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Interference resolution moderates the impact of rumination and reappraisal on affective experiences in daily life

Madeline Lee Pe [a], Filip Raes [a], Peter Koval [a], Karen Brans [a], Philippe Verduyn [a] & Peter Kuppens [a]

[a] Department of Psychology, University of Leuven, Leuven, Belgium

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BRIEF REPORT

Interference resolution moderates the impact of rumination and reappraisal on affective experiences in daily life

Madeline Lee Pe, Filip Raes, Peter Koval, Karen Brans, Philippe Verduyn, and Peter Kuppens

Department of Psychology, University of Leuven, Leuven, Belgium

Research has shown that cognitive control processes play a central role in emotion regulation. While most research has examined whether individual differences in such processes are related to the use of these strategies, a crucial next step involves examining whether such differences influence their *impact* on people's feelings, especially in normal daily life. The present study examined whether impairments in cognitive control (measured using an affective interference resolution task) moderate the impact of using rumination and reappraisal on affective experiences in everyday life (assessed using experience sampling methods). Multilevel analyses revealed that difficulties removing previously relevant negative information from working memory were associated with a larger increase in negative affect following rumination, and smaller increase and decrease in positive and negative affect, respectively, following reappraisal. These findings show that impaired interference resolution for negative information aggravates the deleterious effects of rumination and curbs the benefits of reappraisal in daily life.

Keywords: Emotion regulation; Interference resolution; Rumination; Reappraisal.

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There is a growing understanding that cognitive control processes play an integral role in emotion regulation (Zelazo & Cunningham, 2007). Indeed, the ways in which affective information is controlled in working memory (WM) may reflect the basic cognitive processes that are taking place when people regulate their emotions (Joormann & D'Avanzato, 2010). For example, impairments in the inhibition of negative content are found to be associated with the use of rumination (e.g., Joormann, 2006) and are hypothesised to be involved in reappraisal (Joormann & D'Avanzato, 2010).

Although previous studies have demonstrated that inhibition impairments are associated with the use of emotion-regulation strategies, these studies do not examine whether these deficits affect the impact of such strategies (Joormann & D'Avanzato,

Correspondence should be addressed to: Madeline Lee Pe, Department of Psychology, University of Leuven, Tiensestraat 102, Box 3713, B-3000 Leuven, Belgium. E-mail: madeline.pe@ppw.kuleuven.be

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2010). For instance, knowing that people who have difficulty removing irrelevant negative information from WM ruminate more (Joormann & Gotlib, 2008) does not tell us whether these inhibition impairments also influence the impact of rumination on emotion (e.g., increasing or sustaining negative affect). Therefore, as advocated by Joormann and D'Avanzato (2010), there is a strong need to investigate whether individual differences in cognitive control affect not only the use of emotion-regulation strategies, but also their *effectiveness*. The present study fills this gap in the literature by examining whether deficits in inhibiting previously relevant negative information influence the impact of rumination and reappraisal on negative (NA) and positive affect (PA) in daily life.

Rumination and reappraisal

Rumination and reappraisal are two strategies that people may employ when regulating their emotions. Rumination involves repetitively thinking about negative feelings, their possible causes, meanings and consequences (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Reappraisal refers to viewing emotional events from a different perspective (Gross & John, 2003). Both strategies are implemented cognitively and involve sustained attention on emotional experience (Parkinson & Totterdell, 1999), making them prime candidates to be affected by the very processes outlined above. Yet, they are also clearly distinct in the sense that the former represents a maladaptive strategy (Nolen-Hoeksema et al., 2008) while the latter represents an adaptive one (Gross & John, 2003). As such, the focus on these two strategies allows the testing of predictions for the moderating role of cognitive inhibition on both adaptive and maladaptive effectiveness of emotion regulation on experience.

Interference resolution and emotion regulation

Previous studies have posited that difficulties in inhibiting previously relevant information are related to the use of emotion-regulation strategies. That is, difficulties in resolving interference from previously relevant information in WM may cause recurring and uncontrollable thoughts (triggering rumination; Joormann & Gotlib, 2008; Joormann, Nee, Berman, Jonides, & Gotlib, 2010; Zetsche, D'Avanzato, & Joormann, 2012) and limit the capacity to attend to and process new information (preventing reappraisal; Joormann & D'Avanzato, 2010).

