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The Costs and Benefits of Mindfulness and Reappraisal in Daily Life

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Abstract

Reappraisal and mindfulness represent two fundamentally different ways of dealing with one's emotions: Whereas reappraisal aims at changing one's thoughts and emotions, mindfulness is aimed at *not* changing, but appreciating them. Despite this difference, prior research has shown that both are similarly associated with short-term benefits and trait-level correlates. However, research on the spontaneous use of reappraisal and mindfulness in daily life found that mindfulness is more effective in decreasing negative affect than reappraisal. The spontaneous use of reappraisal may be less effective than mindfulness in daily life given that it is more cognitively taxing. Therefore, we assumed in the present research that the increased costs (i.e., feeling exhausted) of spontaneously endorsing reappraisal compared to mindfulness can explain why reappraisal is less effective in regulating negative affect than mindfulness. In two experience sampling studies ($N = 125$ and $N = 179$), we found evidence for different costs and benefits of reappraisal compared to mindfulness. Regarding short-term benefits, endorsing reappraisal was significantly associated with increases in positive affect, whereas endorsing the mindfulness component acceptance was significantly associated with decreases in negative affect. Regarding short-term costs, we found that endorsing reappraisal was more exhausting, and that reappraisal was selected less often than mindfulness in daily life. Finally, acceptance was associated more strongly with trait level indicators of well-being than reappraisal, which may be explained by the reduced costs of endorsing acceptance compared to reappraisal. Our results demonstrate the importance of assessing both the benefits and costs of emotion regulation in daily life.

Words: 250

Keywords: reappraisal; acceptance; mindfulness; emotion regulation; affect

The Costs and Benefits of Mindfulness and Reappraisal in Daily Life

Emotions are a vital part of human life that can be considered as functional by preparing, energizing, and directing individuals' behavior (Frijda, 2007). In addition, they serve a social function by impacting how individuals interact with and communicate their inner states to others (Rimé, 2009). However, despite their general adaptiveness, emotions have to be regulated appropriately by identifying the need for regulation and by selecting and implementing a suitable strategy (Sheppes et al., 2015). Prior research has demonstrated that “failures” in the regulatory process can negatively impact physical and mental health (Aldao et al., 2010). These negative associations range from depression to eating disorders, and a variety of other psychopathological symptoms (Berking & Wupperman, 2012) to the regulation of glucose, cardiovascular functioning, stress hormones, and immune responses (Thayer & Sternberg, 2006). This wide range of associations between emotion regulation (ER) and well-being highlights the importance of adaptively selecting and implementing ER strategies.

ER strategies are assumed to have short-term and/or longer-term benefits, but using them may also come with costs (e.g., Sheppes, 2020). In the present research, we focused on the costs and benefits of two seemingly contrary regulatory processes that have received attention with regard to fostering well-being and resilience (e.g., Garland et al., 2009), namely cognitive reappraisal and mindfulness. Reappraisal is a type of cognitive-change strategy that is aimed at influencing the meaning of an emotion-eliciting stimulus or its context (Gross, 2015). Mindfulness has been defined as “paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally” (Jon Kabat-Zinn, 1994, p. 8). Thus, reappraisal and mindfulness are fundamentally different, as reappraisal aims at changing one's thoughts and emotions, whereas mindfulness is aimed at *not* changing, but appreciating them. Although reappraisal and mindfulness seem to be opposite processes,

research has found that both are associated with adaptive outcomes (Shallcross et al., 2015) – but their costs and benefits may differ.

Reappraisal is one of the most elaborately studied ER strategies, and presumably one of the most effective ones: According to a large meta-analysis, the instructed use of reappraisal (and other cognitive change strategies) yielded the strongest effect sizes in changing short-term affect compared to attentional deployment and response modulation strategies (Webb et al., 2012). Evidence for the short-term effectiveness of spontaneously used reappraisal in daily life is, however, mixed, with some studies finding insignificant associations with changes in affect (e.g., Brans et al., 2013; Heiy & Cheavens, 2014). These differences between the instructed and spontaneous use of reappraisal may be explained by recent research that demonstrated that individuals often report to be unable to use reappraisal effectively (Ford & Troy, 2019). In particular, reappraisal may be rather costly in terms of cognitive resource expenditure in the short-term (Sheppes, 2020). Thus, cognitive reappraisal might be less effective when confronted with intense emotion-eliciting events than strategies such as distraction, which come with minimal cognitive costs and an effective affective modulation. However, even though reappraisal may be cognitively demanding and only shows weak affective modulation in the short-term, it seems to be positively associated with trait well-being measures. An explanation for the latter may be that the meaning of emotional information is being processed and changed actively so that the elicited emotions will eventually become less intense in similar future situations (Sheppes, 2020).

Mindfulness, on the other hand, is also increasingly acknowledged as contributing to adaptive ER (Chiesa et al., 2013), especially its acceptance facet (Blanke et al., 2018), which is also assumed to be less effortful to implement in comparison to reappraisal (Troy et al., 2018). While the instructed use of both mindfulness and reappraisal were found to be beneficial, this may not be the case in the spontaneous use in daily life. Instead, in daily life,

not only the short-term benefits of ER strategies but also on their costs are of relevance, which could lead to differential endorsement in daily life. In the present research, we investigated the costs and benefits of reappraisal and mindfulness in two data sets, which combined experience sampling (Trull & Ebner-Priemer, 2013; Wenzel & Kubiak, 2018) with trait self-reports.

Reappraisal and Mindfulness: Short-Term Benefits in the Lab and in Daily Life

Before reviewing the evidence regarding short-term benefits, it is important to note that mindfulness is an umbrella term that is used to characterize a wide range of processes and characteristics in relation to aspects of attention, awareness, and acceptance. Here, we adopt a widely cited operational definition that mindfulness is based on two major components (Bishop et al., 2004): (1) the regulation of attention to the present moment (attention component) and (2) the non-judgmental acceptance of these present-moment experiences (acceptance component). Research on mindfulness has often lumped in these two components together (e.g., Grossman et al., 2004; Khoury et al., 2015), although the mindfulness facets may serve different purposes (e.g., Blanke et al., 2018). In the following, we use *attention* to refer to the attention component, *acceptance* to refer to the acceptance component including when acceptance was assessed as an ER strategy, and *mindfulness* when the cited research did not differentiate between any components or when referring to the overall concept.

Just like mindfulness can be examined in different ways, short-term benefits can be assessed by the change in the subjective experience of emotions or its more objective characteristics (e.g., skin conductance level). In the present research, we focused on the subjective experience, that is whether endorsing an ER strategy increases self-reported positive affect (PA) or decreases self-reported negative affect (NA) subsequently.

Instructed Use in Laboratory Research

It is important to differentiate between the instructed use of an ER strategy, which is typically examined in laboratory research, and the spontaneous use of ER strategy as it happens in daily life when individuals are confronted with an emotion-eliciting situation and can select freely from their ER strategy repertoire. Regarding short-term benefits of the instructed use of reappraisal and mindfulness, studies comparing the benefits of reappraisal and mindfulness produced mixed findings based on nonclinical adult samples. Out of five studies, three found that the instructed use of reappraisal compared to acceptance was more effective in decreasing NA (Hofmann et al., 2009; Szasz et al., 2011; Troy et al., 2018), whereas the other two did not find any difference (Asnaani et al., 2013; Wolgast et al., 2011). Furthermore, a large meta-analysis found similar effects sizes for the effects of instructed use of reappraisal and acceptance on changes in affect (Webb et al., 2012): Cognitive reappraisal (termed “reappraise: stimulus” in the meta-analysis) was equally effective in changing affect compared to mindfulness (termed “reappraise: response” there), with $d = 0.38$ (24 included contrasts) vs. $d = 0.31$ (30 included contrasts). This evidence suggests that both reappraisal and mindfulness have similar short-term benefits.

Spontaneous Use in Daily Life Research

Experience sampling research on the spontaneous use of reappraisal and mindfulness further adds to the heterogeneity and mostly found that reappraisal is more strongly associated with increases in PA, whereas mindfulness is more strongly associated with decreases in NA. For example, the spontaneous use of reappraisal was not significantly associated with decreases in current NA (Brans et al., 2013; Wenzel, Rowland, & Kubiak, 2020b) but with increases in PA in one out of two studies (Brans et al., 2013). In one study, significant associations between spontaneously using positive reappraisal and subsequent changes in both PA and NA emerged (Pavani et al., 2017).

