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The Temporal Deployment of Emotion Regulation Strategies During Negative Emotional Episodes

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Time is given a central place in theoretical models of emotion regulation (Gross, 1998, 2015), but key questions regarding the role of time remain unanswered. We investigated 2 such unanswered questions. First, we explored when different emotion regulation strategies were used within the course of an emotional episode in daily life. Second, we investigated the association between the temporal deployment of strategies and negative emotional experience. We conducted a daily diary study in which participants (N = 74) drew an intensity profile depicting the temporal unfolding of their negative emotional experience across daily events (N = 480), and mapped their usage of emotion regulation strategies onto this intensity profile. Strategies varied in their temporal deployment, with suppression and rumination occurring more at the beginning of the episode, and reappraisal and distraction occurring more toward the end of the episode. Strategies also varied in their association with negative emotion: rumination was positively associated with negative emotion, and reappraisal and distraction were negatively associated with negative emotion. Finally, both rumination and reappraisal interacted with time to predict negative emotional experience. Rumination was more strongly positively associated with negative emotions at the end of the episode than the beginning, but reappraisal was more strongly negatively associated with negative emotion at the beginning of the episode than the end. These findings highlight the importance of accounting for timing in the study of emotion regulation, as well as the necessity of studying these temporal processes in daily life.

Keywords: emotion regulation, process model, time, negative emotion

Supplemental materials: http://dx.doi.org/10.1037/emo0000248.supp

Strategies to regulate emotion come in many different shapes and forms, and a primary goal of emotion regulation theory has been organizing these diverse strategies into coherent groups. One of the primary theoretical models for accomplishing this task has been Gross' process model (Gross, 1998b, 2015), which posits that time is a defining feature of emotion regulation. The process model is based on the modal model of emotion, which specifies four sequential steps involved in emotion generation: (a) an emotional situation arises; (b) attention is directed toward the situation; (c) an appraisal of the situation is formed; and finally (d) an emotional response to the situation is generated (Gross & Thompson, 2007). The process model specifies five families of emotion regulation strategies, grouped based on the sequential step of the emotion generation process at which the family of strategies exerts their primary impact. In temporal order, the first and second families are situation selection and situation modification, which have their primary impact on the emotional situation. The third family is attentional deployment, which includes strategies that exert their primary impact on attentional processes, such as distraction and rumination. The fourth family is cognitive change, which includes strategies that exert their primary impact on appraisal processes, such as cognitive reappraisal. The fifth and final family is response modulation, which includes strategies that exert their primary impact on the emotional response, such as expressive suppression (Gross, 1998b).

Temporal Processes in Emotion Regulation

Although time lies at the heart of the process model, there is surprisingly little empirical work investigating temporal dynamics

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in emotion regulation. However, the research that does exist demonstrates clearly that time is an important factor in both *when* emotion regulation strategies exert their influence on emotional outcomes, and *how effective* these strategies are. Turning first to when strategies influence emotional outcomes, lab research has demonstrated that some strategies show psychophysiological signatures consistent with their theoretical place in the emotion generation process. In three studies, distraction, an attentional deployment strategy, reduced the late positive potential (LPP) earlier than reappraisal, a cognitive change strategy (Paul, Simon, Kniesche, Kathmann, & Endrass, 2013; Schönfelder, Kanske, Heissler, & Wessa, 2014; Thiruchselvam, Blechert, Sheppes, Rydstrom, & Gross, 2011). In another study, reappraisal resulted in early prefrontal cortex (PFC) responses, and suppression, a response modulation strategy, in late PFC responses (Goldin, McRae, Ramel, & Gross, 2008). However, there are also some results inconsistent with the process model: the study by Paul et al. (2013) unexpectedly found that expressive suppression also affected the LPP in the early stages, at the same time as distraction. This suggests that, despite theoretically having its main effect later in the emotion generation process, expressive suppression may also have an effect in the earlier stages.

Other research has suggested that, consistent with the process model, the point in the emotion generation process at which strategies are implemented can moderate emotion regulation outcomes. For example, distraction was effective in reducing negative emotion even when initiated late in the emotion generation process, but in contrast, reappraisal was *less* effective when initiated late in the process (Sheppes & Meiran, 2007). The authors posited that this was because, at this stage of the process, the tendency to appraise the stimuli in a certain way was already formed and thus difficult to override. Based on this line of research, Sheppes and Gross (2011) offered a process-specific account of the role of time in emotion regulation. They argued that regulation strategies that target early processing stages, like distraction, require less cognitive effort, and are therefore less affected by emotional intensity. In contrast, regulation strategies that target later processing stages, like reappraisal, require a level of effort in line with emotional intensity. As a result, these strategies will be more difficult to implement, and less used when the emotion is more intense. This suggestion is supported by research on emotion regulation choice, which has found that distraction is preferred to reappraisal when emotional intensity is high (Sheppes, Scheibe, Suri, & Gross, 2011).

