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ORIGINAL ARTICLE

Feeling Too Regretful to Fall Asleep: Experimental Activation of Regret Delays Sleep Onset

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Abstract This study compared the effects of three experimental conditions on sleep: regret (negative emotion condition), pride (positive emotion condition), and description of a typical working day (emotionally neutral condition). A sample of 176 undergraduate students received sealed envelopes to be opened prior to sleep in the evening. The evening envelope contained instructions to describe either "your most burdensome regret," "the action you are most proud of," or, in a neutral and objective manner, a typical day during the working week. The morning envelope contained instructions to rate total wake time, sleep-onset latency, and total sleep time the preceding night. Additional questionnaires on insomnia severity, trait anxiety, and counterfactual processing were completed in a larger data collection session. Analyses revealed that in participants with habitually high levels of regret, focusing on regret prior to sleep significantly delayed sleep onset in comparison with the neutral condition. This effect was independent of preexisting levels of insomnia severity and trait anxiety. In contrast, focusing on pride prior to sleep did not significantly alter sleep, as compared with the neutral condition. These findings suggest that emotional arousal may contribute to sleep disturbance and should be clearly distinguished from cognitive arousal in the etiology of insomnia.

Keywords Affect · Counterfactual thinking · Emotion regulation · Insomnia · Regret · Sleep

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Insomnia is a highly prevalent health problem. In a recent poll of the National Sleep Foundation, 59 % of the respondents reported experiencing at least one symptom of insomnia every night or almost every night (National Sleep Foundation 2012). The individual and societal impact of sleep disturbance is sizeable: The consequences of insufficient sleep include impaired concentration and memory, heightened risk of accidents, increased risk of medical problems such as cardiovascular disease, more frequent use of healthcare institutions, and augmented absenteeism at the workplace (Mai and Buysse 2008).

Over the last few decades, cognitive-behavioral approaches have significantly contributed to the etiology and treatment of insomnia (Edinger and Means 2005; Harvey et al. 2005; Morin et al. 2006). According to these approaches, excessive cognitive activity at bedtime, also termed "cognitive arousal," represents a key impediment to falling asleep (Espie 2007; Harvey 2002). Although sleep-interfering cognitive arousal has long been postulated to be laden with negative affect (Espie 2002; Harvey 2002), the importance of empirically investigating the precise nature of affective processes in insomnia has only recently been recognized (e.g., Baglioni et al. 2010; Schmidt et al. 2011). Emerging evidence suggests that while specific negative affective states may disturb sleep (e.g., anger; Stoia-Caraballo et al. 2008), specific positive affective states may promote sleep (e.g., gratitude; Wood et al. 2009). However, intense positive affective states may also interfere with sleep (e.g., romantic love; Brand et al. 2007), suggesting that the level of arousal rather than the

valence of affective states determines the consequences on sleep.

Given that bedtime may often be the first quiet period in the course of the day available to review one's own behavior, we proposed that this time window might be particularly suitable for the emergence of feelings of regret, shame, and guilt, which, in turn, might interfere with the process of falling asleep (Schmidt and Van der Linden 2009). Regret, shame, and guilt are generally conceived of as counterfactual emotions because they involve comparing the facts of reality with counterfactual imaginations of what might have been (e.g., "If I had [not] done X, I would be in a better situation now"; e.g., Zeelenberg and Pieters 2007). In accord with this assumption, we previously found that university students reported often experiencing counterfactual thoughts and emotions at bedtime and that the frequency of such thoughts and emotions was linked to insomnia severity (Schmidt and Van der Linden 2009). Moreover, we found that students scoring high on impulsive urgency were particularly likely to engage in counterfactual processing at bedtime, suggesting that they mentally replay and reconsider their rash daytime behavior as they try to fall asleep. Impulsive urgency can be defined as the tendency to act rashly, especially under conditions of negative affect (Whiteside and Lynam 2001).

More recently, we essentially replicated these findings in a sample of elderly people, whose age ranged from 51 to 98 years (Schmidt et al. 2011). The pattern of their responses clearly suggested daytime variation in the experience of regrets: While regret frequency remained at comparatively low levels for most of the waking hours, a sharp rise occurred in the evening after going to bed. Furthermore, we found that the nocturnal rise of regrets substantially contributed to insomnia severity independently of other well-known risk factors for late-life sleep disturbance, such as depression, sleep-interfering medical conditions, or medications (for a discussion of these risk factors, see Mai and Buysse 2008). Finally, as with young university students, older adults scoring high on impulsive urgency were especially likely to experience regrets at bedtime and were therefore at a higher risk for sleep disturbances.

By investigating the associations between individual differences in regret anticipation and insomnia, we gathered further evidence for a role of this emotion in sleep disturbance (Schmidt and Van der Linden 2011). We hypothesized that individuals who have difficulties anticipating potential future regrets are at an increased risk of blindly running into situations or adopting behaviors that are prone to evoke regrets. As a consequence, they should experience more actual regrets and related counterfactual emotions, which have been shown to interfere with sleep (Schmidt and Van der Linden 2009; Schmidt et al. 2011). To test these ideas, we developed the Regret Anticipation Failures Scale and administered it, along with other questionnaires, to university students. In line with our predictions, results showed that regret anticipation failures in the course of the day were positively associated with the frequency of regret-related counterfactual thoughts and emotions at bedtime, and that the latter mediated the effect of regret anticipation failures on self-rated insomnia severity (Schmidt and Van der Linden 2011).

