(163) = .16$, $p < .05$.

4

Regulating emotions with experience

The effectiveness of reappraisal variability depends on situational familiarity

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Zeier, P., Sandner, M., & Wessa, M. (submitted). Regulating emotions with experience – The effectiveness of reappraisal variability depends on situational familiarity. *Affective Science*.

4.1 Summary of study #3

Objectives: Previous research identified cognitive reappraisal as an adaptive emotion regulation strategy. However, theories on emotion regulation flexibility suggest that effective cognitive reappraisal may depend on an individual's experience with emotional situations. In this study, we expect individuals with low situational familiarity to profit from high reappraisal variability, i.e., the spontaneous generation of categorically different reappraisals. Individuals with high situational familiarity, however, would be more effective with low reappraisal variability.

Methods: A total of 148 participants completed the Script-based Reappraisal Test (SRT), in which they were presented with situations in textual form eliciting anger and fear. Depending on trial type, participants were instructed to apply cognitive reappraisal (reappraisal-trial) or to react naturally to the situations (control-trial). After each trial, participants indicated their affective state and typed in their reappraisal and negative thoughts. We analyzed the variability of the reappraisal thoughts and assessed reappraisal effectiveness (RE) scores by calculating the difference between affective ratings in reappraisal- and control-trials for valence and arousal. Finally, participants rated the familiarity with each situation.

Results: Multiple regression analyses with reappraisal variability, situational familiarity, and the interaction term as predictors of RE scores revealed a significant model for RE-valence (not RE-arousal) with only the interaction term significantly explaining variance in RE-valence. The moderation was rather driven by a detrimental effect of reappraisal variability for individuals with high situational familiarity rather than an enhancing effect for individuals with low situational familiarity.

Discussion: Our results underline the importance of considering individual experience with emotional content in the research of cognitive reappraisal.

Keywords: emotion regulation; cognitive reappraisal; reappraisal variability; situational familiarity

4.2 Introduction

The interpretation of an event significantly dictates if and to what extent an individual experiences emotions (Smith & Lazarus, 1990). Therefore, it is hardly surprising that cognitive reappraisal – i.e., reinterpreting a situation to alter its emotional impact – is considered one of the most effective emotion regulation strategies (Gross & Thompson, 2007; Webb et al., 2012). Individuals who frequently apply cognitive reappraisal report increased levels of interpersonal functioning and well-being (Gross & John, 2003). Similarly, the use of reappraisal in response to daily stressors is associated with increased positive and decreased negative affect (Troy et al., 2019).

However, another body of literature (for an overview, see Bonanno & Burton, 2013) highlighted the non-uniform effectiveness of emotion regulation strategies such as cognitive reappraisal. Rather, effective emotion regulation would depend on emotion regulation flexibility, i.e., choosing a strategy that meets the contextual demands (Aldao et al., 2015; McRae & Gross, 2020). For example, the effectiveness of cognitive reappraisal was found to depend on the *controllability* of stressful situations (Troy et al., 2013): while cognitive reappraisal ability was associated with lower levels of depression for participants with uncontrollable stress, a positive relationship between cognitive reappraisal ability and levels of depression emerged for participants faced with controllable stress. A similar moderation pattern was observed concerning *socioeconomic status*, with cognitive reappraisal ability being positively related to mental health only for people from lower socioeconomic status (Troy et al., 2017).

In addition to the flexibility between emotion regulation strategies, the variability within a specific strategy has been associated with differences in emotion regulation effectiveness. Regarding cognitive reappraisal, for example, a reinterpretation of the emotional response, proved less effective for downregulating negative affect in contrast to reappraising the emotional stimulus and perspective taking (Webb et al., 2012). Additionally, reappraising pictures via reality challenge proved to be less effective than other reappraisal tactics in upregulating positive affect (McRae, Ciesielski, et al., 2012).

To further elaborate on individual differences in the execution of cognitive reappraisal, Weber, de Assunção, Martin, Westmeyer, and Geisler (2014) introduced the construct of reappraisal inventiveness defined as the ability to create multiple (reappraisal fluency) and categorically different (reappraisal flexibility) reappraisal thoughts. Reappraisal inventiveness is assessed as maximum performance in the Reappraisal Inventiveness Test (RIT), in which

participants are instructed to react to negative situations by generating as many different reappraisals as possible in three minutes. High reappraisal inventiveness has been linked to less symptoms of depression in men (Perchtold et al., 2019). Also, individuals with high reappraisal inventiveness showed more left-lateralized activity in the prefrontal cortex during the RIT, (Papousek et al., 2017), which in turn predicted less chronic stress in women (Perchtold et al., 2018).

We followed up on these interesting findings by introducing the Script-based Reappraisal Test (SRT; Zeier et al., 2019), an experimental task that assesses an individual's reappraisal ideas and reappraisal effectiveness as a reaction to textual descriptions of anger- and fear-eliciting situations presented in multiple trials. In our validation study of the SRT, we applied a similar instruction as the RIT by asking participants to "generate as many different reappraisal thoughts as possible". However, a more inventive reappraisal generation did not predict effective emotion regulation in the SRT. In our view, these results do not contradict previous research on reappraisal inventiveness. Rather, we propose that while individuals profit from being able to generate a maximum of categorically different reappraisal thoughts (reappraisal inventiveness), doing so may not be adaptive for every individual in every context. This notion is in line with theories on emotion regulation flexibility, i.e., the deployment of different emotion regulation strategies depending on context (Aldao et al., 2015). Accordingly, a variable use of emotion regulation strategies irrespective of contextual demands would not necessarily increase emotion regulation effectiveness.

To enable the investigation of variable reappraisal generation with respect to context, we propose a distinction between reappraisal *inventiveness* and reappraisal *variability* (based on the terminology by Aldao et al., 2015). In line with psychometric conventions (Cronbach, 1970), we define reappraisal variability as the *typical* generation of categorically different reappraisal ideas in emotion-eliciting situations, while reappraisal inventiveness captures *maximum* performance. In other words, reappraisal variability does not reflect an individual's general ability to generate reappraisal thoughts but instead indicates an individual's intuitive reappraisal generation in a given situation. Consequently, the investigation of reappraisal variability can help to assess the effectiveness of spontaneous reappraisal generation with regards to contextual factors, for example emotion regulation habits or personality.

The assumption of differential effects of reappraisal variability is based on the implementation-maintenance model (Kalisch, 2009), describing the temporal dynamics of cognitive reappraisal. Accordingly, a reappraisal thought is generated and implemented in an early stage and maintained by shielding the positive reinterpretation from intruding negative

interpretations in later stages. This model was supported by a significant shift of activation in the lateral frontal cortex from left-posterior (associated with reappraisal generation; Papousek et al., 2017) to right-anterior areas (associated with inhibition; Aron, Robbins, & Poldrack, 2014) during the course of reappraisal. On the one hand, reappraisal variability would likely contribute to the implementation stage, by increasing the likelihood to find a suitable reappraisal thought. On the other hand, an overly extensive generation of various reappraisal ideas would delay the maintenance stage leading to less inhibition of negative thoughts. For example, an overly inventive reappraisal strategy may hamper reappraisal effectiveness by introducing unrealistic and ineffective reinterpretations in some situations. Effective reappraisal would consequently require a certain degree of reappraisal variability that grants helpful reappraisal thoughts without being too distracting. Therefore, reappraisal experts are likely to adapt the generation of reappraisal ideas to the contextual demands.

In this study, we argue that the optimal degree of reappraisal variability for effective reappraisal depends on an individual's prior experience with emotional stimuli. Specifically, we expect individuals who are rather familiar with the situations presented in this study to benefit from low reappraisal variability, as suitable reappraisal thoughts can be more easily retrieved from memory. High reappraisal variability in those individuals would instead lead to the aforementioned distracting effect and a decrease of reappraisal effectiveness. However, individuals who are unfamiliar with the situations would not be able to rely on memory retrieval. These individuals are hypothesized to benefit from high reappraisal variability by increasing the probability to find effective reappraisal thoughts in the first place.