Thus, the research reviewed so far has suggested that reappraisal is less effective later in an emotional episode, and that reappraisal is less likely to be used when emotional intensity is high. This suggests an interesting disconnect: given that emotional intensity is generally lower later in emotional episodes (Heylen, Verduyn, Van Mechelen, & Ceulemans, 2015), individuals may choose to use reappraisal later in the episode. However, reappraisal is less likely to be effective at these later stages.

Unanswered Questions About Time

It is clear, both theoretically and empirically, that time matters in emotion regulation. However, we are currently missing three foundational pieces of data critical to understanding the role of time in the emotion regulation process. First, the existing research has generally only investigated the immediate onset stage of emotion regulation in short term lab tasks (e.g., Thiruchselvam et al., 2011), and thus, the temporal order of strategies across a full emotional episode has never been studied. Given the complex, multifaceted ways in which the emotional trajectory changes across full emotional episodes, it is likely that the temporal order of strategies in longer-term real-life emotional events differs in important ways from the temporal order of strategies in the shorter-term emotional onset observed in the lab. We believe that investigating temporal dynamics within a full emotional episode is a critical test, given that more important and higher-intensity events are associated with a longer emotion duration (Verduyn, Delvaux, Van Coillie, Tuerlinckx, & Van Mechelen, 2009), and thus, emotion regulation use is likely to be more necessary in these kinds of events. In addition, thus far, each study has only included one, two, or three strategies, which means that a full test of the order of the multiple strategies proposed in the process model has never been undertaken.

Second, research examining the temporal placement of strategies has thus far focused on when strategies have their effect on the emotion process in response to an instructed emotion regulation manipulation, rather than investigating where in the process people naturally choose to implement each strategy. Instructed emotion regulation is distinct from spontaneously chosen emotion regulation. It may be that people choose to implement strategies at the stages at which they are most likely to affect the emotional process, meaning that our results would reflect studies using instructed emotion regulation, but this is not necessarily the case.

Third, we do not yet have a clear indication of the association between the time a strategy is implemented and emotional experience. Existing theory and research suggests that timing matters, but to our knowledge, empirical work has thus far examined only reappraisal and distraction. In addition, this work has only been conducted in lab contexts. Thus, we are in the dark about the temporal processes surrounding emotion regulation in daily life, in which emotional stimuli are often more varied, more complex, and more personally involving than the emotional stimuli used in the lab.

The Current Study

In this research, we fill these three critical gaps by investigating the temporal course of the deployment and effectiveness of emotion regulation strategies across negative emotional episodes in daily life. We conducted a daily diary study in which participants reported on the temporal dynamics of their negative emotions in daily emotional episodes. We used an intensity profile approach, in which participants were asked to graph their emotional experience across time (Heylen et al., 2015; Sonnemans & Frijda, 1994; Verduyn, Van Mechelen, & Frederix, 2012; Verduyn et al., 2009). We then divided this intensity profile into three separate sections representing the beginning, middle, and end of the emotional episode, and participants were asked to map the emotion regulation strategies they used onto these three sections. We examined strategies drawn from each of the five families of emotion regulation proposed by Gross (1998b), with the exception of situation selection.[1] Using this paradigm, we describe where emotion regulation

[1] Situation selection was not included because we asked participants to recall an event that they had actually experienced: participants who engaged in situation selection would have selected out of experiencing the emotional event and would not have anything to recall.

strategies are temporally located within negative emotional episodes, and investigate the association between the temporal deployment of each emotion regulation strategy and negative emotional experience.

Broadly, our research is exploratory in nature, given that there is little empirical evidence regarding the temporal dynamics of emotion regulation in longer-term emotional episodes. However, based on the existing research examining shorter-term emotions in response to instructed lab manipulations, we can make some tentative hypotheses. First, it may be that the temporal order of emotion regulation strategy use in longer-term emotional episodes reflects the temporal order in which strategies have been shown to have their effect in shorter-term lab tasks. That is, people implement strategies at the point at which they have their effect on emotion. If that were the case, we would expect distraction use to peak early in the episode, reappraisal use to peak after that of distraction, and suppression use to peak later in the episode. To our knowledge, the temporal dynamics of situation modification and rumination have yet to be examined in the lab. However, by the same logic, if these two strategies are implemented at the time-point at which they are theoretically most likely to have their effect, we would expect the use of situation modification to peak the early in the episode, and the use of rumination, as an attentional deployment strategy, to peak around the same time as distraction.