With regard to mindfulness, recent research has demonstrated the importance to separate the mindfulness facets: Whereas acceptance was more strongly associated with decreases in current NA than attention, it was less strongly associated with increases in PA, both in daily life (Blanke et al., 2018) and after mindfulness-based cognitive therapy (Schroevers & Brandsma, 2010). Moreover, the acceptance component was associated with dampened stress reactivity (Blanke et al., 2018; Feldman et al., 2016; Wenzel, Rowland, & Kubiak, 2020a). Attention on the other hand was related to increases in PA (Blanke et al., 2018). Finally, an experience sampling study compared both reappraisal and acceptance and found that acceptance was not only used most often in daily life, but participants also indicated higher success in decreasing current NA than when they endorsed reappraisal, with the latter also not being significantly associated with increases in current PA (Heiy & Cheavens, 2014).

In the present research, we used a unidimensional measure of mindfulness in the first, and a multidimensional measure of mindfulness in the second study, thereby attempting to replicate that differentiating between PA and NA as well as between acceptance and attention (Blanke et al., 2018) is important to understand the benefits of mindfulness. Based on the presented research on the spontaneous use of reappraisal and mindfulness, and unlike research on the instructed use in laboratory settings, we expected generally beneficial associations between reappraisal and acceptance on the one hand and affective well-being on the other. Moreover, we expected that the spontaneous use of reappraisal and attention in daily life should be more strongly associated with PA and less strongly with NA compared to acceptance.

Costs of Reappraisal and Mindfulness

Despite the putatively general adaptiveness of reappraisal, research has shown that it is not without costs. For example, the choice of reappraisal may depend on the intensity of a

situation: Individuals were more likely to choose reappraisal over distraction in situations characterized by lower levels of NA, with the reversing pattern in high-intensity negative situations (e.g., Sheppes et al., 2011). When strong emotions have already developed, reappraisal requires to override the strong and already established appraisals of the given situation, which is mentally taxing. Thus, although reappraisal is generally beneficial, individuals use reappraisal less often than would be expected (Suri et al., 2015), possibly due to increased costs. This, however, has not been studied in daily life so far. Milyavsky et al. (2019) explain this, from an emotion regulatory perspective, contradictory finding with the cognitive energetics theory. According to the cognitive energetics theory, any effortful act such as implementing an ER strategy is a function of the motivation and the difficulty of implementing the strategy. The authors showed that participants avoided implementing reappraisal given its difficulty, which could be countered when the participants were offered a modified reappraisal strategy that was easier to implement.

The experience sampling research on the spontaneous use of ER strategies mirrors the results from the laboratory research on the instructed use by showing that reappraisal is selected rather rarely as an ER strategy compared to other strategies (e.g., Brans et al., 2013; Heij & Cheavens, 2014). This line of research shows that reappraisal may not be as easily deployable as initially thought (Richards & Gross, 2000), but instead might be associated with considerable cognitive costs, particularly in emotionally intense situations. Individuals, thus, may try to avoid these costs by selecting other, less effortful regulatory mechanisms such as mindfulness.

In contrast to reappraisal, mindfulness should not tax executive functions such as working memory capacity or at least to a lesser extent than effortful ER strategies (Shallcross et al., 2013). However, evidence for this notion is relatively scarce. Prior laboratory research has shown that practicing mindfulness was not only associated with relaxation (Rosch, 2007)

but could also with replenishing cognitive resources (Friesen et al., 2012). However, only two laboratory research projects compared the cognitive costs associated with reappraisal and mindfulness: First, participants in a mindfulness and reappraisal condition in a laboratory experiment involving the Stroop task reported significantly lower momentary levels of sadness compared to the control condition (Keng et al., 2013). Thus, both approaches were equally effective. However, participants in the reappraisal compared to the mindfulness condition performed slower on incongruent compared to congruent trials, indicating a greater level of mental fatigue. Second, reappraisal was associated with significantly larger increases in PA and decreases in NA than acceptance when regulating emotions in reaction to a sad video (Troy et al. (2018). However, acceptance was deemed as less difficult to deploy by the participants than reappraisal.

Thus, we hypothesized that when individuals can choose freely in their everyday lives, they often favor acceptance over reappraisal because the latter should be more difficult and taxing (Troy et al., 2018). Consequently, individuals may not only be less exhausted when using acceptance, but may also be more experienced in endorsing acceptance, which together should lead to better short-term benefits when dealing with negative emotions.

Trait-Level Subjective Well-Being Correlates of Reappraisal and Mindfulness

Finally, everyday lives' reappraisal and mindfulness may also be differently associated with subjective well-being measures on the trait level. A meta-analysis found that the habitual use of reappraisal as well as acceptance (i.e., measured as traditional traits) were both negatively associated with both depression and anxiety (Aldao et al., 2010). Meta-analytical evidence suggests that trait mindfulness is associated with a wide range of well-being measures (Mattes, 2019), including affect, depression, life satisfaction, and stress (e.g., Baer et al., 2008; Brown & Ryan, 2003).

However, this line of research usually relied on assessing trait measures of reappraisal and mindfulness to predict trait measures of subjective well-being. Importantly, these trait self-reports provide a different source of information compared to the actual strategy use as approached via experience sampling: Whereas trait reports of habitual strategy use tap more into the believing self, reports of actual use taps into the experiencing self (Conner & Barrett, 2012). Aggregating these repeated reports of actual strategy use, referred to as aggregated states in the following, results in information at the person level, complementary to trait reports.

Importantly, these different sources of trait self-reports and aggregated states can provide different information: Asking young parents repeatedly about their current happiness levels and averaging the results (aggregated states measure) might result in a different answer than asking them retrospectively (trait measure), given that the former will be driven more by the current, often times stressful situational demands, whereas the latter will be driven more by how the parents believe they are or should be (Brose et al., 2013). As a consequence, in addition to examining the costs and benefits of reappraisal and mindfulness at the within-person level, we examined between-person associations between these variables and two aspects of well-being: trait report associations as well as associations of aggregated state reports, the former reflecting general beliefs and the latter reflecting aggregates of actual experiences.

Finally, similar associations between trait reappraisal and trait mindfulness with trait well-being could be the result of common-method variance, that is the systematic error variance that variables from the same source, such as trait self-reports, share (Podsakoff et al., 2003). As a solution to this problem, it is suggested to use a multimethod approach to assess the variables from different sources. In the present research, we used the aggregated state measures of the actual, spontaneous use of reappraisal and mindfulness to predict trait

self-reports of subjective well-being. Thus, this approach does not only address the issue of common-method variance but is also better suited to fully capture the benefits and costs associated with implementing reappraisal and mindfulness in daily life.

The Present Research

Whereas research has focused on the general adaptiveness of ER strategies, the relative effectiveness and costs associated with the implementation of different ER strategies has so far received little attention in daily life research. In the present research, we addressed this research gap and examined the costs and benefits of spontaneous use of reappraisal and mindfulness. To that end, we used two experience sampling datasets to investigate five hypotheses. The two datasets were collected for various purposes: Dataset 1 is from the SMASH study, which examined the effectiveness of a mindfulness intervention (Rowland et al., 2016, 2019). Dataset 2 is a study that was implemented within the Innovation Sample of the German Socio-Economic Panel (SOEP-IS, Richter & Schupp, 2015). The study is Wave 1 of the “Everyday Experiences” in the SOEP-IS study (EE-SOEP-IS; Blanke et al., 2020; Siebert et al., 2017).

In Study 1, we tested the following hypotheses:

Hypothesis 1: The spontaneous use of reappraisal in daily life is *more* strongly associated with increases in PA compared to mindfulness at the within-person level.

Hypothesis 2: The spontaneous use of reappraisal in daily life is *less* strongly associated with decreases in NA compared to mindfulness at the within-person level.

Hypothesis 3: The spontaneous use of reappraisal in daily life is associated with *higher* costs in terms of feelings of exhaustion and depletion compared to mindfulness at the within-person level.

We expected similar associations at the between-person level, specifically at the level of aggregated states. Furthermore, we tested the following hypothesis:

Hypothesis 4: Individuals endorse reappraisal *less* intensely in daily life than mindfulness.

In Study 2, we tested the same hypotheses but differentiated between two mindfulness components:

Hypothesis 1b: The spontaneous use of reappraisal and attention in daily life is *more* strongly associated with increases in PA compared to acceptance.

Hypothesis 2b: The spontaneous use of reappraisal and attention in daily life is *less* strongly associated with decreases in NA compared to acceptance.

Hypothesis 5: The aggregated use of reappraisal in daily life is *less* strongly associated with trait-level subjective well-being compared to the aggregated use of acceptance and attention.