4.3 Method

4.3.1 Participants and Procedure

The study included a sample of 148 students (65% females; age: $M = 21.9$, $SD = 3.5$). Groups of 20 to 25 participants were simultaneously tested. The SRT (Zeier et al., 2019) and PANAS were presented on computers with 24-inch monitors. Upon arrival, participants provided written informed consent and completed the German version of the Positive and Negative Affect Schedule (PANAS; Krohne et al., 1996; Watson et al., 1988) to assess pre-experimental positive and negative affect. Subsequently, participants worked on the SRT and situational familiarity ratings for a total duration of approximately 65 to 70 minutes. After study completion, participants received 13.50 Euro as reimbursement for study participation.

4.3.2 Measures

Reappraisal variability and effectiveness

The SRT was adapted to assess reappraisal variability and reappraisal effectiveness (RE) scores. Each trial of the SRT starts with the presentation of a script describing a fear- or anger-eliciting situation (see Appendix I) for 20 seconds. After participants immerse themselves into the situation, they proceed to an ideation phase lasting one minute. Depending on trial, participants are instructed either "to think about the situation in a less negative way" (reappraisal-trials) or "to react naturally without active emotion regulation" (control-trials). At the end of each trial, participants indicate affective valence and arousal states on a nine-point scale of the Self-Assessment Manikins (SAM; Bradley & Lang, 1994) and finally type in all thoughts they generated during the ideation phase in a recording phase (90 seconds).

The adapted SRT included 12 reappraisal- and 12 control-trials presented in randomized blocks of three trials of the same type. Participants worked on two practice trials before starting with the main experiment. In contrast to our previous study (Zeier et al., 2019), we did not instruct participants to generate as many reappraisal thoughts as possible in reappraisal-trials but rather to intuitively generate reappraisal thoughts to decrease negative emotions. This adaption was applied to measure reappraisal variability rather than reappraisal inventiveness. Consequently, reappraisal variability in the SRT was defined as the total number of spontaneously generated and categorically different reappraisal thoughts in the reappraisal-trials. Three graduate students independently rated the participants' reappraisal ideas in accordance with the categorical rating system of the SRT to determine reappraisal variability scores. Inter-rater reliability for reappraisal variability was *ICC* = .91. For RE- scores, we subtracted the mean SAM-scores in the reappraisal-trials from the mean SAM-scores in the control-trials for valence and arousal, respectively. Accordingly, high RE-scores describe less negative affect (*RE-valence*) and less arousal (*RE-arousal*) in reappraisal-trials compared with control-trials.

Situational familiarity and control variables

After completing the SRT, participants were again presented with all scripts of the reappraisal-trials and asked to rate the familiarity with each situation ("How often have you encountered a similar situation?") on 7-point Likert scales (1 = "never" to 7 = "very often"). For situational familiarity scores, we calculated means across all familiarity ratings. Additionally, we assessed the degree of immersion by asking participants how well they were able to imagine themselves being in the situations on a 5-point Likert scale (1 = "very badly"

to 5 = “very well”). We included the degree of immersion as a covariate in all analyses to control for differences in the ability or motivation to engage with the presented scripts. Likewise, we calculated the total number of negative thoughts from the control-trials of the SRT (*SRT-negatives*) to be included as covariate in all analyses. SRT-negatives would likely be associated with the SAM-ratings in the control-trials and therefore influence RE-scores.

4.4 Results

4.4.1 Preliminary Analyses

Descriptive statistics and correlations of the main variables are presented in Table 4.1. Regarding the scripts, participants reported a high degree of immersion (M = 3.70, SD = 0.83) and a rather low familiarity with the situations (M = 2.28, SD = 0.64). Overall, reappraisal variability was not significantly related to RE-valence ($r(146) = .15$, $p = .08$) and weakly related to RE-arousal ($r(146) = .23$, $p < .05$). Furthermore, within-subjects t-tests revealed significantly less negative affect in reappraisal- (M = 5.49, SD = 1.38) compared to control-trials (M = 6.06, SD = 1.43), $t(147) = -8.22$, $p < .001$, $d = .69$, 95% CI [-0.70, -0.43]. Likewise, participants indicated significantly less arousal in reappraisal- (M = 4.54, SD = 1.75) compared to control-trials (M = 5.49, SD = 1.96), $t(147) = -10.87$, $p < .001$, $d = .96$, 95% CI [-1.12, -0.77], suggesting successful emotion regulation on both affect parameters of the SRT. Neither positive nor negative pre-experimental affect indicated by PANAS-scores was significantly related to RE-valence and RE-arousal (positive: $r(146) = .05$, $r(146) = -.01$; negative: $r(146) = .08$, $r(146) < .01$, all ps > .10).

Table 4.1

Mean, Standard Deviation, Range, and Inter-Correlations of Main Variables.

	Correlation coefficients (r)					
Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Reappraisal variability	1					
(2) Situational familiarity	.08	1				
(3) SRT-negatives	.56**	-.02	1			
(4) Degree of immersion	.28*	.35**	.31**	1		
(5) RE-valence	.15	-.02	.26*	.20*	1	
(6) RE-arousal	.23*	-.07	.28*	.21*	.71**	1
	Descriptive Statistics					
M	29.72	2.28	41.68	3.70	0.57	0.95
SD	8.84	0.64	16.37	0.83	0.84	1.06
Min	5	1.08	5	1	-2.08	-1.00
Max	52	4.75	91	5	3.25	4.58

Note. $N = 148$. *$p < .05$. **$p < .01$. SRT = Script-based Reappraisal Test; RE = Reappraisal effectiveness.

4.4.2 Regression Analysis

To test whether situational familiarity would moderate the relationship between reappraisal variability and RE-scores, we conducted two regression analyses using the PROCESS v.3.2 macro for SPSS (Model 1; Hayes, 2013). We used bootstrap analyses with 5,000 samples and included reappraisal variability as independent variable, SRT-negatives and degree of immersion as covariates, and RE-scores for valance and arousal as separate dependent variables. Situational familiarity was centered at the mean to avoid overestimation (Robinson & Schumacker, 2009) and added as moderator variable.

As shown in Table 4.2, the interaction between reappraisal variability and situational familiarity significantly accounted for approximately 3% (R^2 change = .03, $p < .05$) of the explained variance in RE-valence. We further explored the nature of the moderation using simple slope analyses with conditioning values at one SD above and below the mean (Figure 4.1). Reappraisal variability was not significantly related to RE-valence when situational familiarity was below mean (-1 *SD*: $B = .01$, $p = .287$, 95% CI [-.01, .03]). With

situational familiarity at one standard deviation above mean, a negative relationship between reappraisal variability and RE-valence emerged (+1 *SD*: *B* = -.02, *p* = .093, 95% CI [-.05, <.01]). The Johnson-Neyman technique further revealed that the negative relationship between reappraisal variability and RE-valence was significant when mean situational familiarity ratings were above 3.42 but not significant with lower values of situational familiarity. In other words, reappraisal variability had a detrimental effect on RE-valence when the situations were rated as rather familiar. The second moderation analysis (Table 4.2) indicated that the interaction between reappraisal variability and situational familiarity did not significantly explain variance in RE-arousal (R^2 change < .01, *p* = .345).

Table 4.2

Summary of Regression Analyses for Reappraisal Variability, Situational Familiarity, the Interaction Term, and Covariates Predicting RE-valence and RE-arousal.