Second, based on lab work (Sheppes & Meiran, 2007), we expect that the relationship between reappraisal use and negative emotional experience will be weaker later in the emotional episode, representing the fact that reappraisal has been shown to be less effective when used later in emotion process. However, based on work on emotion regulation choice (Sheppes et al., 2014), which has demonstrated that reappraisal is more likely to be implemented when emotional intensity is low, we expect that reappraisal will be more common later in the event, when emotional intensity has begun to decrease (Heylen et al., 2015). That is, we expect a disconnect between when reappraisal is most frequently deployed (later in the event) and when it is most effective (early in the event). Work conducted in the lab has also examined distraction, and found that there is no change in the effect of distraction in emotion based on when it is implemented (Sheppes & Meiran, 2007). Thus, we do not expect the effectiveness of distraction to vary with time.

Method

Participants

Participants were 74 individuals recruited through Amazon's Mechanical Turk (M_{age} = 36.19, SD_{age} = 12.35, 55% male), who completed 480 daily diaries (M completion = 92.71%). Participants were a subsample of a group of participants (N = 114) recruited for a larger study, and were selected for this study because their browser had the technical capability to display the intensity profile. There were no significant differences between this subsample and the larger study group on demographics, personality traits, depressive symptoms, or emotion regulation.

The initial sample was selected to maximize variation in neuroticism using a stratified sampling approach: to do this, we contacted equal number of participants from each sextile of the Big Five Inventory (John, Donahue, & Kentle, 1991) neuroticism subscale (for a similar approach, see Koval et al., 2015). We selected for variation on neuroticism because it is implicated in negative emotional functioning (Diener, Oishi, & Lucas, 2003), coping with negative events (Suls & Martin, 2005), and emotion regulation choice and success (Gross & John, 2003); hence, we were able to investigate emotion regulation across a group of people with a wide range of negative emotional response styles. To better characterize this sample, we include descriptive statistics for relevant individual difference variables in the supplementary material.

Materials and Procedure

These data were collected as part of a larger project: below we address only the measures relevant to the current research questions.[2] Each evening for 7 days, participants were asked to briefly recall the most negative event they experienced that day. They were then asked a series of questions about that event. Figure 1 outlines the sequence of events in the daily survey.

Participants were emailed the daily link to the survey at 7 p.m., and asked to complete it before they went to sleep that evening. If they had not completed the daily survey by 7 a.m. the next day, they were sent a reminder email. The survey was closed at 11 a.m. the next day, and participants could not respond to that survey after this time. In this sample, the mean time between the survey link being sent and the participant starting the survey was 3.10 hr (SD = 4.33 hr), indicating that the average time at which the survey was started was 10:06 p.m.

Emotion regulation. Participants were asked to report the extent to which they used five emotion regulation strategies derived from the process model of emotion regulation (Gross, 2015) during the event. The five strategies were situation modification ("*I took steps to change the situation*"), reappraisal ("*I changed my perspective or the way I was thinking about the event*"), distraction ("*I distracted myself from the event or my emotions*"), rumination ("*I ruminated or dwelled on the event or my emotions*"), and expressive suppression ("*I suppressed the outward expression of my emotions*"). Participants responded to the items on a 7-point scale (where 1 = *I did not do this at all*, 2 = *I did this a little bit*, and 7 = *I did this very much*).

Episode duration. Participants were asked to report the approximate duration of the episode in hours, seconds, and minutes. Events could not be longer than 24 hr.

Negative emotion intensity profile. To obtain emotional intensity profiles of the episode, we used the procedure outlined by Heylen et al. (2015). Participants were shown a two-dimensional grid with time on the X-axis (ranging from 0 to the participant specified episode duration) and emotional intensity on the Y-axis (ranging from "*no emotion*" to "*very high*"). The Y-axis coordinates were stored with a resolution of 350 pixels, meaning that negative emotional intensity scores ranged between 0 (no emotion) and 350 (very high emotion). Participants were asked to think about the negative event they had recalled, and to draw a profile reflecting how their negative emotional experience varied in intensity across time. Participants could click and drag the computer mouse to draw a line representing their event-related negative emotion, which should begin and end at "no emotion." Before analysis, we interpolated the stored data to reconstruct the profile,

[2] The full study protocol is available upon request.

and then discretized all profiles into 150 equally distanced time-points. Expanding all profiles to the same number of time points for analysis allowed us to account for duration differences (for a similar approach, see Heylen et al., 2015; Verduyn et al., 2009; Verduyn, Van Mechelen, & Frederix, 2012).