Study 1

Method

We affirm that we reported all manipulations and exclusions in the present study but not all measures of the parent studies that recruited the samples. The protocol of Study 1 was approved by the ethics committee of the Institute of Psychology at the Johannes Gutenberg University Mainz, Germany (reference codes 2015-JGU-psychEK-011) and all participants provided informed consent. Dataset 1 as well as all statistical analyses and the full results can be found at OSF (https://osf.io/dezrj/?view_only=d7cfedd1b94e43dba974977e265c55ee).

Table 1 provides an overview of the dataset in Study 1.

Table 1

Overview of the datasets

Dataset	Study 1	Study 2
Parent study	Rowland et al. (2016)	Siebert et al. (2017)
Type	ESM (self-report)	ESM (self-report)
Country of data collection	Germany	Germany
Participants: <i>N</i>	125	179
Gender: % Female	77.6%	52.5%
Age: <i>M</i> in years (<i>SD</i>)	22.9 (5.1)	50.9 (5.8)
Number of days	40	12 (3 times 4 days with 4 pause days in between)
Observations per day	6	6
Max. number of observations	240	96 (goal: 60)
Average no. of observations/participant: <i>M</i> (<i>SD</i>)	182.9 (35.3)	69.3 (7.6)
ESM application	movisensXS (movisens GmbH, Karlsruhe, Germany)	Custom built
ESM hardware (smartphones)	Motorola Moto G	Huawei Ascend G330
Compensation	Course credits	80-90 €
Adherence	76.2%	96.3%
PA items	Excited, happy, relaxed, satisfied	Content, inspired, interested, joyful, relaxed, well
NA items	Angry, anxious, depressed, sad	Angered, distressed, downhearted, jittery, nervous, upset

Note. ESM, experience sampling method; ICC, intraclass correlation; PA, positive affect; NA, negative affect.

Participants

The parent study aimed at recruiting 137 participants to achieve an a priori power of 95% to detect a small effect of Cohen's $d = 0.33$ against $\alpha = .05$ and an expected attrition of 10% for the difference between the mindfulness and control condition in state mindfulness. Thus, data of 137 participants were collected of which 11 participants dropped out during the study and 1 was excluded due to low compliance of fewer than 33% completed signals¹. This yielded a final sample of $N = 125$ participants (77.6% female; $M = 22.9$ years, $SD = 5.1$).

Procedure

The parent study consisted of a six-week experience sampling with seven weekly laboratory sessions. After signing an informed consent form in the first lab session and after an introduction in the Android applications movisensXS (movisens GmbH, Karlsruhe, Germany) that delivered the signals, participants received six randomly distributed signals each day for 40 subsequent days. These six signals were distributed between 10 am and 8 pm, with a mean interval of $M = 103.4$ min ($SD = 34.3$, Range: 45 – 200 mins). Participants returned to the laboratory each week, where they completed questionnaires and a computer-based guided-breathing meditation in the mindfulness training condition each week (see Rowland et al., 2016, 2019 for more information).

Measures

The descriptive statistics of the measures of Study 1 can be found in Table 2.

Reappraisal. In response to each signal, participants indicated to what extent they have viewed the cause of their feelings from a different perspective since the last signal, using a scale from 1 (*not at all*) to 7 (*very much*). The item was „*Since the last beep, I have viewed the cause of my feelings from a different perspective*” (original wording: “*Seit dem letzten Signal habe ich den Grund für meine Gefühle aus einer anderen Perspektive betrachtet.*”).

To assess reliability of the measures (Table 2), we computed ω by including the person-mean

centered items (within-person reliability ω_{within}) and the person means of the respective item (between-person reliability ω_{between}) as indicators in a confirmatory factor analysis (Geldhof et al., 2014). To compute the between-person reliability for single items, we split the data in quarters by coding the day variable (ranging from day 1 to day 40) with the sequence 0, 1, 2, 3. We then aggregated the measures on the new variable for each individual and then used these four variables as indicators in a structural equation model to compute ω as a measure of between-person reliability (Geldhof et al., 2014).

Mindfulness. Mindfulness was assessed unidimensionally by selecting the three items from the state version of the Mindfulness Attention Awareness Scale (MAAS; Brown & Ryan, 2003) that yielded the highest factor loadings (Items 8, 10, 14). These items were rated on a scale ranging from 0 (*not at all*) to 6 (*very much*) and then inverted, so that higher mean scores indicate higher levels of mindfulness (i.e., present-moment attention and awareness).

Affect. Current PA and NA (at the moment of responding to the signal) were assessed based on Kuppens et al. (2010), taking items from the circumplex model of affect (Russell, 1980). Each emotion item (see Table 1) was rated on a scale ranging from 0 to 100, with higher values indicating stronger emotions.

Costs: Subjective depletion. Subjective levels of exhaustion were assessed via three items from the State Self-Control Capacity Scale (SSCCS; Bertrams et al., 2011), which ranged from 1 (*not true*) to 7 (*very true*). The SSCCS captures the current capacity to regulate oneself in a particular moment, which inverse reflects feelings of subjective depletion (example item: *I feel exhausted*).

Table 2

Descriptive statistics (mean, standard deviation, within-/between-person reliability, intraclass correlation, and zero-order associations) of the variables in Study 1

Variable	M^a	SD	ω_{within}	ω_{between}	ICC_{person}	$ICC_{\text{days person}}$	1	2	3	4	5
1. Reappraisal	0.96	0.82	—	.99 ^b	.36	.51	-	-.56	.09	.34	.34
2. Mindfulness (MAAS)	4.76	0.80	.80	.96	.44	.58	-.14	-	.16	-.58	-.55
3. Positive affect	52.46	14.39	.81	.92	.43	.64	-.02	.17	-	-.32	-.31
4. Negative affect	16.32	12.51	.71	.92	.47	.69	.12	-.20	-.50	-	.67
5. Depletion (SSCCS)	0.75	0.70	.79	.91	.40	.61	.12	-.26	-.31	.35	-

Note. ω_{within} = within-person reliability (McNeish, 2018); ω_{between} = between-person reliability; MAAS = Mindfulness Attention Awareness Scale; SSCCS = State Self-Control Capacity Scale. Estimates in bold are significant at $p < .05$.

^aThe mean was calculated based on the person-level aggregated variables.

^bTo compute the between-person reliability for single items, we split the data in quarters by coding the day variable (ranging from day 1 to day 40) with the sequence 0, 1, 2, 3. We then aggregated the measures on the new variable for each individual and then used these four variables as indicators in a structural equation model to compute ω_{between} .

Within-person correlations are shown in the lower left corner, between-person correlations in the upper right corner.

Statistical Approach

For the within-person analyses, we computed multivariate 4-level models (Baldwin et al., 2014). The three outcome variables were simultaneously modeled at Level-1, which allows to test whether random slopes for different outcomes significantly correlate. These three outcome variables were nested within measurement occasions (observations at each signal, Level-2), nested within days (Level-3), and nested within participants (Level-4). For the between-person analyses, we aggregated each outcome on the person-level, resulting in a multivariate two-level model. Following recent recommendations (de Haan-Rietdijk et al., 2016), we compared model fit using the Akaike Information Criterion (AIC) to test whether the inclusion of days as a level improved model fit. Given that this was the case in all models, we kept days as a level in all within-person analyses.

In the result section, the term *current* indicates the assessment of a variable at signal t , *prior* at signal $t-1$, and *recent* at the interval between the current assessment t and the prior assessment $t-1$. All variables termed current, prior, or recent were within-person standardized. We favored within-person standardization over within-person centering (Enders & Tofghi, 2007) since within-person standardization not only provides standard effect sizes, allowing easier interpretation and comparison of the effect sizes, but is also less biased when between-person variance in within-person *SDs* exists, which was the case in our data (Wang et al., 2019). Level-4 variables reflecting between-person differences were z-standardized. To test the difference between the associations of reappraisal and mindfulness when included in the same model, we computed the Wald test:

$$Z = \frac{\beta_{Reappraisal} - \beta_{Mindfulness}}{\sqrt{SE_{Reappraisal}^2 + SE_{Mindfulness}^2 + 2 * cov_{Reappraisal, Mindfulness}}}.$$

All analyses were performed using Stata 16 (Stata Corporation, College Station, TX).

Within-person analyses. No predictors at Level-3 (day level) were introduced to the four-level model as Level-3 was only introduced to improve model-fit. As a preliminary

analysis, we computed within-person associations reflecting zero-order associations.