However, it is also possible to hypothesise that these inhibitory deficits may determine the effectiveness of a certain regulation strategy; that is, the impact they have on actual emotional experience. People who have difficulty inhibiting previously relevant *negative* information would have negative material more readily accessible in WM. As a consequence, the likelihood of using this information when regulating emotions is higher. Thus, more negatively valenced information is available to feed into ruminative and reappraisal processes, leading to a heightened experience of negative mood when ruminating, and a smaller increase and decrease of positive and negative mood, respectively, when reappraising.

This assumption is not unique to the present study. Ciesla and Roberts (2007) proposed a cognitive catalyst model in which the type of cognitive content (negative cognitions) is deemed important in determining the effect of emotion regulation (rumination) on affect (depressed mood). From this perspective, rumination does not cause negative cognitions nor do negative cognitions cause rumination, but rather rumination heightens the effect of negative cognition on depressed affect.

Indeed, several empirical studies have supported this proposition (Ciesla, Felton, & Roberts, 2011; Ciesla & Roberts, 2007; Robinson & Alloy, 2003). Individuals who ruminated and had high levels of negative thought content experienced heightened depressed affect, whereas in those who had low levels of negative thought content, the relationship between rumination and depressed affect was blunted.

The present study

The present study responds to Joormann and D'Avanzato's (2010) call to examine whether the

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effect of emotion-regulation strategies on changes in NA and PA in daily life is a function of one's ability to resolve interference from previously relevant negative information. Building on the cognitive catalyst model (Ciesla & Roberts, 2007), we expected that for people who have difficulty removing previously relevant negative information from WM, rumination would lead to a greater increase and decrease in NA and PA, respectively.

While to our knowledge there is no research examining interference resolution in relation to the effectiveness of reappraisal, we hypothesised that according to the same principles, individuals who have difficulty removing negative information from their WM would be less likely to reappraise successfully. We therefore expected that for individuals who had such deficits in WM, the beneficial effect of reappraisal on affective experience would be blunted (i.e., lesser increase and decrease in PA and NA, respectively).

METHOD

Participants

Out of 439 first-year undergraduates from University of Leuven who completed the Centre for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977), 100 participants, representing a wide, balanced, and uniform range of depression scores (range = 0–50, $M = 19.27$, $SD = 12.53$), were selected to take part in a large experience sampling study. One participant withdrew early and four participants were excluded from data analyses (due to equipment malfunction, $n = 3$, or poor compliance, $n = 1$) leaving a final sample of 95 participants (59 women, 36 men, $M_{age} = 19.06$ years, $SD_{age} = 1.28$). Participants were paid €70 for participation.

Procedure

At the start of the study, participants were invited to the lab and assigned to individual cubicles. During the first session, the affective interference resolution task was administered among others, on a desktop computer. Next, participants received a Tungsten E2 palmtop computer and instructions for general use and how to respond to the questions at each beep.

During the week, participants carried the palmtop computer as they went about their daily activities and responded to the questions when signalled (i.e., beep from the palmtop). Palmtops were individually programmed (using ESP 4; Barrett & Feldman-Barrett, 2005) to beep 10 times a day (during a 12-hour period) for seven consecutive days. On each day, the 12-hour sampling period was divided into 10 equal time blocks and one beep was programmed to occur randomly within each block. Items were presented in random order at each beep. Overall, participants responded to 91.5% ($SD = 6.2$) of the programmed beeps, demonstrating very good compliance.

After one week, participants returned to the lab to return their palmtops and complete a series of additional tasks. Subsequently, they were debriefed and paid for their participation.

Materials

Repeated assessment of emotions. Using a continuous slider scale that ranged from 1 (*Not at all*) to 100 (*Very much*), participants recorded their current levels of anger, sadness, dysphoria, anxiety, happiness and relaxation at each beep. For each beep, composite scores for NA (beep-level reliability = .66; person-level reliability = .98) and PA (beep-level reliability = .65; person-level reliability = .97) were created by taking the mean scores of the negative and positive feeling items, respectively.