Emotion regulation timing. Participants were then presented with an image of their intensity profile divided into three equal sections with vertical lines. For each of the three sections, participants were presented with the list of emotion regulation strategies they had reported using (i.e., strategies that they rated at least a 2 on the 7-point scale, which corresponded with "*I did this a little bit*"). For each section, participants were asked to select from this list the strategies that they used during that section of the episode, creating a dichotomous emotion regulation use variable for each regulation strategy for each section. Participants were able to identify each emotion regulation strategy as belonging to more than one of the sections, or as belonging to none of the sections.

Results

To account for the nested nature of these data, we conducted multilevel analyses using HLM-7 (Raudenbush et al., 2011). We used a three-level model, with sections at Level 1 (N = 1,440) nested within events at Level 2 (N = 480) nested within persons at Level 3 (N = 74). Given the nature of our research questions, we included random intercepts but not random slopes in these models.

Episodes ranged in duration from 10 s to 24 hr, with a mean duration of 2h51′06″ (SD = 4h00′54″).[3] The median episode duration was 1h25′12″, and the modal episode duration was 2h00′00″. This indicated that most of the emotional episodes studied were relatively short in duration.

The mean event intensity was 168.39 (SD = 93.13). Reappraisal was used during 164 of the 1,440 sections (11.4%), distraction during 224 sections (15.6%), rumination during 299 sections (20.8%), and suppression during 280 sections (19.4%). Situation modification was used during only 21 sections (1.5%), and thus, we advise that results with this strategy should be interpreted with caution. The mean intensity of emotion regulation strategy usage (across all three sections) was 3.43 for situation modification (SD = 2.39), 2.44 for reappraisal (SD = 1.89), 2.99 for distraction (SD = 1.98), 3.01 for rumination (SD = 1.96), and 3.40 for suppression (SD = 2.19).

Where Are Emotion Regulation Strategies Temporally Located?

First, we tested the relationship between section number and emotion regulation strategy usage. As the dependent variable was dichotomous, we estimated logistic population-average models.[4] We entered a centered section number variable (−1 = beginning, 0 = middle, 1 = end) at Level 1 to predict the use of each of the emotion regulation strategies (0 = not used, 1 = used) separately.[5] Figure 2 displays the frequency of strategy usage in each event section, and Table 1 depicts the results of the inferential analyses. Section number was positively associated with the use of reappraisal and distraction, indicating that these strategies were more likely to be used later in the episode. In contrast, section number was negatively associated with the use of rumination and suppression, indicating that these strategies were more likely to be used earlier in the episode. Section number was not associated with situation modification.

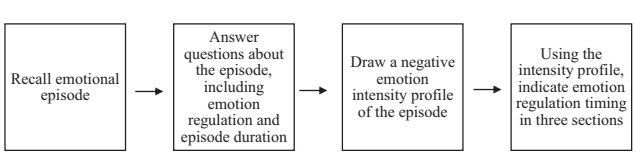

Figure 1. Sequence of events in daily survey.

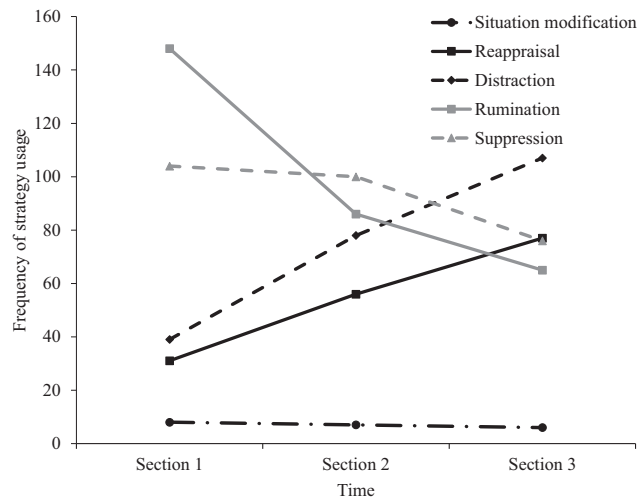

Figure 2. Frequency of usage of each emotion regulation strategy in each episode section (N = 480 episodes).

What is the Relationship Between the Temporal Deployment of Emotion Regulation Strategies and Negative Emotional Experience?