Following recent recommendations (Bakdash & Marusich, 2017), we computed the averaged within-person correlations by using 3-level models; in each of these, one within-person standardized variable (y) given an observation i nested in days j nested in participants k was regressed on the fixed (β_{11}) and random slope (v_{11k}^x) of one level-1 predictor (x_{ijk}), see Equation 1. Please note that we included the fixed intercept (β_{10}), which was zero, and the random intercept ($\mu_{1k}^{Days|Participants}$) of days but did not include a random intercept for participants ($\mu_{2k}^{Participants}$) given that we used within-person standardization, resulting in $M = 0$ for all variables and, thus, no differences in participants' intercepts.

$$y_{ijk} = \beta_{10} + \mu_{1k}^{Days|Participants} + (\beta_{11} + v_{11k})x_{ijk} + \varepsilon_{ijk} \quad (1)$$

To test Hypothesis 1 to 3, we computed a single multivariate four-level model (variables nested in observations nested in days nested in participants) where we regressed PA, NA, and depletion (SSCCS) on within-person standardized recent reappraisal (REA) and recent mindfulness (MIND). In addition, we included the two-way interactions between the z-standardized mindfulness training (MT) and reappraisal and mindfulness, respectively, to control for the possible influence of the mindfulness training (Equation 2). Moreover, we controlled for prior PA (predicting only PA), prior NA (predicting only NA), and prior SSCCS (predicting only SSCCS) to examine the changes in the respective outcomes due to recent reappraisal and recent mindfulness.

$$\begin{aligned}
y_{hijk} = & \beta_{10}PA_k + \beta_{20}NA_k + \beta_{30}SSCCS_k + (\beta_{11} + v_{11k})REA_{ijk}PA_k + (\beta_{21} \\
& + v_{21k})REA_{ijk}NA_k + (\beta_{31} + v_{31k})REA_{ijk}SSCCS_k + (\beta_{12} \\
& + v_{12k})MIND_{ijk}PA_k + (\beta_{22} + v_{22k})MIND_{ijk}NA_k + (\beta_{32} \\
& + v_{32k})MIND_{ijk}SSCCS_k + \beta_{13}PriorPA_{ijk}PA_k + \beta_{23}PriorNA_{ijk}NA_k \\
& + \beta_{33}PriorSSCCS_{ijk}SSCCS_k + \beta_{14}REA \times MT_{ijk}PA_k \\
& + \beta_{24}REA \times MT_{ijk}NA_k + \beta_{34}REA \times MT_{ijk}SSCCS_k \\
& + \beta_{15}MIND \times MT_{ijk}PA_k + \beta_{25}MIND \times MT_{ijk}NA_k \\
& + \beta_{35}MIND \times MT_{ijk}SSCCS_k + \mu_{1jk}^{Days|Participants} + \varepsilon_{1ijk}PA_k \\
& + \varepsilon_{2ijk}NA_k + \varepsilon_{3ijk}SSCCS_k
\end{aligned} \tag{2}$$

Unpacking Equation 2, y_{hijk} is the respective outcome h ($y_{1ijk} = PA$, $y_{2ijk} = NA$, and $y_{3ijk} = SSCCS$) at time i of day j for person k . $\beta_{10}PA$ is the intercept of PA. PA_k , NA_k , and $SSCCS_k$ are indicator variables: For example, PA_k is 1 for PA, 0 for NA, and 0 for SSCCS.

Consequently, terms that include NA_k or $SSCCS_k$ are not included in the prediction of PA (y_{1ijk}). The term $(\beta_{11} + v_{11k})REA_{ijk}PA_k$ is the fixed (β_{11}) and random slope (v_{11k}) of PA regressed on reappraisal. $\beta_{13}PriorPA_{ijk}PA_k$ controls for prior PA at time $t-1$ and $\beta_{14}REA \times MT_{ijk}PA_k$ is the two-way interaction between reappraisal and the mindfulness training on PA. Please note that we did not include the main fixed effect of the mindfulness training nor random person intercepts given that we within-person standardized the Level-2 variables including the outcome. Thus, each mean outcome was zero for each participant, leaving no random person intercept variance that could be explained by Level-4 predictors such as the mindfulness training. Moreover, we allowed for random covariances but only included random slopes for reappraisal and mindfulness to avoid convergence issues due to an increased complexity of an already complex multivariate multilevel model.

Between-person analyses. Given that we within-person standardized the within-person variables, which removes all between-person variance, we could not examine between-person associations in the same model. Instead, we aggregated the measures on the person-level (Level-4) and regressed z-standardized PA, NA, and SSCCS on z-standardized aggregated reappraisal, mindfulness, and mindfulness training as well as on the two-way interactions between the mindfulness training and reappraisal and mindfulness in a multivariate two-level model where the outcomes were nested in participants (Equation 3).

$$\begin{aligned}
 y_{hk} = & \beta_{10}PA_k + \beta_{20}NA_k + \beta_{30}SSCCS_k + \beta_{11}REA_kPA_k + \beta_{21}REA_kNA_k \\
 & + \beta_{31}REA_kSSCCS_k + \beta_{12}MIND_kPA_k + \beta_{22}MIND_kNA_k \\
 & + \beta_{32}MIND_kSSCCS_k + \beta_{14}REA \times MT_kPA_k + \beta_{24}REA \times MT_kNA_k \\
 & + \beta_{34}REA \times MT_kSSCCS_k + \beta_{15}MIND \times MT_kPA_k \\
 & + \beta_{25}MIND \times MT_kNA_k + \beta_{35}MIND \times MT_kSSCCS_k + \beta_{16}MT_k \\
 & + \varepsilon_{1k}PA_k + \varepsilon_{2k}NA_k + \varepsilon_{3k}SSCCS_k
 \end{aligned} \tag{3}$$

Results

Short-Term Benefits of Reappraisal and Mindfulness: Associations With Positive and Negative Affect

As illustrated in Table 3 (the full results can be found at OSF at https://osf.io/dezrj/?view_only=d7cfedd1b94e43dba974977e265c55ee) the multivariate four-level model revealed that only mindfulness but not state reappraisal was significantly associated with increases in PA (Hypothesis 1). Thus, against our hypothesis, the difference between reappraisal and mindfulness when testing the differences with a Wald test was significant but in the opposite direction to expectations, $b_{diff} = -.13$, $SE = 0.02$, $p < .001$. That is, mindfulness was more strongly associated with increases in PA than reappraisal. Regarding NA (Hypothesis 2), we found significant associations for both state reappraisal

and mindfulness, with a significant difference in the predicted direction, $b_{diff} = .21$, $SE = 0.02$, $p < .001$ (Table 3). Of note, the main effect of state reappraisal was positive and, thus, in the opposite direction than assumed, with higher reappraisal being associated with an increase in NA.

For the between-person analyses, we aggregated the data on the person-level and then computed the multivariate two-level regression. We found support for Hypothesis 2 but not for Hypothesis 1: Both the aggregated means of reappraisal and of mindfulness were significantly associated with PA and the difference between the two predictors was not significant (Hypothesis 1). For the aggregated means of NA, only mindfulness but not reappraisal was significant, with a significant difference in the predicted direction (Hypothesis 2).

Short-Term Costs of Reappraisal and Mindfulness: Associations with Subjective Depletion

Regarding the short-term costs of endorsing ER strategies, we hypothesized that reappraisal was associated with higher levels of subjective depletion than mindfulness (Hypothesis 3). The multivariate four-level model, indicated in Table 3, demonstrated that endorsing reappraisal more strongly than a participant was usually doing was significantly associated with an *increase* in subjective depletion. In contrast, recent state mindfulness was associated with significantly *decreased* subsequent subjective depletion. The difference between recent state reappraisal and mindfulness was significant in the predicted direction. The results on the between-person level were consistent with the within-person level: Whereas the aggregated means of reappraisal were *positively* associated with the aggregated means of subjective depletion, the aggregated means of mindfulness were *negatively* significantly associated with the aggregated means of subjective depletion. Again, the difference was significant in the predicted direction.

Table 3

Coefficients of reappraisal and mindfulness predicting short-term positive affect, negative affect, and subjective depletion in Study 1

Outcome	Standardized regression coefficients		Wald test of the difference in regression coefficients
	Reappraisal	Mindfulness	Reappraisal – mindfulness
Short-term benefits (ESM self-reports on the within-person level)			
Positive affect	.02 [-.004, .04]	.14 [.12, .17]	-0.13 [-0.16, -0.09]
Negative affect	.06 [.04, .08]	-.15 [-.18, -.12]	0.21 [0.18, 0.24]
Depletion	.05 [.03, .08]	-.22 [-.25, -.20]	0.28 [0.24, 0.32]
Short-term benefits (ESM self-reports on the between-person level)			
Positive affect	.30 [.09, .51]	.32 [.12, .52]	-0.02 [-0.21, 0.18]
Negative affect	.08 [-.09, .26]	-.56 [-.73, -.38]	0.64 [0.47, 0.80]
Depletion	.10 [-.07, .28]	-.50 [-.68, -.33]	0.61 [0.44, 0.77]

Note. ESM = experience sampling method. Estimates in bold are significant at $p < .05$.