A limitation of our previous investigations into the links between counterfactual emotions and sleep disturbance resides in their correlational nature, which precludes causal inferences. To overcome this limitation, we experimentally manipulated regret experiences prior to sleep in the present study. Specifically, our experimental design compared sleep in three conditions: (a) a condition in which we activated regret experiences; (b) a condition in which we activated pride experiences; and (c) a control condition in which participants were asked to describe a working day in a neutral and objective manner. On the basis of our previous correlational findings, we hypothesized that activation of preexisting regret in the evening would impair sleep the following night (as assessed by sleep-onset latency, total wake time in bed, and total sleep time), as compared with the neutral condition. In light of emerging evidence that positive affective states may have beneficial effects on sleep (Emmons and McCullough 2003, Study 3; Wood et al. 2009), we further hypothesized that activation of pride in the evening might facilitate sleep the following night, as compared with the neutral condition.

In view of previously established relations between regret and anxiety (e.g., Roese et al. 2009), as well as between anxiety and insomnia (e.g., Mitchell et al. 2012), we administered an anxiety questionnaire to control for this potential confounding variable. Furthermore, given that our experimental design involved activation of preexisting regret experiences, we included a questionnaire on regret-related counterfactual processing in order to differentiate between people with high and low levels of regrets. People may indeed differ in terms of regret-evoking experiences and also in terms of their propensity for counterfactual processing (Sanna et al. 2006). Finally, we used a sleep questionnaire to assess whether activation of regret and pride experiences might impact sleep independently of preexisting levels of sleep disturbance.

Method

Participants

One hundred eighty-two undergraduate students of psychology participated in this study to fulfill a course

requirement. Six participants were excluded from analyses because they had not completed all sections of the questionnaires. The final sample thus comprised 176 participants, 155 women and 21 men, aged 17–45 ($M = 20.94$; $SD = 4.18$).

Procedure

On the occasion of a larger data collection session for first-year students in psychology, participants were asked to complete two questionnaires, which are described in detail below. They were assessed in groups of up to 40 people, with questionnaires being administered on computers. Upon completion of the questionnaires, participants were handed two sealed envelopes and instructed to open the "evening envelope" just before going to bed and to open the "morning envelope" upon awakening the next day. To randomly assign the participants to the three experimental conditions detailed below, the envelopes were handed to them from a pile that contained the three corresponding types of documents in alternating order, which was invisible to both research assistants and participants. A similar envelope method has previously been used in dream research (e.g., Wegner et al. 2004).

The three different types of documents in the envelopes corresponded to the following three experimental conditions: the regret condition, the pride condition, and the neutral condition. The evening document in the regret condition instructed participants to "describe in detail on the lines below the most burdensome regret in your mind." It was further specified that "the regret can concern something you have done or something you have not done" and that the regret "can refer to a recent or remote episode of your life." All instructions were printed at the top of an A4 page, with lines covering the rest of the page for participants' reports.

The evening document in the pride condition instructed participants to "describe in detail on the lines below the action you are most proud of." It was further specified that "the action can be recent or remote." We specified in the regret and pride conditions that the episode or action could be "recent or remote" because research suggests that intense regrets may refer to remote experiences (e.g., Roese and Summerville 2005), whereas participants might expect that the most recent episodes of regret are likely most important. Thus, with this instruction, we intended to widen the scope of memory search for regrets by providing participants with a metacognitive frame of what to look for.

Finally, in the neutral control condition, the evening document instructed participants to "describe below in a neutral and objective manner a typical day during the working week (Monday through Friday)." It was further specified that "this day should be representative of a habitual day." This experimental condition was inspired by the neutral condition in Emmons and McCullough (2003, Study 1) but in contrast to these authors, we explicitly mentioned in the instruction that the task was to describe a typical working day in a "neutral and objective manner." A qualitative analysis of the reports in the neutral condition revealed that participants, in compliance with this instruction, typically described their general working day schedule without mentioning specific emotion-eliciting events. The morning document, which was identical in all three experimental conditions, asked participants to record the time it took them to fall asleep (sleep-onset latency), the amount of time they spent awake in bed during the night (total wake time in bed), and the amount of sleep obtained in total (total sleep time).

Questionnaires

Bedtime Counterfactual Processing Questionnaire (BCPQ)

To assess habitual levels of counterfactual thoughts and emotions during the pre-sleep period as a control variable, we used the BCPQ (Schmidt and Van der Linden 2009). The questions are preceded by the following instruction: "When in bed in the evening, one sometimes reviews the day that has just come to an end. Hereafter, please indicate how often different kinds of thoughts occur to you as you are trying to get to sleep." In the present study, we used an extended version of the original BCPQ that included three new items (numbered 3, 6, and 9 hereafter) designed to control for response bias effects (Schmidt et al. 2011). These items assess pride-related experiences, thus quite the contrary to feelings of regret, shame, and guilt.