To test how strategy usage and section number were associated with negative emotion, we ran a series of models predicting the intensity of negative emotional experience, which was operationalized as the mean negative emotional intensity depicted on the intensity profile for each section. First, to examine the main effect of section on intensity, we created three dummy variables in which the focal section number was coded as 1, and the other two sections were coded as 0. We then ran a series of models in which two of these variables were entered as predictors, making the third variable the reference category. Negative emotion intensity was

[3] We replicated all analyses including episode duration as a control variable, and found no substantive differences in the results.

[4] In the analyses reported, we used normal *SE*s, rather than corrected robust *SE*s, because robust *SE*s have been shown to be inaccurate when the top-level sample size is less than 100 (as in this study; Maas & Hox, 2004). We also ran all the models reported using robust *SE*s, and the results are comparable except for two differences: the difference in intensity between section 1 and section 2 was no longer significant, and the difference in the simple slopes of reappraisal use across sections 1 and 3 was no longer significant.

[5] We also conducted a series of analyses in which we included both linear and quadratic section number predictors. None of the quadratic terms were significant, indicating that our focal relationships were linear.

significantly lower in section 3 ($M = 123.52$, $SD = 88.00$) than in section 1 ($M = 194.93$, $SD = 84.94$), $\gamma = -71.40$, $SE = 3.49$, $p < .001$, and section 2 ($M = 186.72$, $SD = 89.64$), $\gamma = -63.20$, $SE = 3.49$, $p < .001$. It was also significantly lower in section 2 than section 1, $\gamma = -8.21$, $SE = 3.49$, $p = .019$.

Next, to examine the effects of the emotion regulation strategies on intensity, we ran a series of models in which each strategy was entered separately as an uncentered predictor.[6] In these analyses, coefficients represent the change in negative emotional intensity when the strategy was used. There were significant negative effects of reappraisal, $\gamma = -38.87$, $SE = 7.23$, $p < .001$, and of distraction, $\gamma = -25.45$, $SE = 5.89$, $p < .001$, and a significant positive effect of rumination, $\gamma = 52.80$, $SE = 5.38$, $p < .001$, on negative emotional intensity. There was no effect of situation modification, $\gamma = 17.66$, $SE = 17.59$, $p = .316$, or suppression, $\gamma = 10.92$, $SE = 5.98$, $p = .068$.[7]

Finally, to examine whether strategy use interacted with section number to predict emotional intensity, for each emotion regulation strategy, we entered the main effect of the emotion regulation strategy, two of the three section number dummy variables, and two variables representing the interaction between the strategy and these two dummy variables. This made the third section the reference category. To determine the differences between all three sections, we ran each of these models two times, changing the reference category each time. This strategy allowed us to determine the simple slopes of emotion regulation use in each section and to compare the slopes across sections. The results of these analyses are in Table 2. There was no difference in the effect of situation modification, distraction, or suppression on intensity between the three sections. However, there were differences for reappraisal and rumination. As displayed in Figure 3, the negative association between reappraisal use and negative emotional intensity was weaker in section 3 than in section 1. As displayed in Figure 4, the positive association between rumination use and negative emotional intensity was stronger in section 3 than in sections 1 and 2.

Discussion

In this study, we investigated the temporal deployment of emotion regulation strategies within daily negative emotional episodes. We found differences in both the temporal deployment of the emotional regulation strategies, and the relationship between this deployment and negative emotional experience. Here, we review our findings and speculate about underlying mechanisms. However, we should note that our data are correlational in nature, and thus, causality and directionality cannot be inferred from these results.

Table 1
Analyses Predicting Emotion Regulation Strategy Usage (0 = Not Used, 1 = Used) by Section Number (−1 = Section 1, 0 = Section 2, 1 = Section 3)

Emotion regulation strategies	γ	*SE*	*p*	OR	95% CI
Situation modification	−.13	.17	.473	.88	[.63, 1.24]
Reappraisal	.48	.10	<.001	1.62	[1.34, 1.96]
Distraction	.55	.09	<.001	1.74	[1.46, 2.07]
Rumination	−.54	.08	<.001	.58	[.50, .68]
Suppression	−.19	.07	.019	.83	[.71, .97]

Note. OR = odds ratio; CI = confidence interval of the odds ratio.

Table 2
Simple Slopes of Emotion Regulation Use in Each Section Predicting Negative Emotional Intensity

Emotion regulation strategies	Section 1	Section 2	Section 3
Situation modification	−1.49 (22.43)	17.05 (23.93)	24.76 (25.65)
Reappraisal	$-40.53\ (11.96)_a$	−19.81 (9.22)	$-10.67\ (8.06)_a$
Distraction	−21.46 (10.50)	−11.84 (7.81)	.79 (6.94)
Rumination	$21.27\ (6.27)_a$	$31.01\ (7.59)_b$	$59.04\ (8.44)_{ab}$
Suppression	3.29 (7.22)	−1.91 (7.39)	2.83 (8.13)

Note. Shared superscripts (a, b) in the same row indicate significant differences between slopes at $p < .05$.