Repeated assessment of rumination and reappraisal. At each beep, participants responded to an item on rumination ("Have you ruminated[1] since the last beep?") and an item on reappraisal

[1] We used the Dutch word *piekeren* for rumination. While the word "rumineren" exists in Dutch, it is not used in everyday language. In contrast, "piekeren" is the term that is used in everyday language to refer to rumination (and worrying). *Piekeren*, thus, broadly refers to recurrent negative thinking.

("Have you viewed the cause of your feelings from a different perspective since the last beep?") using a continuous slider that ranged from 1 (*Not at all)* to 100 (*Very much*). Participants also responded to items probing about other emotion-regulation strategies (i.e., suppression, reflection, social sharing and distraction). For each beep, a mean emotion regulation(ER mean) score was calculated based on the average of all emotion-regulation items for each beep. This represents how much participants tried to regulate their feelings in general at each moment.

Depression. The CES-D (Radloff, 1977) consists of 20 items and is one of the most widely used self-report scales to assess the severity of current depressive symptoms.

Affective interference resolution task. We adapted the affective interference resolution task from Levens and Phelps (2008). Stimuli were Dutch translations of affective words taken from the Affective Norms of English Words list (ANEW; Bradley & Lang, 1999). Words with valence ratings ranging between 1–4, 4–6, and 6–9 were identified as negative ($M = 2.47$, $SD = 0.74$), neutral ($M = 5.19$, $SD = 0.43$) and positive ($M = 7.62$, $SD = 0.55$), respectively. Words were matched for arousal ratings and word length.

The task was divided into one practice block comprising eight trials (not scored) and 144 actual trials separated into eight blocks. Each trial began with a target set of four words displayed around a fixation cross on the centre of the screen for 1,200 ms. This was followed by a delay of 3,000 ms, where only the fixation cross was presented. The fixation cross was then replaced by a probe word for 1,500 ms. Participants were then asked to respond as quickly and accurately as possible whether or not the probe word was part of the current target set. Using the computer keyboard, participants pressed "1" if the answer was "Yes" and "2" if the answer was "No".

Each target set contained two words that had been presented in the previous target set and two words that had not appeared in each of the two previous target sets. In addition, there was always at least one positive, one neutral and one negative word in each target set. An item never appeared in more than two consecutive trials.

There were four trial types (recent no, 45 trials; non-recent no, 36 trials; recent yes, 27 trials; and non-recent yes, 36 trials)[2] divided equally among three valence conditions (*negative*, *neutral* and *positive*). A recent no response trial meant that the probe word did not match any items in the current target set (requiring a "no" response), but matched one of the words from each of the two previous target sets; a non-recent no response trial meant that the probe word did not match any items in the current target set (requiring a "no" response) nor from the two previous target sets; a recent yes response trial meant that the probe word matched an item in the current target set (requiring a "yes" response) and from the previous target set; and a non-recent yes response trial meant that the probe word matched an item in the current target set (requiring a "yes" response), but did not match any of the items from the previous set. The valence of each trial was determined by the probe word.

Data preparation

For each trial type of every valence condition, we applied the data preparation procedure[3] of Friedman and Miyake (2004) for response time (RT) measures. Only correct trials were included in the analysis ($M = 90\%$, $SD = 5\%$). Upper and lower criteria were determined through visual inspection of the overall RT distributions; values < 300 ms and $> 2{,}000$ ms were eliminated. For each participant, RTs more than 3 *SD*s from the participant's mean for each condition were replaced with values that were 3 *SD*s from the participant's mean for that condition. Between-subjects RT distributions were then examined for each condition, and scores above or below 3 *SD*s from the group

[2] The proportion of trials was taken from D'Esposito, Postle, Jonides, and Smith (1999).

[3] All 100 participants completed the affective interference resolution task. For data preparation, we used data of all participants.