	RE-valence					RE-arousal				
Variable	*B*	*SE B*	95% *CI*	*t*	*p*	*B*	*SE B*	95% *CI*	*t*	*p*
Constant	-.53	.36	[-1.24, 0.18]	-1.47	.144	-.36	.45	[-1.57, 0.20]	-0.80	.427
Reappraisal variability	-.01	.01	[-0.02, 0.01]	-0.56	.577	-.01	.01	[-0.01, 0.03]	0.92	.357
Situational familiarity	-.06	.11	[-0.28, 0.17]	-0.50	.617	-.21	.14	[-0.76, 1.21]	-1.48	.139
SRT-negatives	**.01**	**.01**	**[< 0.01, 0.02]**	**2.32**	**.022**	.01	.01	[< 0.01, 0.02]	1.65	.100
Degree of immersion	.17	.09	[-0.01, 0.35]	1.85	.067	**.24**	**.15**	**[0.01, 0.46]**	**2.08**	**.039**
Reappraisal variability × situational familiarity	**-.03**	**.01**	**[-0.05, -0.01]**	**-2.18**	**.031**	-.01	.02	[-0.05, 0.01]	-0.95	.345
R^2				**.12**					**.12**	
F				**3.79**	**.003**				**3.96**	**.002**
ΔR^2				**.03**					< .01	
F				**4.73**	**.031**				0.90	.345

Note. Situational familiarity was great mean centered. *N* = 148. CI = confidence interval for B. SRT = Script-based Reappraisal Test; RE = reappraisal effectiveness.

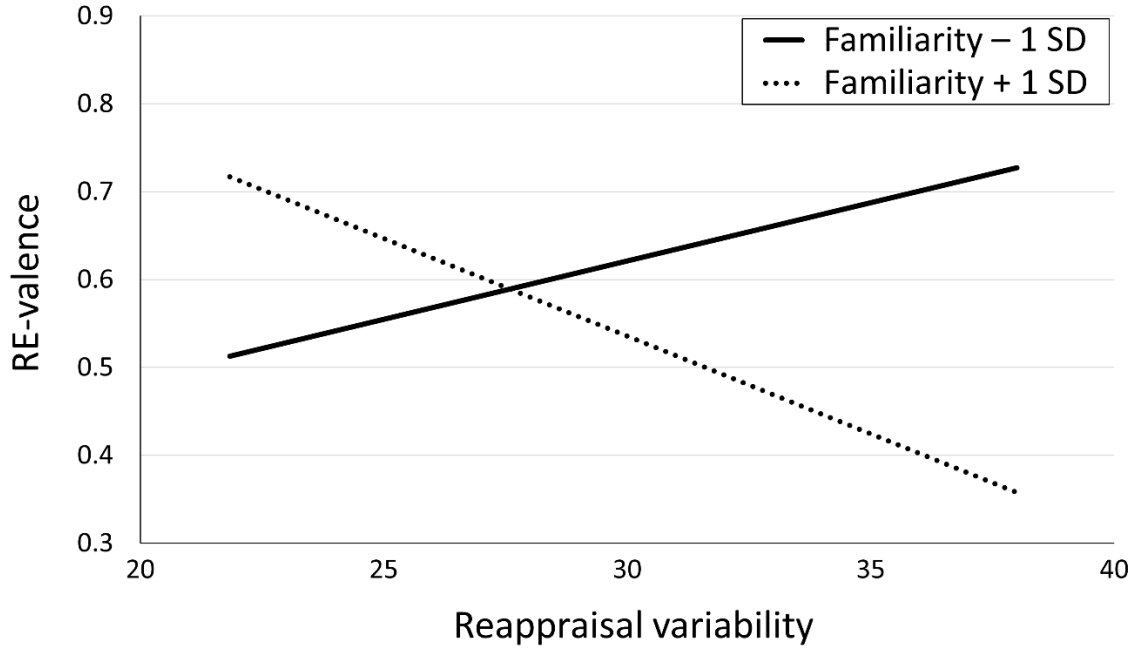

Figure 4.1. Conditional Effects of Situational Familiarity on the Relationship Between Reappraisal Variability and Reappraisal Effectiveness on a Valence Level (RE-valence). *Note.* Conditional Effects of Situational Familiarity at One Standard Deviation Above (+ 1SD) and Below (- 1SD) Mean. RE = Reappraisal Effectiveness.

4.5 Discussion

The goal of this study was to investigate whether the relationship between reappraisal variability and reappraisal effectiveness was moderated by situational familiarity. In line with the implementation-maintenance model of cognitive reappraisal (Kalisch, 2009), we hypothesized that generating many categorically different reappraisal thoughts would be rather distracting and less effective for individuals with high situational familiarity. Individuals with low situational familiarity, however, would be more effective with high reappraisal variability, as they increase the probability of generating a helpful reappraisal thought.

The results of this study partly supported our hypothesis, as the interaction between reappraisal variability and situational familiarity significantly predicted reappraisal effectiveness. However, the moderation was mainly driven by a detrimental effect of reappraisal variability when situations were rated as familiar. These participants may have been distracted by an overly variable reappraisal strategy, as they were more likely to invite ineffective reinterpretations or negative thoughts due to less inhibition. This finding can be integrated into theoretical models of emotion regulation flexibility (Bonanno & Burton, 2013) that suggest three sequential components necessary for effective emotion regulation: first, evaluating

situational demands (*context sensitivity*), second, selecting an emotion regulation strategy (*repertoire*), and third, monitoring the effectiveness of the chosen strategy (*feedback*). For example, a repertoire of various emotion regulation strategies would not contribute to emotion regulation effectiveness, if inappropriate strategies are chosen due to missing context sensitivity (Kobylinska & Kusev, 2019). Likewise, our results indicate that individuals who generate various reappraisal thoughts without considering contextual demands, such as familiarity, experience less effective cognitive reappraisal. This finding also fits with theories on creativity (e.g., Cropley, 2006) suggesting that divergent thinking without corrective would lead to ineffective novelty.

Contrary to our hypothesis, high reappraisal variability did not improve reappraisal effectiveness for individuals with low situational familiarity. This finding encourages a reconsideration of the temporal dynamics in cognitive reappraisal. Although individuals with high reappraisal variability would be more likely to find a suitable reappraisal thought, they would still experience the trade-off between spending resources on the generation process while focusing less on maintenance and inhibition processes (Kalisch, 2009) in the SRT. Consequently, the benefits of initially high reappraisal variability may only be observed after individuals repeatedly encounter similar situations and are then able to implement a suitable reappraisal thought more successfully. To test this hypothesis, future research may apply an adapted version of the SRT, in which participants create reappraisal thoughts for unfamiliar situations in a first step and select and implement the most helpful reinterpretation in a second step.

Interestingly, the interaction between reappraisal variability and situational familiarity did only significantly predict RE-valence but not RE-arousal scores. The literature on the effects of cognitive reappraisal on the downregulation of distinct affective components is ambiguous. In an early experimental study (Gross, 1998), cognitive reappraisal of an aversive film clip decreased the subjective experience of disgust but not sympathetic activation. On the other hand, habitual reappraisal was found to be negatively related to the arousal but not the valence aspect of everyday negative affect (Kuppens, Oravecz, & Tuerlinckx, 2010; Meyer, Smeets, Giesbrecht, & Merckelbach, 2012). In the current study, participants reported significantly lower scores of arousal as well as valence in reappraisal- compared with control-trials. However, only the degree of immersion significantly predicted individual differences in RE-arousal. In other words, the arousal aspect of affect in the SRT may be more prone to differences in an individual's ability or motivation to engage with the scripts rather than different reappraisal styles or personal experience.

The findings of this study are limited by the overall low ratings of situational familiarity in the SRT. While the data indicated variance of the situational familiarity ratings, the scripts did not cover the entire range of familiarity. In order to rectify this in future studies, we suggest the inclusion and experimental manipulation of scripts based on participants' prior reports of recurring microstressors (e.g., assessed via MIMIS; Chmitorz et al., 2020). An adapted design would also help to examine how much the current emotional situation would have to resemble past events to enable a transfer of established reappraisal thoughts.