The Temporal Deployment of Emotion Regulation Strategies

We found that reappraisal and distraction were significantly more likely to be used later in emotional episodes, in contrast with rumination and suppression, which were significantly more likely to be used early in episodes. These findings suggest that the typical temporal profile of emotion regulation might involve first using strategies that are generally ineffective at down-regulating emotional experience (e.g., Gross, 1998a; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), or, in the case of expressive suppression, are targeted at regulating the expressive rather than the experiential dimension of emotion (Gross & Levenson, 1997; Kalokerinos, Greenaway, & Denson, 2015). This may then be followed by a shift to strategies that are generally more effective at down-regulating emotional experience (Webb, Miles, & Sheeran, 2012).

Why are these more effective strategies used later in daily emotional episodes? Broadly, it seems likely that this pattern may occur *because* these strategies are effective at reducing negative emotional experience, and thus, their use leads to the end of the emotional episode. This explanation seems even more plausible when we note that episode duration did not play a role in these results. Here, it may be illuminating to consider emotion goals (Tamir, 2016): it could be that at first, individuals do not have a strong goal to down-regulate negative emotion because they are still focused on fully processing the negative event. Thus, they are more likely to use strategies that do not target the down-regulation of negative emotional experience. However, later in the episode, they decide it is time to move past their negative emotion, and as a result, enact a negative emotion down-regulation goal and begin

[6] We also ran a model in which we entered all five strategies simultaneously. The effects of the strategies were unchanged with the exception of suppression, which was a significant positive predictor of negative emotional intensity in this model, $\gamma = 14.08$, $SE = 5.75$, $p = .015$.

[7] We also conducted lagged analyses. In these analyses, we predicted negative emotional intensity at section *t* from emotion regulation use at the previous section, *t*-1, and negative emotional intensity at *t*-1. This approach allowed us to model the relationship between emotion regulation use and change in negative emotional intensity across sections. The pattern of results was the same as the analyses reported in text, except that the relationship between reappraisal and intensity was marginal, $p = .055$.

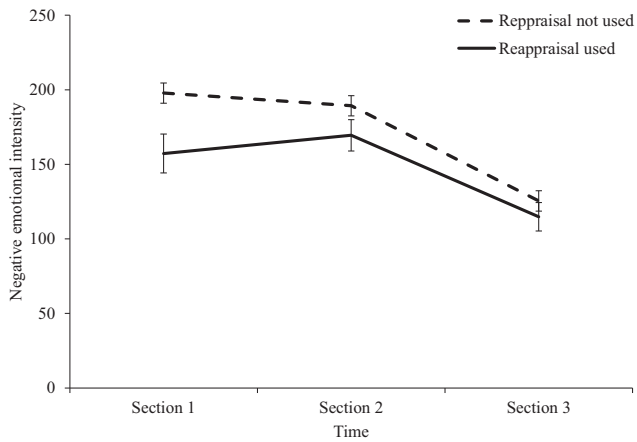

Figure 3. Predicted negative emotional intensity after the use or nonuse of reappraisal across time. Error bars represent *SE*s of the regression coefficients.

to implement strategies that achieve this goal. In turn, these strategies trigger the end of the emotional episode. Of course, a more thorough investigation of the temporal nature of goals and motives in emotion regulation will be necessary to verify this interpretation (cf. Tamir, 2016).

When considering specific strategies, there are also several other potential explanations for the observed pattern of results. As we discussed in the introduction, the increased use of reappraisal later in the episode may also be explained by previous research demonstrating that reappraisal is not preferred as a strategy when emotional intensity is high (Shafir, Schwartz, Blechert, & Sheppes, 2015; Sheppes & Gross, 2011; Sheppes et al., 2014). In line with these findings, in our study, emotional intensity was significantly higher earlier in the episode, and there was also a significant negative association between reappraisal use and emotional intensity. Thus, it could be that participants are avoiding reappraisal early in the episode because their emotional intensity is high.