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mean were replaced with values that were plus or minus 3 *SD*s from the mean, respectively.

The amount of interference that needs to be resolved is reflected in the difference score in RTs between the recent no and non-recent no trials (Levens & Gotlib, 2009). Interference scores were calculated separately for each valence (negative, neutral, positive). A higher score reflects a higher amount of interference that participants needed to resolve (i.e., more difficulty resolving interference; D'Esposito et al., 1999; Levens & Gotlib, 2009).

Since we were interested in valence effects, the relevant variables in the present study are reflected in the difference scores between the interference scores from negative and neutral trials (negative interference level), and between positive and neutral trials (positive interference level).

Statistical model

To examine the impact of emotion regulation on affect in daily life, a hierarchical linear modelling approach was employed to take into account the nested structure of the experience sampling data: Measurement occasions (Level 1) nested within persons (Level 2). At Level 1, we modelled how much the use of an emotion-regulation strategy at time $t+1$ (e.g., rumination, which was assessed "since the last beep") was associated with a *change* in affect (e.g., NA) from time t to $t+1$, where time t to $t+1$ refers to two consecutive beeps within the same day:

$$NA_{t+1} = \beta_{0j} + \beta_{1j}(NA_t) + \beta_{2j}(Rumination_{t+1}) + r_{1j}$$

At Level 2, we modelled how the rumination–NA slope (β_{2j}) is a function of individual differences in valenced interference levels (e.g., negative interference):

$$\beta_{0j} = \gamma_{00} + \gamma_{01}(Negative\ interference) + u_{0j}$$

$$\beta_{1j} = \gamma_{10} + \gamma_{11}(Negative\ interference) + u_{1j}$$

$$\beta_{2j} = \gamma_{20} + \gamma_{21}(Negative\ interference) + u_{2j}$$

Such a multilevel model was estimated separately for each affect (positive/negative), emotion-regulation strategy (rumination/reappraisal), and interference level (negative interference/positive interference).

RESULTS

Affective interference task

To examine within-subject differences in RT for the different conditions, a two-way (Trial Type × Valence) repeated-measures analysis of variance (ANOVA) was conducted on RTs. Significant main effects of Trial Type, $F(3, 92) = 91.04$, $p < .01$, $\eta_p^2 = .75$, and valence, $F(2, 93) = 5.22$, $p < .01$, $\eta_p^2 = .10$, were found. There was no significant Trial Type by Valence interaction, $F(6, 89) = 0.82$, $p = .56$, $\eta_p^2 = .05$. For the main effect of Trial Type, participants responded fastest in the non-recent no condition ($M = 649.60$, $SD = 99.26$, accuracy = 98%) and slowest in the recent no condition ($M = 740.30$, $SD = 121.18$, accuracy = 90%), revealing an interference effect. There was no difference between the RT scores for the non-recent yes ($M = 680.95$, $SD = 108.56$, accuracy = 84%) and recent yes conditions ($M = 682.12$, $SD = 115.05$, accuracy = 87%). For the valence main effect, participants were faster in responding to the neutral condition ($M = 681.39$, $SD = 105.59$, accuracy = 90%) compared to the positive ($M = 690.55$, $SD = 107.84$, accuracy = 90%) and negative valence conditions ($M = 692.78$, $SD = 107.72$, accuracy = 89%).

A one-way repeated-measures ANOVA was conducted to examine whether interference levels of the valence conditions differed within individuals. No significant differences were found among the interference levels of the three valence conditions (negative: $M = 102.11$, $SD = 78.41$; neutral: $M = 84.58$, $SD = 76.88$; positive: $M = 85.40$, $SD = 85.14$), $F(2, 93) = 1.89$, $p = .16$, $\eta_p^2 = .04$.

Preliminary analyses

Descriptive statistics and intercorrelations for the different variables are presented in Table 1.