By investigating the heterogeneity in the execution of cognitive reappraisal with regards to an individual's experience, this study contributes to a growing body of literature emphasizing a more personalized and context sensitive research of emotion regulation strategies (Aldao, 2013; Dore et al., 2016; Kobylinska & Kusev, 2019). Pursuing this differentiated perspective on cognitive reappraisal offers the opportunity to tailor psychological interventions and inform individuals on how to find and maintain helpful reinterpretations of negative situations.

Conflict of interest statement

The authors declare no conflict of interest.

Funding details

The current study received funding from the German Research Foundation (Deutsche Forschungsgemeinschaft) as part of the CRC1193 on the "Neurobiology of resilience" (Project C05).

Data Availability Statement

The data that support the findings of this study are openly available in Open Science Framework at http://doi.org/10.17605/OSF.IO/T5YGH.

5

General Discussion

5.1 Summary and synthesis of findings

This dissertation is dedicated to the details of ER in the light of contextual factors. Specifically, three studies were conducted to unravel individual differences in the execution of CR and their relations to stressful experiences. To that end, in study #1, I introduced and validated the SRT in a sample of 143 participants. Although the SRT reliably assessed reappraisal inventiveness and effectiveness scores, both measures were not significantly related. In accordance with resilience theories, study #2 expanded the focus by investigating the predictive value of an individual's exposure to daily hassles for the variance in reappraisal ability. Multiple regression analyses indicated a linear positive relationship between self-reported exposure to daily hassles and SRT scores. Finally, in study #3, I suggested a distinction between reappraisal inventiveness, the stable ability, and reappraisal variability, the intuitive response of generating various reappraisal thoughts. The results impressively demonstrated the value of this conceptual specification, as high reappraisal variability was associated with indeed less reappraisal effectiveness for individuals with high situational familiarity. Altogether, the three studies emphasized the complexity and non-uniformity in the execution and effectiveness of single ER strategies depending on context.

5.1.1 Associations between concepts of cognitive reappraisal

The present findings tie in with past research on CR by providing information on two already established concepts, i.e., reappraisal effectiveness (Ochsner et al., 2004) and reappraisal inventiveness (Weber et al., 2014), as well as their interrelation. Interestingly, in studies #1 and #2 high reappraisal inventiveness did not significantly predict more effective CR. This finding seems especially surprising, as recent research considered high reappraisal inventiveness adaptive due to associations with more distal mental health outcomes (Perchtold et al., 2019; see section 1.2.3). So why did the generation of multiple categorically different reappraisal thoughts not translate into higher reappraisal effectiveness in the SRT?

At least two theoretical considerations may explain these seemingly contradictive findings. First, as outlined in section 1.2.4, reappraisal inventiveness may be a necessary but not sufficient condition for effective CR. Instead, individuals would rather need to be able to adapt the inventiveness of the reappraisal generation to the contextual demands of a certain situation (Bonanno & Burton, 2013). However, the instructions of the SRT in studies #1 and #2 (and RIT; Weber et al., 2014) do not permit context sensitive reappraisal generation, as

participants are asked to generate as many reappraisal thoughts as possible. In study #3, an adapted version of the SRT was conducted to enable participants to freely generate a certain number of reappraisal thoughts as required. As expected, and in line with studies #1 and #2, the generation of various reappraisal thoughts did not have a positive main effect on reappraisal effectiveness. On the contrary, high reappraisal variability even impaired the reappraisal process in individuals with high situational familiarity. This finding hints at the importance of context sensitivity, as some participants may have been unable to perceive and incorporate the contextual information (i.e., situational familiarity) into their execution of CR. Future studies should include a more direct assessment of context sensitivity to follow up on this hypothesis. For example, in an experimental design, context sensitivity could be manipulated so that in one group (high context sensitivity) participants are instructed to pay attention to a presumably relevant context information, e.g., situational familiarity, before starting the reappraisal process while a control group does not receive these assisting instructions (low context sensitivity). In a next step, such a design would enable a comparison between both groups regarding reappraisal variability and effectiveness.

A second explanation for the non-significant main effect of reappraisal inventiveness on reappraisal effectiveness arises from the assumption of linear relationships between both variables. On the one hand, a linear increase of reappraisal effectiveness due to higher reappraisal inventiveness seems plausible, as individuals generate a larger repertoire of reappraisal thoughts to draw from. In addition, the serial order effect in creativity research suggests that ideas that occur in the later stages of the generation process tend to be most creative (Beaty & Silvia, 2012; Christensen, Guilford, & Wilson, 1957). Individuals who stop the process of reappraisal generation early would consequently be limited to more common reappraisal ideas. On the other hand, it remains unclear whether more creative and uncommon reappraisal thoughts are perceived as either helpful for the ER goal at hand or rather become more unrealistic and distracting. According to the shielding-shifting dilemma (Dreisbach & Frober, 2019; Kalisch, 2009; Pruessner et al., 2020; see section 1.2.4), such ideas would impair maintenance processes by unnecessarily depleting cognitive resources that are needed to fend off negative thoughts. Consequently, most effective CR may result from generating some but not too many reappraisal ideas. This hypothesis could be tested by investigating possible quadratic relationships between reappraisal inventiveness and reappraisal effectiveness. However, scatter plots in all three studies did not suggest non-linear associations (see Appendix VIII). As reliable investigations of polynomial regressions require large

numbers of observations (Peddada & Haseman, 2005), longer trial durations in the SRT may be necessary to rule out non-linear relationships.

Interestingly, the results of study #3 indicated that a variable generation of reappraisal thoughts did not even improve reappraisal effectiveness for individuals who were rather unfamiliar with the situations in the SRT. In line with the shielding-shifting dilemma, this finding may imply a trade-off between variable reappraisal generation and inhibition processes, which both are expected to contribute to effective CR. To better understand the sub processes of CR, future studies should apply CR tasks, in which the generation and implementation stages are more clearly separated. Although high reappraisal inventiveness did not immediately enhance reappraisal effectiveness, such an effect may be delayed and only observable through further confrontations with similar situations. Specifically, individuals who generate various reappraisal thoughts on initial contact with an emotional stimulus would be more likely to have found an effective reappraisal thought and therefore better prepared for future encounters with a similar stimulus. To test this hypothesis, participants could be repeatedly confronted with similar situations, for example in an adapted version of the SRT. Such a design would enable analyses of individual improvement rates of reappraisal effectiveness in relation to differences in initial reappraisal inventiveness.

5.1.2 Associations between stressor exposure and cognitive reappraisal

In study #2, I hypothesized that CR abilities would improve through more experience with emotional situations. In line with resilience theories (Crane et al., 2019; Kalisch et al., 2015; Seery & Quinton, 2016), the results indicated improved reappraisal inventiveness and reappraisal effectiveness for individuals with high exposure to daily stressors. These findings may reflect a practice effect due to increased experience with emotional stimuli. However, the self-reflection model of resilience strengthening (Crane et al., 2019) proposes that an improvement of ER strategies due to stressor exposure would only occur under three conditions.

First, individuals require *resilient beliefs*, defined as "(...) beliefs about how successful one will be when interacting with the world, one's capacity to change themselves in positive ways, and one's confidence to do so (...)" (Crane et al., 2019, p. 10). Following this definition, resilient beliefs also include concepts of ER self-efficacy, i.e., the confidence in one's ability to change emotional states (Tamir, John, Srivastava, & Gross, 2007). ER self-efficacy is based on the belief that emotions are malleable, which in turn was found to relate to higher well-being,

less depressive symptoms, and better social adjustment (Tamir et al., 2007). It seems plausible that stressor exposure would not increase CR abilities in individuals who perceive emotions as fixed entities, as this belief inhibits ER attempts. To test this potentially moderating effect, future studies should assess such beliefs, for example, via the Implicit Theories on Emotions Scale (Tamir et al., 2007).