The increased use of distraction later in the episode may seem surprising when viewed in the context of lab research, which has demonstrated that distraction has its physiological effects early in the emotion process (Paul et al., 2013; Schönfelder et al., 2014; Thiruchselvam et al., 2011). However, there are two key differences between these studies and the current study that could explain this pattern of results. First, these studies investigated when instructed emotion regulation strategies had their effect on physiological parameters, rather than when participants chose to implement those strategies. Our findings suggest that these two dimensions do not align. Second, it is important to note the differences between a constrained lab scenario and the complex emotional episodes faced in daily life. In daily life, it may be that situational demands mean it is simply not feasible to distract oneself as the emotional event is still unfolding, but distraction becomes more feasible once the event is fully formed. Here, it is clear that we need a better understanding of contextual factors to better characterize the processes at work (cf. Aldao, 2013). It is also interesting that, despite distraction being used more later in the episodes, there was no difference in its effectiveness across the three sections. This suggests that distraction may be useful across the temporal spectrum.

The increased use of expressive suppression earlier in the episode is also inconsistent with some data suggesting it has a later onset effect on physiological parameters (Goldin et al., 2008), although here we should again note the difference between lab research and daily life. However, other lab data are more in line with this finding, suggesting that expressive suppression can have an early onset effect (Paul et al., 2013). To better understand the role of suppression, we believe that it will be important to differentiate the temporal trajectory of emotional expression from that of emotional experience.

Finally, we should note that the low frequency of situation modification meant that we could not fully explore the temporal deployment of this strategy. However, this low frequency was only evident in the placement of situation modification on the intensity profile: when participants were asked the intensity with which they used situation modification across the entirety of the episode, the numbers were comparable with the other four strategies. This disconnect between intensity and frequency may occur because participants implement situation modification strategies before the onset of their negative emotion. If that is the case, these strategies could not be placed on the negative emotion profile, which begun at emotion onset.

The Associations Between Emotion Regulation Use and Negative Emotional Experience

There were significant negative associations between negative emotional intensity and the use of reappraisal and distraction. There was a significant positive association between negative emotional intensity and the use of rumination. These findings are in line with research indicating that reappraisal and distraction are effective strategies in down-regulating emotional experience (Webb et al., 2012), and rumination is ineffective in doing so (Brans, Koval, Verduyn, Lim, & Kuppens, 2013; Nolen-Hoeksema et al., 2008).

However, here it is important to note that our research was correlational, and thus, it may be that the relationships run in the other direction: that is, when negative emotional experience is

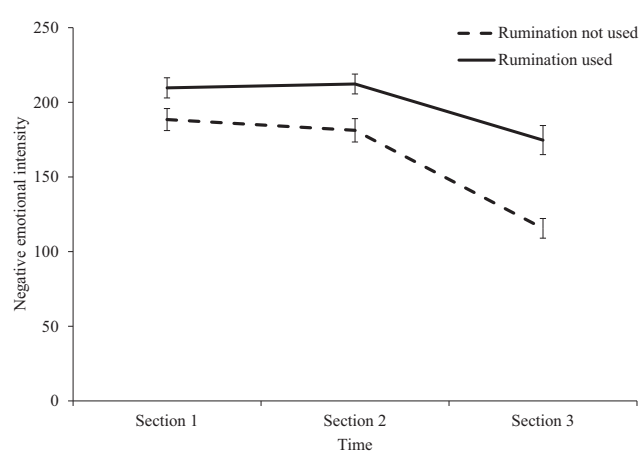

Figure 4. Predicted negative emotional intensity after the use or nonuse of rumination across time. Error bars represent *SE*s of the regression coefficients.

more intense, people choose to ruminate, and when negative emotional experience is less intense, people choose to reappraise, or to use distraction. Such an interpretation would fit within the process-specific timing model outlined by Sheppes and Gross (2011). This model suggests that reappraisal involves late stage-processing, that individuals will prefer reappraisal when emotional intensity is low, a suggestion that is in line with our findings. However, work on emotion regulation choice suggests that distraction is preferred when emotional intensity is high (Sheppes et al., 2011), a finding that runs counter to what we observe in these data. In summary, it is likely that there are bidirectional relationships at work here, such that the choice of emotion regulation strategy influences emotional intensity, which in turn influences emotion regulation choice. Such complex relationships will be important to disentangle in future research.

The Associations Between Emotion Regulation Use and Negative Emotional Experience as a Function of Timing

Reappraisal and rumination were the only strategies that interacted with time to predict negative emotion. The negative association between reappraisal use and negative emotional intensity was weaker at the end of the episode than at the beginning of the episode. This result suggests that, in line with lab studies (Sheppes & Meiran, 2007, 2008), reappraisal is less effective in down-regulating negative emotion when used later in the emotional episode. As per the lab research, it may be that once an appraisal of the event is fully generated and used by the individual to understand the situation, it is difficult to replace that interpretation with a reappraisal. Here it is also interesting that despite reappraisal potentially being less effective later in the process, it is also more frequent at this stage, suggesting that perhaps laypeople are not aware of this potential pitfall of reappraisal.