Table 1. *Descriptive statistics and intercorrelations among Level 1 and Level 2 variables*

	Correlations						
Measure	*1*	*2*	*3*	*4*	*5*	*M*	*SD*
Level 1 variables							
1. PA	–					57.12	22.09
2. NA	−.55	–				15.71	15.31
3. Rumination	−.40	.53	–			27.29	26.07
4. Reappraisal	.10	.18	.21	–		18.27	19.07
5. ER mean	−.21	.43	.62	.56	–	23.92	14.79
	6	*7*	*8*				
Level 2 variables							
6. Positive interference	–					0.83	107.53
7. Negative interference	.58	–				17.53	104.38
8. CES-D	.17	.10	–			0.73	0.48

Notes: Correlations set in **bold** are significant at $p < .01$. Multilevel correlations (Level 1 variables) were calculated following Nezlek (2012). As multilevel correlations are not symmetrical, the coefficients above represent the average of the correlations obtained when each variable was entered as the outcome and the predictor for each pairwise relationship. Pearson *r* correlations were used for Level 2 variables. PA = Positive Affect; NA = Negative Affect; ER mean = average emotion regulation use.

For the daily measures, results revealed a negative correlation between PA and NA. Rumination was positively associated with NA and negatively with PA, while reappraisal was positively associated with both PA and NA. Finally, ER mean was positively correlated with NA and negatively with PA. For the trait measures, results revealed a significant positive correlation between positive and negative interference levels, while neither was significantly correlated with CES-D.

To test whether interference levels were associated with daily measures of rumination and reappraisal, we ran four multilevel models with rumination or reappraisal as a Level 1 dependent variable and added each interference level variable separately as a Level 2 predictor. No significant associations were found between positive or negative interference levels with rumination or reappraisal (see Table 2).[4]

Relationship between affective interference levels and rumination/reappraisal strategies, uncorrected raw scores

Rumination. There was a significant positive relationship between rumination and change in NA, and a significant negative relationship between rumination and change in PA for individuals with average levels of interference (as reflected in the intercepts, γ_{20}, in Table 2). This implies that, on average, the use of rumination predicts an increase in NA and decrease in PA.

We predicted that individual differences in negative interference levels (calculated as RTs of negative interference minus neutral interference) would moderate the relationship between rumination and change in NA and PA in daily life. Findings supported this prediction for NA (as reflected in the slopes, γ_{21}, in Table 2): The larger the negative interference level, the larger the increase in NA when using rumination. Positive interference levels (calculated as RTs of positive interference minus neutral interference) did not predict this relationship. No significant relationships were found for PA (see Table 2).

Reappraisal. For individuals at average interference levels, reappraisal showed a significant positive relationship with NA; no significant relationship was found with PA. The results however showed that individual differences in negative interference level moderated the relationship between reappraisal and change in PA. Participants who had a more difficult time resolving interference from negative stimuli experienced a decrease in PA when using reappraisal. Positive interference level did not predict this relationship. No significant moderation was found for NA (see Table 2).

[4] We ran the same models with NA as a Level 1 covariate and results remained the same.

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Table 2. *Multilevel analyses for the relationships between affective interference and rumination/reappraisal, and affective interference and rumination/reappraisal–change in affect relationship*