Second, and strongly connected to resilient beliefs, individuals would have to *apply ER strategies* in stressful situations to improve ER ability and benefit from a resilience strengthening effect. Although this hypothesis is implied in numerous resilience theories (Crane et al., 2019; Kalisch et al., 2015; Seery & Quinton, 2016), to my knowledge, no study has directly tested so far whether the relationship between stressor exposure and resilience is mediated by the frequency of using ER strategies. To better understand how individuals can benefit from stressful situations, future research should include EMA studies, in which participants report daily hassles as well as their employment of ER strategies. In contrast to retrospective self-report measures of habitual ER, e.g., via the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), EMA studies presumably offer higher ecological validity due to stronger relationships with daily affect (Brockman, Ciarrochi, Parker, & Kashdan, 2017; Colombo et al., 2020). Furthermore, a study applying EMA methodology seems more appropriate for the proposed hypothesis than assessing ERQ scores of CR frequency, as the latter were found to be only weakly related to CR ability measures in previous research (McRae, Jacobs, et al., 2012; Weber et al., 2014) and study #1.

Third, an improvement of ER abilities due to stressor exposure would rely on *coping resources*, which include "(…) the available practical, cognitive, motivational, and social resources that can help people to cope with stressors" (Crane et al., 2019, p. 10). This hypothesis strongly reflects the contextual considerations of recent ER theories (e.g., Aldao, 2013; Dore et al., 2016; see sections 1.1.3 and 1.2.4). For example, the practice effect of CR abilities in the face of stressors may be more pronounced in individuals who possess higher amounts of relevant cognitive resources for CR, e.g., working memory, set shifting, and inhibition (Pruessner et al., 2020; Schmeichel & Tang, 2015). A similar benefit seems plausible for individuals with many social resources, as social support has been found to be positively related to post-traumatic growth (Armstrong, Shakespeare-Finch, & Shochet, 2014). Interestingly, previous research did not indicate greater improvement of CR abilities after stressor exposure for individuals with more financial resources. Instead, the benefits of high CR ability were indeed negatively related to socioeconomic status (Troy et al., 2017).

In line with the concept of limited coping resources, I hypothesized decreased CR for individuals with high (vs. moderate) stressor exposure in study #2. However, the results suggested a linear rather than inverted U-shaped relationship between the frequency of daily hassles and the SRT scores. A more heterogeneous sample including severely stressed individuals may be necessary to explore the limits (and possibly inversion) of this enhancement of reappraisal inventiveness and reappraisal effectiveness. All in all, future research should further investigate under which circumstances stressor exposure leads to improved ER capacity to provide a better understanding of resilience strengthening mechanisms.

5.2 Strengths, limitations, and future directions

5.2.1 Strengths

A major contribution of this dissertation is the investigation of the reappraisal generation process to overcome the black box phenomenon in CR research. Recording participants' reappraisal ideas in the SRT offers at least two advantages over past CR paradigms (e.g., Ochsner et al., 2004). First, the recorded information allows the measurement of the extent to which participants deviate from the instructions. In fact, the results of all three studies indicated a rather small but relevant rate of invalid answers (mean percentage of invalid answers: study #1: 6.53%; study #2: 4.89%; study #3: 5.87%). Participants who do not comply with the instructions in most trials may in turn be excluded from further analyses, as was done in study #1. However, it should be noted that invalid answers in the reappraisal-trials are not necessarily caused by a participant's lack of attention or motivation but may also reflect difficulties in applying CR or individual preferences for other ER strategies. For a clearer interpretation of this SRT parameter, future studies should investigate the correlation between invalid answers and questionnaire measures of ER deficits, e.g., via the Difficulties in Emotion Regulation Scale (Gratz & Roemer, 2008).

Second, the recording phase in the SRT enables a series of analyses regarding the generation process in CR. Although the RIT (Weber et al., 2014) was also constructed to shed light on the generation of various reappraisal thoughts, the SRT, to my knowledge, is the first ER task to combine these process-related measures of CR with the respective affective outcomes in an experimental design. By incorporating both aspects of CR, the SRT is a suitable method to investigate context-specific hypotheses, as was shown in study #3. Furthermore, the analyses of the information from the recording phases in the SRT need not be limited to the

variability or inventiveness of the reappraisal thoughts. For example, with the help of the rating system of the SRT, the content of participants' answers may also be examined to determine which reappraisal categories are used most frequently and most effectively depending on context. Thus, the insights of previous research (McRae, Ciesielski, et al., 2012; Perchtold et al., 2018) regarding the usefulness of different reappraisal tactics may be expanded. Aside from content-related variables, the SRT also provides timing-related information of the generation process in CR, as participants indicate upcoming reappraisal ideas by clicking on a button. In this regard, for example, a more immediate generation of the first reappraisal idea may also predict higher reappraisal effectiveness, as individuals would experience the initial and automatic negative reaction for a shorter period of time. To test this hypothesis, reaction times of the first button click may be included as a predictor of reappraisal effectiveness in a regression analysis.

A second strength of the presented research lies in the more active and dynamic engagement of participants during the SRT. The scripts were not merely constructed to induce negative affect and arousal but also to assess and manipulate relevant context information. Thus, I introduce a methodology that is apt to investigate hypotheses derived from current theories on person- and situation-dependent ER (Aldao, 2013; Dore et al., 2016; Kobylinska & Kusev, 2019; Troy et al., 2013; see section 1.1.3). Taking the context of emotional stimuli into account is especially relevant for CR. For example, it has been found that, independent of emotional intensity, individuals choose CR more often in situations with high *reappraisal affordances*, defined as the opportunities for reinterpretation that a stimulus offers (Suri et al., 2018; Young & Suri, 2020). Additionally, in study #3, I demonstrated that situations also vary regarding their familiarity, which in turn predicted the effectiveness of reappraisal variability. These findings undermine the importance of carefully validating and selecting emotional stimuli in ER research.

Another context variable that was incorporated in the design of the SRT is the type of induced emotion. Specifically, the scripts describe situations of perceived threat, unintentional harm to oneself, or harm by another person to evoke fear, anger directed at oneself, or anger directed at others, respectively. Although this set of discrete emotions was mainly included to enhance the generalizability of the results, past research indicates that the type of emotion influences CR processes. For example, multiple experiments showed that individuals who experience anger, in contrast to disgust, were more likely to choose CR over distraction (Young & Suri, 2020). On the contrary, it has been found that individuals perceive anger related appraisals as appropriate and helpful to a certain degree, which in turn may decrease the

motivation to apply and maintain reappraisal strategies (Weber, 2004). The results from another study suggest more frequent use of CR when individuals experience sadness and anxiety compared to anger (Dixon-Gordon, Aldao, & De Los Reyes, 2015). Future studies should apply the SRT to investigate whether the type of emotion influences reappraisal inventiveness and reappraisal effectiveness while controlling for other relevant context variables, e.g., reappraisal affordances and emotional intensity.

5.2.2 Limitations and future directions

The present research also exhibits some shortcomings, which should be tackled by future studies. As a first limitation, it should be noted that all major findings were based on correlative analyses. Therefore, the causal relationships between the investigated variables remain unclear. To increase the interpretability of the presented results, follow up studies should employ experimental or quasi-experimental designs. The (in-)dependence between reappraisal inventiveness and reappraisal effectiveness, for example, could be experimentally tested by realizing two conditions with different instructions for the reappraisal-trials in the SRT: a high reappraisal inventiveness (highRI) condition, in which participants receive the original instructions, i.e., to generate as many categorically different reappraisal thoughts as possible; and a low reappraisal inventiveness (lowRI) condition, in which participants are instructed to limit themselves to one reappraisal thought. Both conditions can then be directly compared regarding reappraisal effectiveness. An extension of this design seems suitable to follow up on study #3. Accordingly, situational familiarity may be manipulated by applying scripts that were rated as either very unfamiliar (lowFam) or very familiar (highFam) in a pre-study. This would lead to a 2 (lowRI vs. highRI) x 2 (lowFam vs. highFam) design. The results of study #3 would suggest lowest reappraisal effectiveness scores in the highRI x highFam condition. Although both factors could be manipulated in a within-subjects design, this would result in an increased number of trials and a longer total duration of the SRT. To avoid potential fatigue effects, a between-subject design seems preferable.