Related Associations in Costs and Benefits

Finally, in addition to our hypotheses, we explored whether changes in costs due to the implementation of reappraisal and mindfulness correlated with changes in benefits. This can be tested by examining the covariances between the random slopes of, for example, reappraisal in predicting the three outcomes. In the present research, we were interested in whether the associations of reappraisal and PA/NA were significantly related to the associations of reappraisal and subjective depletion. Thus, do individuals with a larger increase in PA after endorsing reappraisal experience also less feelings of depletion afterwards? The multivariate four-level model for Hypothesis 1 to 3 revealed that participants who reported a stronger *increase* in subjective depletion on average when endorsing reappraisal also reported *more* NA when endorsing reappraisal, $b_{cov} = .005$, $SE = .002$, $p = .021$, 95% CI [.001, .009], $r = .35$, revealing a medium-to-large effect size. No significant association was found for PA, $b_{cov} = -.002$, $SE = .002$, $p = .233$, 95% CI [-.005, .001], $r = -.21$. These associations were larger for mindfulness: Participants who experienced a stronger *increase in PA* on average when endorsing mindfulness also reported to be *less* depleted on average when in a mindful state, $b_{cov} = -.006$, $SE = .002$, $p = .011$, 95% CI [-.011, -.001], $r = -.36$. In turn, participants who experienced a stronger *decrease in NA* on average when endorsing mindfulness also reported to be *less* depleted on average when in a mindful state, $b_{cov} = .009$, $SE = .002$, $p < .001$, 95% CI [.005, .014], $r = .64$. However, the covariances of the random slopes did not differ significantly between reappraisal and mindfulness, neither for the PA-SSCCS association, $b_{diff} = -.004$, $SE = .003$, $p = .143$, nor the NA-SSCCS association, $b_{diff} = .005$, $SE = .003$, $p = .132$. Thus, the costs and benefits were similarly associated when endorsing reappraisal or mindfulness, which provided no evidence that the decreased costs of endorsing mindfulness were significantly more strongly associated with increased benefits.

Intensity of Reappraisal and Mindfulness Use

Finally, we tested Hypothesis 4 that reappraisal is endorsed less than mindfulness. To that end, we aggregated the reappraisal and mindfulness intensity measures on the person-level and computed a two-level model where the aggregated values of reappraisal and mindfulness were nested within individuals. We controlled for the mindfulness training by including the main effect of the mindfulness training and its two-way interaction with the binary variable (0 = reappraisal, 1 = mindfulness). This model revealed that reappraisal was implemented less strongly in daily life ($M = 0.96$, $SE = 0.07$) than mindfulness ($M = 4.76$, $SE = 0.07$), $t(123) = -35.94$, $p < .001$, $d_z = -3.24$.

Discussion

Study 1 looked at the short-term benefits and costs of reappraisal and mindfulness. Our hypotheses were largely supported: Compared to mindfulness, reappraisal was significantly less effective in decreasing NA (Hypothesis 2), significantly more exhausting (Hypothesis 3), and significantly less strongly endorsed than mindfulness (Hypothesis 4). Of note, with regard to H2, reappraisal was also significantly and positively related to increases in NA. This may suggest that efforts to use reappraisal to combat increases in NA (e.g., following stressors) were ineffective. The only exception was Hypothesis 1, where we neither found on the within- nor on the between-person level that reappraisal was significantly more effective in increasing PA.

Finally, the results from the multivariate multilevel models show that the costs and benefits of emotion regulation are significantly interrelated, with a particularly strong association between person-specific changes in NA and depletion: Individuals who reported lower depletion after regulating their emotions also reported lower levels of NA afterwards. While this association was medium-to-large in size when endorsing reappraisal ($r = .35$, Fisher's $z = 0.37$), it was two times larger when endorsing mindfulness ($r = .64$, Fisher's $z =$

0.74). Thus, it might be that the stronger benefits in terms of decreasing NA when endorsing mindfulness compared to reappraisal could be explained by its decreased costs. However, that this relatively large difference did not reach significance despite Study 1's sample with a relatively large number of observations provides further evidence for the low power of these tests, which was highlighted in previous research (Hertzog et al., 2006). Future research with more power is needed to test whether the decreased costs of mindfulness can explain the increased benefits in terms of decreasing NA.

Taken together, our results demonstrate differential costs and benefits of reappraisal and mindfulness in daily life. However, given that Study 1 only included the unidimensional MAAS as a measure of state mindfulness, we were not able to differentiate between the mindfulness components. While the MAAS nominally measures mindfulness attention and awareness, it was argued that also includes a non-accepting stance, indirectly combining both facts (Bergomi et al., 2013; Blanke et al., 2018). Furthermore, Study 1 did not include trait well-being reports. Thus, the aims of Study 2 were to (a) replicate the evidence regarding short-term benefits, (b) differentiate between different mindfulness components, and (c) include trait self-reports of affect, mental health, life satisfaction, and stress as indicators of subjective well-being.

Study 2

Method

We affirm that we reported all manipulations and exclusions in the present study but only describe the measures of the larger parent study that are relevant to the research questions of the present research. The protocol of Study 2, the Everyday Experiences in the SOEP-IS Study (EE-SOEP-IS; Blanke et al., 2020; Siebert et al., 2017) was approved by the ethics committee of Humboldt-Universität zu Berlin. All participants provided informed consent. All statistical analyses and the full results can be found at OSF

(https://osf.io/dezrj/?view_only=d7cfedd1b94e43dba974977e265c55ee). The data can be obtained via the German Institute for Economic Research (DIW, 2020). Table 1 provides an overview of the dataset in Study 2.

Participants

The target sample size of the parent study of 180 participants was almost achieved with $N = 179$ participants (52.5% female, $M_{age} = 50.9$ years, $SD_{age} = 5.8$). Participants could receive up to 90 €, with 10 € contingent on completing at least 60 observations in the experience sampling phase of the study.

Procedure

Participants were visited in their private households to sign an informed consent form, complete questionnaires and receive the study smartphones (Huawei Ascend G33) including an introduction on how to use them. The ecological momentary assessment started the following day and was broken up into three assessment phases; each phase consisting of four sampling days with a pause of up to four days between the phases. Two of the four pausing days were optionally used to prolong the assessment phase if participants missed more than one assessment a day. Adherence was very good, with 98.7% completed signals consistent with prior publications. All data were analyzed, including signals that were only partially completed.

Measures.

Descriptive information and reliabilities are reported in Table 4 (state measures) and in Table 5 (trait measures).

State measures.

Reappraisal. Reappraisal was assessed as positive reappraisal using the item “*Since the last signal/ Since waking up: I’ve been looking for the positive side of the matter*” (original

wording: *Seit der letzten Befragung/ Seit dem Aufwachen: Ich habe nach positiven Seiten der Angelegenheit gesucht*), using a response scale ranging from 0 (*not at all*) to 6 (*very much*).

Mindfulness. Acceptance and attention were assessed by one item each that were based on the Multidimensional State Mindfulness Questionnaire (MSMQ; Blanke & Brose, 2017). The item for acceptance was “*Things went through my mind that I should not really be engaging myself with*” (reverse coded; original wording: *Mir sind Dinge durch den Kopf gegangen, die mich eigentlich nicht beschäftigen sollten*) and for attention “*I opened myself up to what was happening (e.g., a meal / conversation / music)*” (original wording: *Ich habe mich auf das eingelassen, was gerade geschah [z.B. ein Essen / ein Gespräch / Musik]*). Both items were rated on a scale ranging from 0 (*not at all*) to 6 (*very much*) and, like reappraisal, referred to the time between beeps / since waking up.

Affect. Current PA and NA were measured using six items each selected to represent higher and lower arousal in accordance with the quadrants of the affect circumplex (Russell, 2003), including PANAS items (Watson et al., 1988). All affect items (Table 1) were rated on a scale ranging from 0 (*not at all*) to 6 (*very much*).