Level 1 variables			*Level 2 variables*						
				Negative interference level			*Positive interference level*		
Emotion regulation strategy		*Change in affect*		*Coefficient*	*SE*	*t*	*Coefficient*	*SE*	*t*
Interference levels on daily rumination and reappraisal									
Rumination			Intercept (γ_{20})	−.27	1.99	−0.14	−.90	1.73	−0.52
Reappraisal			Intercept (γ_{20})	−.31	1.30	−0.24	−2.30	1.36	−1.69†
Interference levels on ER strategy–change in affect relationship									
Uncorrected raw scores									
Rumination	→	NA	Intercept (γ_{20})	.22	0.01	15.84**	.22	0.01	15.26**
			Slope (γ_{21})	.03	0.01	2.95**	.00	0.01	0.27
Rumination	→	PA	Intercept (γ_{20})	−.26	0.02	−12.92**	−.26	0.02	−12.76**
			Slope(γ_{21})	−.03	0.02	−1.45	−.00	0.02	−0.02
Reappraisal	→	NA	Intercept (γ_{20})	.08	0.01	5.22**	.08	0.01	5.47**
			Slope (γ_{21})	.02	0.01	1.42	.01	0.02	0.82
Reappraisal	→	PA	Intercept (γ_{20})	.02	0.02	1.19	.03	0.02	1.23
			Slope (γ_{21})	−.04	0.02	−2.28*	−.02	0.02	−0.75
Controlling for mean overall emotion regulation strategy									
Rumination	→	NA	Intercept (γ_{20})	.17	0.02	10.72**	.17	0.02	10.29**
			Slope (γ_{21})	.03	0.01	2.26*	.00	0.01	0.22
Rumination	→	PA	Intercept (γ_{20})	−.30	0.02	−13.04**	−.30	0.02	−12.84**
			Slope(γ_{21})	−.03	0.02	−1.64	.00	0.02	0.17
Reappraisal	→	NA	Intercept (γ_{20})	−.06	0.01	−4.10**	−.06	0.01	−4.24**
			Slope (γ_{21})	.02	0.01	2.08*	.02	0.01	1.85†
Reappraisal	→	PA	Intercept (γ_{20})	.13	0.02	6.05**	.13	0.02	6.16**
			Slope (γ_{21})	−.04	0.02	−1.83†	−.02	0.02	−0.95

Notes: In each analysis, the predictors at Level 1 were group-mean centred. Each of the Level 2 variables were grand-mean centred. The intercept (γ_{20}) reflects the effect of an emotion-regulation strategy on change in affect at average levels of valence-interference scores (relative to interference scores from neutral stimuli) across participants. The slope (γ_{21}) reflects the association between such interference scores and the impact of an emotion-regulation strategy on change in affect. $^{**}p < .01$; $^{*}p < .05$; $^{\dagger}p < .10$.

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Relationship between affective interference levels and rumination/reappraisal strategies, controlling for average use of emotion regulation strategies

Based on the existing literature, it was counter-intuitive to find that reappraisal was associated with increased negative emotions. However, it is not unlikely that people who experience negative emotions will just use more emotion-regulation strategies in general at a given time, resulting in a positive association between the use of reappraisal and negative affect. This seems to suggest a response style bias (Schimmack, Oishi, & Diener, 2005); that is, higher ratings in use of overall emotion regulation strategies when experiencing NA (see Table 1).

Following Schimmack et al.'s (2005) approach, we overcame this confound by controlling for how much participants engaged in emotion regulation overall at each sampling moment by including the ER mean score in our analyses. We included this measure as a Level 1 predictor in each of the multilevel models. Such analyses control for response style bias in emotion-regulation strategies when examining whether the use of rumination or reappraisal are associated with increases or decreases in affect. A summary of findings is found in Table 2.

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Rumination. Results remained similar for the main effects of rumination on NA and PA for individuals of average interference levels, even after controlling for ER mean. Likewise, the moderating role of negative interference level on change in NA was replicated (see above for interpretation). No other significant relationships were found.

Reappraisal. When controlling for mean use of emotion-regulation strategies, a significant negative relationship between reappraisal and NA, and a significant positive relationship between reappraisal and PA were found for individuals at average levels of interference. Thus, in line with previous research, reappraisal was associated with decreased NA and increased PA. Moreover, individual differences in negative interference levels moderated the effect of reappraisal on changes in NA and PA (marginally significant). That is, participants who had a more difficult time resolving interference from negative stimuli experienced a blunted effectiveness of reappraisal on affective experiences in daily life: They showed a smaller decrease in NA and a smaller increase in PA following reappraisal. There was also a trend that showed positive interference level to be associated with a lesser decrease in NA in daily life. No other significant relationships were found.[5,6]

DISCUSSION

The present study was designed to respond to Joormann and D'Avanzato's (2010) call by examining whether individual differences in cognitive-control processes influence the effectiveness of emotion-regulation efforts on affective experiences. Our results demonstrated that difficulties in resolving interference from negative information (but not positive information) influence the impact of rumination and reappraisal on emotional functioning in everyday life. Specifically, we found that participants who had high negative interference levels experienced greater increase in NA, but not greater decrease in PA, when ruminating. Moreover, participants who had high negative interference levels experienced smaller decreases in NA and smaller increases in PA (although marginally significant) when reappraising. These results imply that difficulties in resolving interference from previously relevant negative information aggravates the deleterious effects of rumination and curbs the benefits of reappraisal in daily life.