Regarding the results of study #2, a positive relationship between exposure to daily hassles and reappraisal abilities, future research should consider quasi-experimental designs. For example, SRT measures could be compared in samples with low, moderate, or high exposure to stressors. As mentioned in section 5.1.2, an EMA methodology, in which participants indicate upcoming stressors as well as the employment of ER strategies on a daily basis, seems most appropriate for mainly two reasons. First, the acquired information would

enable a reliable division of the total sample regarding different degrees of stressor exposure. Second, the proposed practice effect of CR due to stressor exposure may be analyzed based on the EMA data. In general, a methodology that combines daily EMA information with experimental SRT scores would increase the ecological validity of CR research.

Another shortcoming of the presented research is the limited generalizability of the findings due to rather homogeneous samples. Especially in study #1 and #3, the samples consisted exclusively of students. It has been found that university students are only representative of the entire population to a limited extent, as they are mostly WEIRD (Western, Educated, Industrialized, Rich, and Democratic; Henrich, Heine, & Norenzayan, 2010a, 2010b). These sample characteristics may have systematically influenced the presented results. For example, as mentioned in section 1.1.3, individuals of high socioeconomic status experience less beneficial consequences from high CR abilities (Troy et al., 2017). Furthermore, individuals from cultures that are oriented towards insight and self-reflection use CR more frequently compared to individuals from other cultures (Haga, Kraft, & Corby, 2009; Matsumoto, Yoo, Nakagawa, & Multinational Study of Cultural Display Rules, 2008). Additionally, both habitual reappraisal and reappraisal inventiveness have been positively associated with higher degrees of the personality trait openness to experience (Hughes, Kratsiotis, Niven, & Holman, 2020; Weber et al., 2014), which in turn is more pronounced in younger individuals (Srivastava, John, Gosling, & Potter, 2003).

Therefore, the results of studies #1 and #3 should be replicated in a more heterogeneous sample, especially regarding personality, age, cultural values, and socioeconomic status. Although we also recruited non-students in study #2 to increase the sample variance, we did not explicitly include participants with a history of very high stressor exposure. Consequently, we were not able to provide evidence for potential boundaries or reversals of the improvement of CR ability with increasing stress levels. Thus, future studies should administer the SRT in highly stressed individuals, e.g., firefighters, police officers, and medical staff (Schafer, Sopp, Staginnus, Lass-Hennemann, & Michael, 2020) and clinical populations with ER deficits, e.g., individuals suffering from major depression (Joormann & Stanton, 2016) or borderline personality disorder (Carpenter & Trull, 2013). A detailed investigation of CR processes in the latter two populations via SRT seems especially relevant considering recent findings that suggest decreased reappraisal effectiveness and less fluency at generating reappraisal ideas in both samples compared to healthy controls (Daros et al., 2020). Yet, shorter versions of the SRT seem more appropriate for studies with clinical samples to avoid confounding effects of fatigue.

Finally, the presented findings are exclusively based on a specific set of stimuli, i.e., scripts that describe a variety of emotional situations. Although scripts are frequently used in affective science to induce emotions (e.g., Wingenbach, Morello, Hack, & Boggio, 2019) and seem appropriate to provide and manipulate context information in CR research (e.g., Suri et al., 2018), further validation efforts would help substantiate the results of all three studies. For example, it remains unclear whether demand characteristics of the instructions in the SRT influenced the ER effect. To exclude such unwanted effects, recent ER research included physiological measurements. Specifically, numerous studies applying CR instructions similar to the SRT in an fMRI setting have found significant correlations between self-report of affective responses and corresponding neural (de-)activations, e.g., in the amygdala (Kanske et al., 2015; Ochsner et al., 2004; Sandner, Zeier, Lois, & Wessa, 2021; Shermohammed et al., 2017). Additionally, the robustness of successful downregulation of negative emotions via CR in experimental paradigms has been supported by studies including measures of peripheral physiology (Holzman & Bridgett, 2017; Ray, McRae, Ochsner, & Gross, 2010). Although these findings provide indirect evidence for the validity of the SRT measures, follow-up studies should include physiological data to amend this methodological shortcoming.

5.3 Implications

5.3.1 Theoretical implications

The findings of this dissertation yield interesting theoretical implications, especially for the fields of ER and resilience research. First and in line with previous studies (McRae, Ciesielski, et al., 2012; Weber et al., 2014), CR was found to be a rather heterogeneous conglomerate of different tactics. Although the proposition of five families of ER strategies in the process model of ER (Gross, 2015) offers high heuristic value, this distinction may be too unspecific for the prediction of relevant consequences, for example, mental health outcomes in varying contexts. Accordingly, the results of study #3 indicated impaired reappraisal effectiveness due to high reappraisal variability in individuals with high situational familiarity. The frequent use of ineffective CR in turn was found to deteriorate mental health (Ford et al., 2017; Ford & Troy, 2019). Thus, the findings of this dissertation contradict the notion of unconditionally beneficial consequences of CR use in specific, and a dichotomous categorizations of ER strategies into adaptive or maladaptive in general. In other words, whether a specific ER strategy is helpful in a given situation depends on the context and the execution of the respective strategy. While the context specificity of ER has already been

proposed and investigated by previous research (Aldao, 2013; Dore et al., 2016; Kobylinska & Kusev, 2019), this dissertation adds to this notion by stating that not only the contextual demands but also the details of ER strategies (and their interaction) matter.

The introduction of reappraisal variability served as a starting point to operationalize this theoretical line of reasoning. In contrast to reappraisal inventiveness, reappraisal variability describes the variance in reappraisal thoughts that individuals generate without explicit maximum performance instructions. This approach is consistent with studies investigating the uninstructed use of ER strategies (e.g., Silvers, Wager, Weber, & Ochsner, 2015). Allowing individuals to respond more naturally to emotional stimuli helps understand how they adapt the choice and execution of ER strategies to the context at hand. Aside from situational familiarity, various contextual factors may influence reappraisal variability. For example, when confronted with stimuli of high emotional intensity, individuals were found to deviate from instructed CR and apply distraction instead, as the latter poses less cognitive demands (Opitz, Cavanagh, & Urry, 2015; Shafir et al., 2015). For a similar reason, high emotional intensity may lead individuals to choose (and be more effective with) a less variable CR style. Another context variable that is closely related to CR is the individual capacity for inhibition. Individuals with high inhibition abilities were found to apply CR more frequently and more effectively (Cohen & Mor, 2018). As generating multiple reappraisal thoughts presumably necessitates a simultaneous inhibition of competing negative thoughts, high reappraisal variability may be less effective for individuals with low inhibition abilities. In general, the approach and methodology of this dissertation pave the way for various possible interaction effects between CR tactics and context variables.