Trait measures. As indicators of well-being, we selected PA and NA, life satisfaction, depression, as well as stress. PA and NA were measured with the same six items as in the experience sampling part, in the trait version referring to the average affect in the last twelve months. Life satisfaction was assessed with the 5 items from the German version (Glaesmer et al., 2011) of the Satisfaction With Life Scale (SWL; Diener et al., 1985). Depression was assessed with 10 items from the Center for Epidemiologic Studies Depression Scale (CES-D; Irwin et al., 1999), which assesses depressive symptoms in the last week. Finally, stress was measured with the 10 items from the Perceived Stress Scale (PSS; Cohen et al., 1983; Klein et al., 2016) and with 6 items from the Trier Inventory of Chronic Stress (TICS; Schulz & Schlotz, 1999). While the PSS measures stress in the last month, in the abbreviated version of

the TICS, we measured three of six domains for chronic stress in the last year, namely work overload (e.g., *“Too many tasks that I have to fulfill”*), work discontent, (e.g., *“Negative attitudes towards the work/tasks I have to fulfill everyday”*), and stressful memories (*“Memories of events that burden me greatly”*).

Table 4

Descriptive statistics (mean, standard deviation, within-/between-person reliability, intraclass correlation, and zero-order associations) of the state measures in Study 2

State measure	M^a	SD	ω_{within}	ω_{between}	ICC_{person}	$ICC_{\text{days person}}$	1	2	3	4	5
1. Reappraisal	2.45	1.41	—	.87 ^b	.49	.59	-	-.13	.15	.37	.04
2. Acceptance	4.52	1.13	—	.79 ^b	.42	.57	-.03	-	.12	.18	-.70
3. Attention	3.79	1.21	—	.84 ^b	.45	.56	.07	.05	-	.42	-.25
4. Positive affect	3.19	0.76	.81	.91	.39	.59	.16	.14	.21	-	-.29
5. Negative affect	1.05	0.81	.81	.96	.47	.63	-.02	-.33	-.16	-.37	-

Note. ω_{within} = within-person reliability and ω_{between} = between-person reliability (Geldhof et al., 2014; McNeish, 2018).

^aThe mean was calculated based on the person-level aggregated variables. Estimates in bold are significant at $p < .05$.

^bTo compute the between-person reliability for single items, we computed the mean for each of the three measurement bursts and then used the three indicators in a structural equation model to compute ω_{between} .

Averaged within-person correlations are shown in the lower left corner, between-person correlations in the upper right corner.

Table 5

Descriptive statistics (mean, standard deviation, range, and reliability) of the trait measures in Study 2

Trait measure	<i>M</i>	<i>SD</i>	Possible range	Actual range	ω	1	2	3	4	5
1. Positive affect (PANAS)	3.41	0.60	1 - 5	1.83 - 5.00	.85	-				
2. Negative affect (PANAS)	2.46	0.80	1 - 5	1.00 - 4.75	.90	-.54	-			
3. Life satisfaction (SWLS)	4.54	1.12	1 - 7	1.00 - 6.80	.85	.54	-.38	-		
4. Depression (CES-D)	0.85	0.51	0 - 3	0.00 - 2.60	.84	-.61	.59	-.46	-	
5. Perceived stress (PSS)	1.60	0.57	0 - 4	0.40 - 3.20	.83	-.60	.66	-.47	.66	-
6. Chronic stress (TICS)	1.77	0.77	0 - 4	0.33 - 4.00	.85	-.54	.74	-.39	.56	.68

Note. PANAS = Positive and Negative Affect Schedule; SWLS = Satisfaction With Life Scale; CES-D = Center for Epidemiologic Studies Depression Scale; PSS = Perceived Stress Scale; TICS = Trierer Inventar zur Erfassung von chronischem Stress [Trierer Inventory of Chronic Stress]. Estimates in bold are significant at $p < .05$.

Analytic Approach

The analytic approach in Study 2 was the same as in Study 1. Given the relatively large number of trait well-being measures, we did not compute the mean across these measures but instead performed a mega-analysis (Boedhoe et al., 2019; Curran & Hussong, 2009). This is recommended when raw data are available given that this approach is associated with greater precision as reflected in smaller standard errors. In the mega-analysis, the individual well-being measures are nested within participants. Thus, we computed a two-level model predicting the nested trait well-being measures by z-standardized aggregated reappraisal, acceptance, and attention.

Results

Short-Term Benefits of Reappraisal and Mindfulness: Associations with Positive and Negative Affect

We first were interested in the differential relation between change in affect from one measurement occasion to the next, and recent reappraisal, acceptance, and attention to examine short-term benefits of these strategies. To that end, we computed multivariate four-level models (measures nested observations nested within days nested within individuals) predicting current PA and NA by recent reappraisal, recent attention, and recent acceptance while controlling for prior NA and PA and allowing for random slopes and covariances. Table 6 shows that recent reappraisal, acceptance and present-moment attention were all significantly associated with increases in current PA. Importantly, the Wald test showed that the difference between the coefficient of recent reappraisal and of acceptance testing Hypothesis 1b was significant and in the predicted direction, but that the difference between the coefficient of recent reappraisal and of attention was not significant. In turn, recent acceptance and attention were both significantly related to decreases in current NA, whereas recent reappraisal was not. To test Hypothesis 2b, that acceptance was more effective in

decreasing NA than reappraisal and attention, we computed Wald tests again, which found support for Hypothesis 2b: Implementing state acceptance in daily life was significantly associated with a stronger decrease in NA compared to implementing state reappraisal and attention.

To examine between-person differences in the relation between affect, reappraisal, and mindfulness, we computed a multivariate two-level model predicting averaged state PA and NA by averaged state reappraisal, attention, and acceptance. As illustrated in Table 6, the results were consistent with the within-person analyses, demonstrating that individuals who endorsed reappraisal more strongly than others reported higher levels of PA. Testing Hypothesis 1b by computing Wald tests revealed that the difference between the coefficient of aggregated reappraisal and aggregated acceptance was significant and in the predicted direction, $b = 0.23$, $SE = 0.08$, $p = .006$. The difference between the coefficient of aggregated reappraisal and aggregated attention, however, was not significant. In turn, individuals who accepted their own thoughts and feelings more strongly, but not those who endorsed reappraisal more strongly, reported lower levels of NA. With regard to Hypothesis 2b, we found that acceptance was significantly more effective in decreasing NA than reappraisal and attention, $b = 0.66$, $SE = 0.07$, $p < .001$, with no significant difference between the latter (Table 6).

Thus, our results suggest a differential relation between current affect and the regulatory efforts of reappraisal, present-moment attention, and acceptance.

Table 6

Coefficients of person-level aggregated reappraisal, attention, and acceptance predicting short- and long-term well-being in Study 2

Outcome	Standardized regression coefficients			Wald test of the difference in regression coefficients		
	Reappraisal	Acceptance	Attention	Reappraisal – acceptance	Reappraisal – attention	Acceptance – attention
Within-person level benefits (ESM self-reports on the within-person level)						
PA	.13 [.11, .15]	.08 [.05, .11]	.14 [.12, .17]	0.05 [0.01, 0.09]	-0.01 [-0.05, 0.03]	-0.06 [-0.10, -0.02]
NA	-.02 [-.05, .01]	-.26 [-.30, -.23]	-.12 [-.15, -.09]	0.25 [0.20, 0.29]	0.10 [0.06, 0.14]	-0.14 [-0.19, -0.10]
Between-person level benefits (ESM self-reports on the between-person level)						
PA	.35 [.23, .48]	.12 [-.004, .25]	.33 [.21, .46]	0.23 [0.06, 0.39]	0.02 [-0.18, 0.21]	-0.21 [-0.40, -0.02]
NA	-.02 [-.13, .08]	-.68 [-.79, -.58]	-.16 [-.27, -.06]	0.66 [0.52, 0.80]	0.14, [-0.02, 0.30]	-0.52 [-0.68, -0.37]
Trait-level well-being measures						
PA	.17 [.02, .31]	.25 [.10, .39]	.17 [.03, .31]	-0.08 [-0.26, 0.11]	-0.003 [-0.22, 0.22]	0.07 [-0.14, 0.29]
NA	-.19 [-.33, -.06]	-.41 [-.55, -.28]	-.11 [-.24, .03]	0.22 [0.04, 0.39]	-0.09 [-0.29, 0.12]	-0.30 [-0.50, -0.10]
Life satisfaction	.07 [-.08, .22]	.15 [.005, .30]	.15 [.01, .30]	-0.08 [-0.27, 0.11]	-0.08 [-0.31, 0.14]	-.002 [-0.22, 0.22]
Depression	-.11 [-.25, .03]	-.38 [-.52, -.24]	-.14 [-.28, >-.01]	0.27 [0.09, 0.44]	0.03 [-0.18, 0.24]	-0.24 [-0.44, -0.03]
Perceived stress	-.05 [-.19, .09]	-.39 [-.52, -.25]	-.16 [-.30, -.02]	0.34 [0.16, 0.51]	0.11 [-0.10, 0.32]	-0.23 [-0.43, -0.02]
Chronic stress	-.17 [-.31, -.04]	-.43 [-.57, -.30]	.01 [-.13, .15]	0.26 [0.08, 0.43]	-0.19 [-0.39, 0.02]	-0.44 [-0.65, -0.24]
Overall well-being	.12 [.01, .22]	.31 [.21, .42]	.15 [.04, .25]	-0.20 [-0.34, -0.06]	-0.03 [-0.19, 0.13]	-0.17 [0.01, 0.33]

Note. ESM = experience sampling method. Overall well-being results are derived by a multilevel model, in which the individual well-being measures are nested within participants. This mega-analytical or integrative approach is associated with greater precision than meta-analyses or computing the mean of the well-being measures (Boedhoe et al., 2019; Curran & Hussong, 2009). Estimates in bold are significant at $p < .05$.