The positive association between rumination use and negative emotional intensity was stronger at the end of the emotional episode than at the beginning and in the middle of the episode. This suggests that rumination may be particularly problematic for negative emotional experience when used later in the episode, or conversely, that continued negative emotion later in the episode may trigger increased rumination. Rumination used at the end of an event may be a signal of continual dysregulation, and perhaps of emotion regulatory failure: despite time passing, the individual is unable to stop continually dwelling on the event or their emotions.

Limitations and Future Directions

Overall, it is important to note that this work was intended to be descriptive: we mapped *where* strategies fell in the emotion regulation process, but we did not assess *why* this was the case. Moving forward, answering these "why" questions will undoubtedly be important: we believe an examination of emotion regulation goals in this temporal process could constitute a fruitful first step. We also took a relatively coarse approach to measuring time, asking participants to map their strategy usage onto only three intervals. As a result, we could not test the extended process model (Gross, 2015), which posits that emotion regulation occurs in cycles that iterate across the course of an event. To test this proposition, we hope that future work will take a more fine-grained approach to measuring time, perhaps using an ecological momentary assessment approach.

In addition, there were some limitations with our method of data collection. First, we assessed emotional episodes retrospectively, meaning that participants' responses were vulnerable to recall biases. In addition, using a recall paradigm may have reactivated participants' event-related emotions. This is potentially problematic given that the intensity profile asked participants to draw their event-related emotion. However, here we should note that we specifically asked participants to recall the emotion experienced *during* the episode. In line with these instructions, participants should not have recorded any emotion reactivation because of the recall task on the profiles. Moving forward, investigating emotion as it unfolds in real time using ecological momentary assessment methodology will help address these issues. Second, our data were self-report, so we are only able to describe conscious processes in emotion regulation. Here, we view our data as complementary to lab research, in which the time course of neural and physiological emotional responding can be better illuminated.

Participants were asked to begin and end their intensity profile at zero emotion. This was consistent with previous work using intensity profiles (e.g., Verduyn et al., 2009; Verduyn, Van Mechelen, & Frederix, 2012), and reflects the normal emotional process. However, ending the profile at zero may be problematic in cases where participants are still feeling negative emotion about the event they are recalling. In these cases, the profiles would be artificially forced to end at zero, meaning that the intensity in the third section may be lower than in reality. However, given the median duration of the emotional episodes in our study was fairly short (1 hr, 30 min), and controlling for event duration did not change the reported analyses, we believe this is unlikely to be a problem in our data. Nonetheless, in future research, it would be best not to constrain profiles to end at zero.[8]

In this work, we only investigated negative emotion. We chose to focus on negative emotion because it is more frequently targeted for regulation (Brans et al., 2013), as well as being more frequently studied (Webb et al., 2012), and thus, better understood than positive emotion regulation. Including positive emotion in future work will help to determine if the patterns we observe in this work are unique to negative emotion, or represent the temporal patterns of emotion regulation more generally. In addition, in drawing the intensity profiles, we asked participants to draw their overall negative emotion, rather than asking them to draw specific emotions like anger, guilt, or sadness. We believe it will be important for future research to determine the temporal profile of emotion regulation in response to specific emotions, and to establish whether there any differences between specific emotions.

[8] To determine whether being asked to begin and end at zero affected our results, we also replicated the analyses reported excluding the first and last 10 time-points. The results of these analyses mirror the results reported here, with one minor exception: in these analyses, the negative association between distraction and negative emotional intensity was significantly stronger in section 3 than in section 1, $\gamma = 25.52$, $SE = 11.82$, $p = .031$. These analyses suggest that the requirement to begin and end at zero did not substantively impact results.

Conclusions

In summary, it is clear that to better understand emotion regulation, we need to better understand the underlying temporal processes. At its heart, emotion regulation is a temporally bound process, and much work on emotion regulation is guided by a theory with time at its center (Gross, 2015). Our data show that strategy implementation, and the relationship of this implementation to emotional experience, vary across time in daily negative emotional episodes. In addition, our data indicate that research conducted on the temporal order of strategies in the lab cannot be generalized to the temporal order of strategies in as they unfold in real-life emotional episodes. We believe our findings represent an important first step on the path to a more thorough understanding of how temporal factors interact with emotion regulation choice and success in daily life.

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