Additionally, this dissertation contributes to resilience theories by supplying information on important resilience mechanisms. Both a moderate degree of stressor exposure and CR ability has been connected to increased psychological resilience (Crane et al., 2019; Kalisch et al., 2015; Seery & Quinton, 2016). However, to my knowledge, the relationship between both variables has not been directly investigated before. Although being correlational, the results of study #2 hint at the importance of practicing ER strategies in everyday life to benefit from strengthened resilience in the long run. In line with current theoretical accounts, resilience should therefore be rather construed as a malleable than stable property of individuals. Interestingly, frequent exposure to daily hassles was not only correlated with increased reappraisal effectiveness but also reappraisal inventiveness. Stressor exposure under the right circumstances has already been related to better divergent thinking in unemotional contexts. For example, stress with low evaluative context has been found to increase creative

performance (Byron, Khazanchi, & Nazarian, 2010). Similarly, future research should concentrate on contextual moderator variables, as stressor exposure has the potential to improve resilience mechanisms in multiple ways.

5.3.2 Practical implications

Emotion regulation via CR is a key component in cognitive behavior therapy (Beck, 1976, 2019). Furthermore, in recent years, an increasing number of brief mental health interventions aimed at improving CR abilities in multiple domains, e.g., internet-based or ecological momentary interventions (for an overview, see Colombo et al., 2020; Morris, Schueller, & Picard, 2015; Porat, Erel, Pnueli, & Halperin, 2020). The findings of this dissertation enrich the conceptualization of such attempts. First, all three studies yield extensive information on what thoughts individuals resort to when they use CR. Thus, this dissertation expands previous research (McRae, Ciesielski, et al., 2012; Weber et al., 2014) by offering a more detailed categorization system for multiple specific emotions. In study #1, for example, participants most frequently resorted to the category "turning a disadvantage into an advantage" when experiencing anger at oneself, to the category "thinking about less malevolent motives of the offender" when experiencing anger at others, and "thinking about ways how to minimize the threat" when experiencing fear. Tailored interventions may use this information to provide individuals with a selection of different reappraisal alternatives in a given situation as well as their respective usage by others.

Consequently, populations with ER deficits can profit from the experiences of more adept CR users. For example, a tailored ecological momentary intervention for patients with depressive symptoms could suggest various reappraisal ideas as a reaction to daily stressors. This assistance seems especially relevant in an initial acquisition of CR. For a long-term stabilization of this cognitive process, the provision of reappraisal thoughts may be gradually phased out with increasing expertise. The idea of supporting another individual's CR process is closely related to the concept of *interpersonal* ER (Gross & Thompson, 2007). Accordingly, emotions are not necessarily regulated single-handedly but also in social interactions. Along these lines, *co-reappraisal*, defined as reinterpreting a situation to alter the emotional impact in interaction, was found to decrease depression in couples (Horn & Maercker, 2016). Apparently, reappraisal ideas do not always need to be self-generated for effective ER. Furthermore, the results of study #2 suggest that individuals do not necessarily have to avoid daily hassles, as such experiences can turn into daily opportunities to practice CR abilities. Interestingly,

reappraising stressors as challenges is in itself an established coping strategy (Lazarus, 1999; Tomaka, Blascovich, Kelsey, & Leitten, 1993).

Based on the findings of study #3, an improvement of reappraisal effectiveness may also be achieved by enhancing an individual's context sensitivity. An intervention may exploit this aspect of ER by increasing the salience of relevant contextual information. Specifically, individuals who experience an emotional situation may receive prompts via mobile app that promote an elaboration of the situational cues. Prompts could, for example, draw an individual's attention to the situational familiarity ("How familiar are you with this situation?"), the type of emotion ("Which emotion do you feel right now?"), or the emotional intensity ("How intensely do you feel the emotion right now?"). As a result, individuals would be able to adapt the CR process more adequately (e.g., the degree of reappraisal variability or use of a specific CR category) to the contextual demands at hand. Improvements in the ability to identify stressor cues could then be assessed via the recently developed Context Sensitivity Index (Bonanno, Maccallum, Malgaroli, & Hou, 2020). As individuals with high compared to low emotion context sensitivity report fewer depressive symptoms following experiences of bereavement (Coifman & Bonanno, 2010), the proposed context-focused intervention has the potential to increase ER abilities and mental health. Conversely, interventions that merely focus on practicing ER strategies are presumably less effective in populations with impaired or biased context perception, e.g., patients with major depressive disorder (Bylsma, 2020; Rottenberg & Hindash, 2015) or borderline personality disorder (Bortolla et al., 2020; Domes, Schulze, & Herpertz, 2009).

5.4 General Conclusion

Dealing with negative emotions is an intricate issue. Therefore, an appropriate investigation of ER strategies requires a differentiated analysis. In this dissertation, I aimed at providing a methodology to assess CR in detail as well as first insights into context- and process-related variables that predict reappraisal effectiveness. Specifically, the presented research revealed successful CR to be positively related to exposure to daily hassles and negatively related to high reappraisal variability in individuals with high situational familiarity. As expected, ER is not a uniform process, and an unconditional dichotomization of ER strategies into adaptive or maladaptive appears inaccurate. Instead, the findings of this dissertation serve as a starting point for new and fruitful research questions that are not only in line with the most recent developments in ER research but also closely related to a wide field of application possibilities.

Although emotions enrich our lives and most often provide us with vital information, they can also sometimes be hindering and misleading. The successful alteration of such unwanted emotional states notably contributes to the maintenance and recovery of mental health. This dissertation brings us one step closer to understanding how we can keep – not only our academic – lives rich in emotions without falling prey to them.

6. References

6.1 References General Introduction

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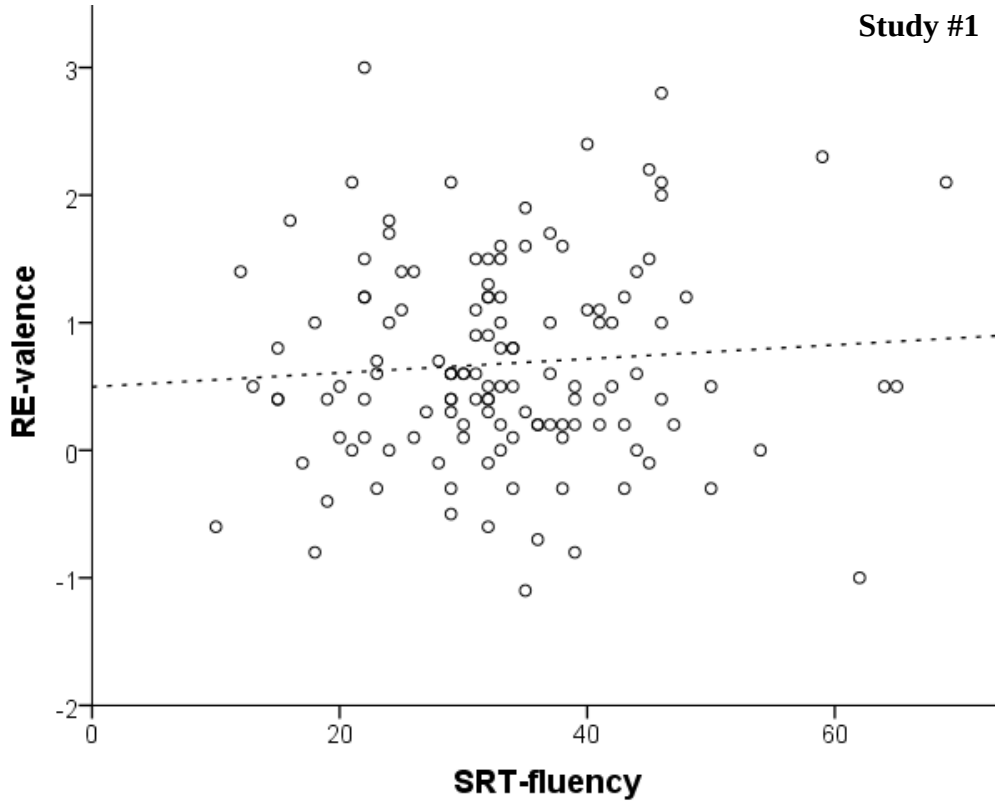
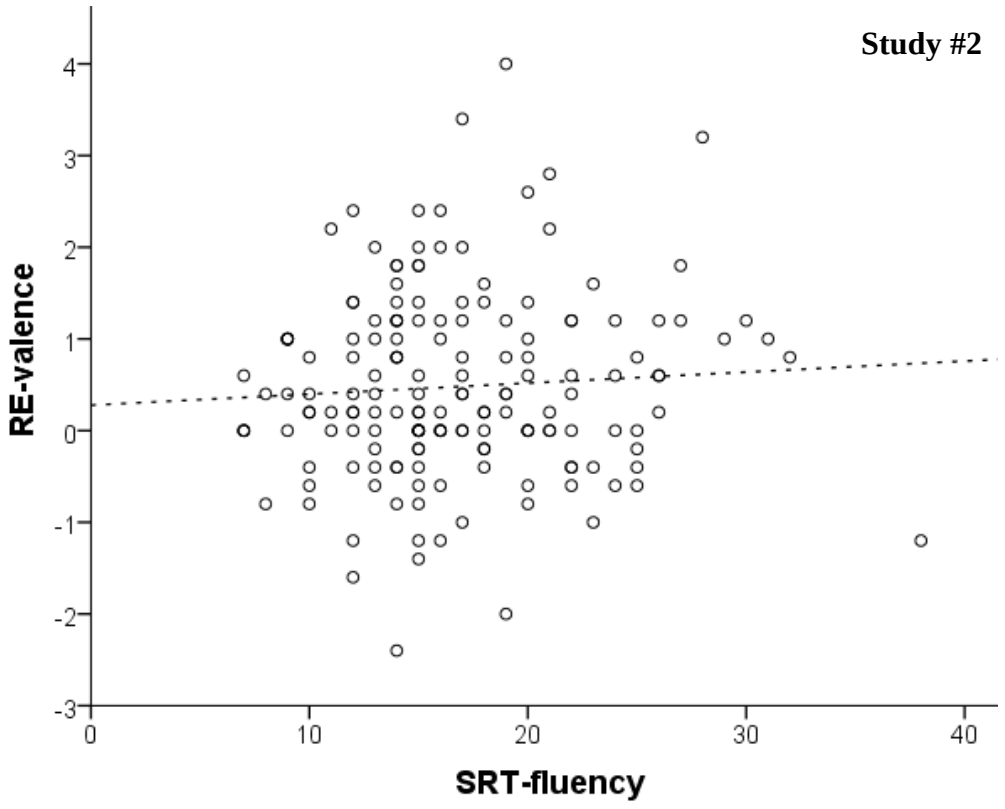
7. Appendix