Associations of Reappraisal and Mindfulness with Trait-Level Subjective Well-Being

In addition, we modelled correlates in the domain of subjective well-being by examining the association between aggregated state reappraisal, acceptance, and attention with trait well-being measures (Hypothesis 5). Specifically, the respective well-being measures were predicted by aggregated state reappraisal, acceptance, and attention.

Table 6 shows that acceptance was a significant predictor of all six well-being measures. Moreover, except for life satisfaction and PA, acceptance always showed the largest effect sizes, which were significantly larger than the effect sizes of reappraisal and attention when predicting NA, depression, and stress. Finally, the mega-analysis on overall subjective well-being further demonstrated that acceptance emerged as the strongest predictor of overall subjective well-being that was significantly stronger associated with overall subjective well-being than reappraisal and attention. The difference between reappraisal and attention was not significant, as the difference was very close to zero.

Intensity of Reappraisal and Mindfulness Use

Based on prior research, we hypothesized that reappraisal is used less often than mindfulness (Hypothesis 4). As in Study 1, reappraisal was endorsed less strongly ($M = 2.45$, $SD = 1.41$) compared to acceptance ($M = 4.52$, $SD = 1.13$), $t(178) = -14.48$, $p < .001$, $d_z = -1.08$, or attention ($M = 3.79$, $SD = 1.21$), $t(178) = -10.47$, $p < .001$, $d_z = -0.78$. Finally acceptance was implemented more strongly than attention, $t(178) = -6.32$, $p < .001$, $d_z = -0.47$.

Discussion

In Study 2, we replicated our results in relation to Hypothesis 1, 2, and 4. Additionally, we differentiated between the mindfulness facets present moment attention and acceptance to compare their associations with affective well-being in relation to reappraisal. In line with Hypothesis 1b, we found that reappraisal and present moment attention were both similarly

associated with PA, suggesting that reappraising a situation and being aware of momentary sensations can be equally more beneficial for one's present PA than accepting things as they are.

However, in line with Hypothesis 2b, we found that acceptance more effectively decreased NA than reappraisal and present moment attention. This was not only the case on the within- but also on the between-person level in that acceptance was additionally best to predict several well-being measures. In line with the beneficial effects of acceptance, individuals also preferred implementing acceptance most intensely in daily life, while reappraisal was used less intensely than present moment attention and acceptance, which confirmed Hypothesis 4.

In sum, the findings in Study 2 suggest (i) that it is important to examine the unique effects of mindfulness facets on present affective experiences, (ii) that associations between reappraisal/mindfulness and affective well-being were consistent on the within- and between-person level, and (iii) that there was not a single strategy that was generally (most) adaptive for both PA and NA. Instead, acceptance was most adaptive for decreasing NA, whereas reappraisal and attention were most effective in increasing PA.

General Discussion

Given that past research mostly focused on examining the beneficial effects of instructed mindfulness and reappraisal in controlled laboratory settings, there is only limited knowledge about the potential costs that come with their spontaneous implementation. Therefore, the present research aimed to examine and compare within- as well as between-person benefits and costs between the spontaneous use of mindfulness and reappraisal in daily life.

Daily Life Benefits and Costs

Regarding the benefits of implementing the two strategies, we found mindfulness and reappraisal to enhance present PA. With respect to the different mindfulness facets, this positive association was particularly pronounced when individuals paid attention to the present moment. However, when it came to reducing NA, mindfulness and more specifically accepting present experiences was most strongly negatively associated with NA, while reappraisal did not seem to play an important role in the downregulation of NA. Moreover, individuals who reported high levels in mindfulness and more specifically acceptance on average, reported less NA in daily life than other individuals. Thus, the present research replicated past findings on the differential benefits of the spontaneous use of mindfulness facets (Blanke et al., 2018) and reappraisal in daily life (Brans et al., 2013). Furthermore, it adds evidence that reappraisal and present moment attention can be equally effective in enhancing present moment PA, while acceptance seems to be more important than reappraisal in reducing NA.

Concerning the costs of the spontaneous use of the strategies, we found that when individuals endorsed reappraisal more strongly, they also felt more exhausted. In contrast, the implementation of mindfulness was mentally less taxing and even decreased feelings of exhaustion. These daily life findings match to past laboratory studies' findings that acceptance is less effortful to implement than reappraisal (Troy et al., 2018) and may even help to restore cognitive resources (Frieze et al., 2012). Thus, future research may not only focus on the benefits associated with ER strategies but also acknowledge their costs, which are important aspects of ER in daily life.

Besides the mental costs of using reappraisal, recent research also showed that almost half of the individuals in an experience sampling study reported being unsuccessful in reappraising a negative situation in daily life (Ford et al., 2017). Furthermore, it is assumed

that the accumulated effect of unsuccessfully trying to reappraise can be detrimental for one's mental health (Ford et al., 2017; Ford & Troy, 2019). Therefore, reappraisal may only be beneficial for one's well-being when it is used successfully (Ford et al., 2017). Nevertheless, both reappraisal and mindfulness tend to be equally effective in enhancing PA in the short-term, but mindfulness provides a less mentally taxing way for individuals to improve their present feelings. In line with this, our further findings indicate that individuals more frequently implemented mindfulness in comparison to reappraisal, which already suggests that they prefer beneficial, but less mentally taxing approaches to ER in daily life.

Finally, PA and particularly NA were strongly correlated with depletion when endorsing either reappraisal or mindfulness: Participants who decreased their NA more strongly by ER also reported to feel less depleted. Thus, individuals who were less compared to more depleted, also reported to experience increased PA or decreased NA, hinting at the importance of the costs of emotion regulation for individuals' affective well-being. Thus, future research on ER could more elaborately examine the costs of emotion regulation in daily life and when ER efforts fail and how it affects individuals, possibly connecting to self-regulation research on the setback effect (Wenzel, Rowland, Hofmann, et al., 2020).

Benefits for Individuals' Subjective Well-Being on the Trait-Level

Whereas the associations using the current and aggregated PA and NA measures reflect the experiencing self, we were also interested in the associations with trait measures of well-being that tap more into the believing self (Conner & Barrett, 2012). To that end, we examined associations between the daily use of mindfulness and reappraisal and trait-reports of subjective well-being that capture individuals' overall appraisal of their well-being. Although we expected reappraisal to show smaller associations with trait-reports of well-being than mindfulness, we found in particular acceptance to be the best predictor of almost all trait-well-being measures while reappraisal and present-moment attention showed equally

small effects. Thus, while individuals who were more accepting than others only experienced less NA, but not more PA than others in daily life, they more positively evaluated their overall well-being than others. However, Table 6 illustrates that acceptance showed the lowest associations with the two trait measures of well-being that focus on positive aspects of wellbeing, namely PA and life satisfaction. Although this result is consistent with the results for momentary and aggregated PA and NA, the overlapping 95% CIs indicate that these two regression coefficients likely did not significantly differ from the other more negative aspects. More research is needed to further evaluate the role of reappraisal and attention to the present moment for positive aspects of trait well-being or flourishing.