The current investigation has several important contributions: First, previous research has shown that inhibition of previously relevant negative information is associated with rumination (e.g., Joormann et al., 2010). Moreover, Ciesla and Roberts (2007) have proposed that the interaction between rumination and thought content would influence the experience of negative affect. The present study extends both of these findings to daily life and further gives evidence to the cognitive catalyst model by demonstrating that difficulties resolving interference from previously relevant negative information (which may result in

[5] We ran all the models while controlling for depression and depression–interference resolution interactions, and results remained the same.

[6] We also wanted to test whether there is an effect of time on affective experience. It is possible that affective experience may have decreased or increased over repeated assessments, which would then be a confound to the current results. For example, participants may just experience less NA over time, and this may be independent of the kind of emotion-regulation strategy used or the impact of interference resolution on the effectiveness of this strategy. To examine this possibility, we ran multilevel models (separately for PA and NA) with measurement occasion as a predictor. Results showed that although NA did not change over measurement occasions ($\beta = -0.00$, $SE = 0.02$, $p = .87$), participants' level of PA decreased over time ($\beta = -0.10$, $SE = 0.03$, $p < .01$). From this result, it seemed reasonable to control for measurement occasion when examining the moderating effect of interference resolution on the relationship between emotion regulation and change in PA. When controlling for measurement occasion, the results for NA remained the same, but the results for PA changed in the expected direction for both the uncorrected raw scores and controlling for ER mean. That is, difficulties removing previously relevant negative information from WM led to a larger decrease in PA when ruminating (uncorrected: $\gamma_{21} = -.04$, $SE = 0.02$, $p < .05$; controlling for ER mean: $\gamma_{21} = -.04$, $SE = 0.02$, $p = .01$), and a smaller increase in PA when reappraising (uncorrected: $\gamma_{21} = -.05$, $SE = 0.01$, $p < .01$; controlling for ER mean: $\gamma_{21} = -.05$, $SE = 0.01$, $p < .01$).

readily accessible negative material in WM) and the engagement in rumination result in a greater increase in NA; while effectively resolving interference from previously relevant negative information would result in a lesser increase in NA when ruminating. Second, the present study also reveals that such cognitive control impairment has an adverse effect on the effectiveness of reappraisal. Importantly, this may help explain why reappraisal is not an effective strategy for depressed participants (Joormann & D'Avanzato, 2010). Since depressed participants are shown to have impairments in inhibiting previously relevant negative information (e.g., Joormann & Gotlib, 2008), this may result in difficulties replacing negative thought content whenever they reappraise. Such a cognitive process would lead to a blunted effectiveness of reappraisal. Finally, with regards to methodology, we demonstrate the importance of controlling for response bias when assessing emotion-regulation strategies in daily life. It is not surprising to find a positive correlation between average use of emotion-regulation strategies and NA since people can be expected to engage in multiple regulation strategies when faced with negative emotions in daily life. Uncorrected scores would mask the true relationship between a specific emotion-regulation strategy and any variable of interest.

We write this paper with two important limitations in mind. First, we did not give specific instructions to the participants on how they should respond to the rumination question in the experience sampling part of the study. We used the Dutch word *piekeren*, which broadly refers to recurrent negative thinking. This word, however, does not differentiate between worrying and ruminating, and participants could have responded to this question either or both ways. Second, because the current findings are based on correlations, we cannot draw conclusions about a causal relationship between interference resolution and the impact of rumination and reappraisal on affective experience.

In conclusion, the findings of this study corroborate and extend previous findings on the association between cognitive control and emotion regulation. Future research should look into the directionality of this association (e.g., by means of longitudinal data), and also examine other executive processes to better understand the cognitive processes that may underlie the effect of emotion regulation.

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