Appendix VIII





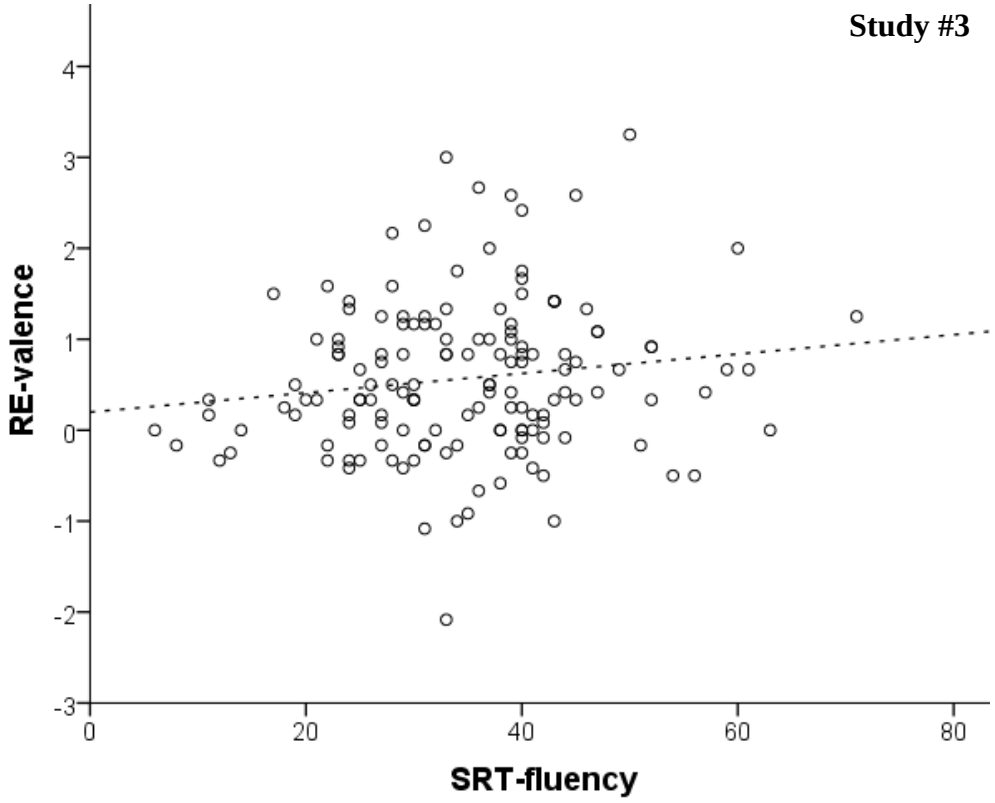


Figure A.2. Relations Between Reappraisal Fluency in the Script-based Reappraisal Test (SRT) and Reappraisal Effectiveness (RE) on a Valence Level in All Three Studies. Study #1: $r(127) = .07$, $p = .40$; study #2: $r(163) = .07$, $p = .40$; study #3: (146) = .14, $p = .09$.

8. Danksagung

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9. Erklärung

gemäß § 6 Absatz 2 g) und gemäß § 6 Absatz 2 h) der Promotionsordnung der Fachbereiche 02, 05, 06, 07, 09 und 10 vom 04. April 2016

Name (ggf. Geburtsname): Zeier
Vorname: Peter

Hiermit erkläre ich, dass ich die eingereichte Dissertation selbständig, ohne fremde Hilfe verfasst und mit keinen anderen als den darin angegebenen Hilfsmitteln angefertigt habe, dass die wörtlichen oder dem Inhalt nach aus fremden Arbeiten entnommenen Stellen, Zeichnungen, Skizzen, bildlichen Darstellungen und dergleichen als solche genau kenntlich gemacht sind.

Von der Ordnung zur Sicherung guter wissenschaftlicher Praxis in Forschung und Lehre und zum Verfahren zum Umgang mit wissenschaftlichem Fehlverhalten habe ich Kenntnis genommen.

Bei einer publikationsbasierten Promotion:
Meine Erklärung bezieht sich auf Schriften, die ich als alleiniger Autor eingereicht habe oder bei Ko-Autorenschaft auf jene Teile, für die ich mich verantwortlich zeichne.

Ich habe keine Hilfe von kommerziellen Promotionsberatern in Anspruch genommen.

08.11.2021

Datum, Unterschrift

10. Curriculum Vitae

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Jul 2015	M. Sc. Psychologie an der Ruprecht-Karls-Universität Heidelberg, 4 Fachsemester
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Prüfungsfächer:
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[redacted]

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Sandner, M., Lois, G., Streit, F., Zeier, P., Kirsch, P., Wüst, S. & Wessa, M. (2020). Investigating individual stress reactivity: High hair cortisol predicts lower acute stress responses. *Psychoneuroendocrinology*, *118*, 1-10. https://doi.org/10.1016/j.psyneuen.2020.104660

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Submitted for Publication

Zeier, P., Meine, L. E., & Wessa, M. (submitted). It's worth the trouble – Stressor exposure is related to increased cognitive reappraisal ability. *Stress and Health.*

Zeier, P., Sandner, M., & Wessa, M. (submitted). Regulating emotions with experience – The effectiveness of reappraisal variability depends on situational familiarity. *Affective Science.*