The present findings regarding the accepting stance in daily life is in line with findings from trait-measures of acceptance which showed acceptance as an important predictor of overall (affective) well-being (Carpenter et al., 2019). This also means that findings from past studies, which relied on trait-measures, cannot be reduced to the shared variance due to the common method. Thus, the present multi-method approach that we used to examine associations between ER strategies in daily life and trait well-being measures provides new evidence that the actual implementation in daily life and not just the retrospective evaluation of one's ER is beneficial for individuals' well-being. This is particularly highlighted by the diverging results for reappraisal in Study 1, which was positively associated with PA on the between-person level but not on the within-person level. Moreover, it was not significantly associated with NA on the between-person level but with increased not decreased NA on the within-person level, possibly reflecting the increased costs of implementing reappraisal in daily life.

In sum, based on our and others' past research, we assume that acceptance comes with less drawbacks, is mentally less costing than reappraisal and may result in an overall better subjective well-being over the time. In contrast, while the successful spontaneous use of

reappraisal is positively associated with one's short-term well-being, the accumulated effects of feeling exhausted after using reappraisal may dampen these benefits on one's overall well-being or may even be detrimental for individuals' overall well-being in the long run (Troy et al. 2017).

Limitations and Future Directions

Although our research provides important evidence for both the costs and benefits of implementing mindfulness and reappraisal in daily life, we still have to acknowledge some limitations, which we will discuss in the following paragraphs.

First, we found a somewhat counterintuitive result with regard to reappraisal in Study 1. While we expected reappraisal to be less negatively associated with NA than mindfulness, we found that when individuals used reappraisal more intensely than usual, they also reported more NA than they usually do. Given that this was only the case in Study 1, but not in Study 2, this finding may be explained by the different wordings of the reappraisal items. In Study 1, reappraisal was measured by asking individuals to what degree they have tried to view the cause of their feelings from a different perspective, which is best characterized as *cognitive reappraisal*. In Study 2, individuals were asked to what degree they have tried to view the positive side of a matter, which is a operationalization of *positive reappraisal* (Garland et al., 2009). Thus, while in Study 1, the cause of one's feelings may also be negative and reappraising the situation does not specifically aim at improving present feelings, in Study 2, individuals actively tried to find positive meaning in a difficult situation. This is also in line with a past study's findings: Bringing to mind the possible causes of an event (which was called analytical rumination) was found to maintain negative feelings of anger during an anger-inducing memory recall task, whereas positive reappraisal and distraction reduced anger (Denson et al., 2012). Thus, viewing the cause of one's feelings from another

perspective may have differential consequences than actively focusing on positive aspects of a situation, which may explain our diverging findings.

Furthermore, the reappraisal items referred to how individuals regulated their feelings since the last signal while affective experiences referred to the present moment. Thus, NA that apparently followed reappraisal may not solely be the result of using reappraisal. More likely, NA may be the result of a complex interplay between negative events that caused NA responses and the used ER strategies aimed at regulating NA over time. However, given that recent reappraisal was positively associated with present NA, the implementation of reappraisal might have been not successful enough in the given short timeframe to regulate NA down to baseline levels. Thus, in order to identify the interplay between emotionally relevant events and used ER strategies and their effect in present affective experiences, a more elaborate experience sampling approach that combines event-, signal-, and interval contingent sampling methods may be fruitful.

Second, Study 2's findings highlight the importance to differentiate between the mindfulness facets acceptance and attention given that both facets were differently associated with benefits in daily life. However, differentiating between the two facets may be equally important with regard to the costs of implementing mindfulness and reappraisal. Unfortunately, we could only examine the costs of implementing mindfulness in Study 1 in which we measured mindfulness using three items from the MAAS (Brown & Ryan, 2003), not differentiating between the two facets. Even though the MAAS was constructed to measure only present moment attention and awareness, it may also capture nonjudgmental acceptance: The MAAS uses solely negatively formulated items that implicitly capture a rather judging and critical stance (Bergomi et al., 2013). In line with that, the MAAS was found to be more strongly associated with the acceptance subscale of other mindfulness questionnaires than with an observing stance (e.g., Höfling et al., 2011). Thus, since the

MAAS intertwines both mindfulness facets, we cannot clearly state whether attention or acceptance or both restore one's cognitive capacities and are mentally less taxing than reappraisal. Given that appraising oneself as being exhausted is also a negative judgement of one's present willpower, using acceptance may also decrease that negative appraisal. Furthermore, NA and PA may be experienced independently from depletion when endorsing acceptance since a mindful stance was also found to be associated with a better ability to differentiate between emotions (Hill & Updegraff, 2012). Particularly the differentiation between negative emotions is viewed as an important indicator for individuals' well-being (Erbas et al., 2014). Future research may choose state measures of mindfulness that more clearly differentiate between both facets (e.g., Blanke & Brose, 2017).

Third, we cannot make any causal conclusions based on our results as our data is observational and the analyses mostly correlational. For example, although reappraisal was associated with more feelings of exhaustion, there may be several other factors possibly contributing to those feelings. It may be the case that individuals already tried and switched between several other ER strategies to regulate their feelings before using reappraisal (Guiller et al., 2019), which may be mentally taxing by itself. However, in controlled laboratory settings, reappraisal was rated as being more difficult to implement than mindfulness (Troy et al., 2018). Thus, our findings provide evidence from daily life that the implementation of reappraisal can be mentally taxing, even though we possibly missed other situational factors that contributed to that exhaustion.

Fourth, besides the mentally taxing costs of implementing reappraisal and the possibility that reappraisal is not always successful, this strategy may also come with another drawback: Ford and Troy (2019) discussed in a recent paper that using reappraisal is not always functional depending on individual and situational regulation goals (Tamir, 2013). First, it may be the case that the NA that was targeted could be successfully improved, but if

the individual does not feel authentic in regulating their negative feelings, a negative meta-emotion may increase instead of decrease. Furthermore, NA may actually be a motivator to change something in a given situation, but the successful regulation of that NA may reduce the motivation to actually change something. Thus, more problem-focused actions may be neglected in favor of reducing NA, which does not improve the situation itself and is assumed to have long-term consequences for one's health (Ford & Troy, 2019). Therefore, it may be fruitful for future research to also consider further costs and drawbacks that come with implementing reappraisal and mindfulness in daily life. For example, by examining individuals' regulation goals, it could be investigated how reappraisal and mindfulness support or hinder reaching these goals, which may also be longer-term instead of only short-term as in the present research.

Fifth, although we think it is very beneficial to reanalyze existing experience sampling datasets given the relatively heavy burden of data collection not only for the participants, one disadvantage is that these studies were not tailored to the hypotheses of the present research. For example, we could not differentiate between the mindfulness facets in Study 1. Future research could utilize a complete multitrait-multimethod approach by assessing reappraisal, the mindfulness facets, and well-being with different methods such as trait questionnaires and experience sampling to test the full range of associations and to fully control for issues regarding common method variance.

Finally, reappraisal and mindfulness and its facets were assessed with only one item each to reduce the burden for the participants. Although this is a common approach in experience sampling in order to find an appropriate trade-off between participants' burden and reliability, it also reduces the complexity of the given constructs. For example, eight different subtypes of reappraisal have been reported (McRae et al., 2012), only two of which

we assessed in the present research. Thus, future research could use at least three items for key strategies (e.g., Blanke & Brose, 2017, for mindfulness).

Conclusion

The present research provides evidence for the benefits and costs that come with the implementation of reappraisal and mindfulness in daily life. While reappraisal and mindful attention were equally effective in upregulating PA, reappraisal was more mentally costing than mindfulness. Given that individuals implemented mindfulness more strongly than reappraisal, they may prefer beneficial, but less mentally taxing strategies in daily life. Additionally, acceptance played the most important role in downregulating NA and also in predicting trait-measures of subjective well-being. Thus, the reduced cognitive costs that come with a mindful accepting stance in comparison to reappraisal may have beneficial effects more broadly. Accepting emotions and thoughts as they are instead of trying to change them may be a healthy and comparatively less cognitively effortful way to handle difficult situations in everyday life, which possibly enhances individuals' subjective well-being.

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Footnotes

¹No commonly accepted guidelines exist regarding the minimum number of completed observations in experience sampling studies. To be consistent with our prior handling of the datasets, we excluded participants with fewer than 33% completed observations in Study 1 only.

²Although multivariate multilevel models have many benefits when comparing different outcomes (Baldwin et al., 2014), there were rarely computed in prior emotion regulation research. To facilitate comparison with evidence from prior research, we also performed univariate analyses, which results can be found in Tables S7-S13 in the online supplementary materials at OSF (https://osf.io/dezrj/?view_only=d7cfedd1b94e43dba974977e265c55ee). Please note that the fixed and random effects of the multivariate models were identical or very close to those of the univariate analyses with PA, NA, and SSCCS as the respective outcome.