The wording of the 10 items is as follows: (1) "After going to bed, how often do you regret your behavior toward others?"; (2) "After going to bed, how often do you think: 'If only I had made another choice!'"; (3) "After going to bed, how often do you feel proud of yourself when you look back at all that you accomplished?"; (4) "After going to bed, how often do you feel guilty because you have the impression of having done wrong to others?"; (5) "After going to bed, how often do you think: 'If only I were more prudent!'"; (6) "After going to bed, how often do you congratulate yourself for the way you treated other people?"; (7) "After going to bed, how often do you feel ashamed of yourself because of your behavior?"; (8) "After going to bed, how often do you imagine how you would have liked to behave, but did not?"; (9) "After going to bed, how often do you feel happy with the way you handled a conflict with other people?"; and (10) "After going to bed, how often do you feel preoccupied with the consequences of your behavior toward others?" Answers are given on a 5-point Likert scale ranging from 0 (*almost*

never) to 4 (*very often*). The original BCPQ (without the three control items) and the extended version have been shown to capture a single dimension and to possess high internal consistency, with Cronbach's alpha ranging from .81 to .87.

Insomnia Severity Index (ISI)

To evaluate levels of sleep impairment during the month preceding the experiment, we used the French version of the ISI (Blais et al. 1997). The ISI contains seven items that are rated on a 5-point Likert scale ranging from 0 (*not at all*) to 4 (*extremely*). Respondents are asked to evaluate the following dimensions of insomnia: (a) severity of insomnia during the past month (difficulty falling asleep, difficulty staying asleep, problem waking up too early); (b) satisfaction with current sleep patterns; (c) interference with daytime functioning; (d) noticeability of impairment to significant others; and (e) level of distress caused by the sleep problem. Total scores range from 0 to 28, with higher scores indicating higher perceived insomnia severity. The French version of the ISI has been shown to possess good internal consistency ($\alpha = .88$) and to correlate strongly ($r = .67$) with the Pittsburgh Sleep Quality Index (Blais et al. 1997; Buysse et al. 1989). Concurrent validity of the ISI has also been demonstrated using other-administered versions of this instrument, polysomnography, and cardiovascular measures (Bastien et al. 2001; Schmidt et al. 2010).

State-Trait Anxiety Inventory (STAI-T)

To assess habitual levels of anxiety, we used the French version of the STAI-T (Spielberger et al. 1993), which is a 20-item scale measuring anxiety as a trait. Respondents are asked to indicate on a 4-point Likert scale ranging from 1 (*almost never*) to 4 (*almost always*) the degree to which they endorse statements like "I feel nervous and restless." The internal consistency of this scale has been shown to be high across a variety of participant samples (range of Cronbach's α: .89–.92; Spielberger et al. 1993).

Quantitative Content Analysis

To explore the life domains that the participants' reports in the regret and pride conditions were drawn from, two independent raters assigned the reports to the 12 domains that Roese and Summerville (2005) distinguished in relation to regrets: career, community, education, parenting, family, finance, friends, health, leisure, romance, spirituality, and the self. Interrater reliability for the codings was 95.0 %, with a Cohen's kappa of .88 ($p < .001$).

Table 1 Cronbach's Alpha Coefficients, Means, and Standard Deviations for the Questionnaire Scores

Variables	α	*M*	*SD*
BCPQ total score	.89	10.78	6.11
ISI total score	.85	10.40	5.46
STAI-T total score	.93	45.47	11.07

BCPQ Bedtime Counterfactual Processing Questionnaire, *ISI* Insomnia Severity Index, STAI-T Stait-Trait Anxiety Inventory

Table 2 Participant characteristics by experimental condition

Experimental condition	Mean age	*SD*	Range
Regret ($n = 63$)	20.71	3.87	17–45
Pride ($n = 59$)	21.34	4.42	17–37
Neutral ($n = 54$)	20.78	4.32	17–42

Results

Preliminary Analyses

For the three questionnaires that participants filled out during a data collection session prior to the experiment, Cronbach's alpha coefficients, mean scores, and standard deviations are provided in Table 1. The range of alpha coefficients (.85–.93) indicates that the three questionnaires possess excellent internal consistency. Participant characteristics are shown in Table 2.

According to the norms for the ISI provided by Bastien et al. (2001), 30.7 % of our participants did not show any sign of clinically significant insomnia prior to the experiment (score range [Bastien et al.] = 0–7), 44.9 % gave evidence of subthreshold insomnia (range = 8–14), 22.7 % could be considered as suffering from moderate clinical insomnia (range = 15–21), and 1.7 % obtained scores corresponding to severe clinical insomnia (range = 22–28).

Correlational Analyses

To explore the associations between the questionnaire-based scores, we computed Pearson correlations, which are displayed in Table 3. In accord with previous investigations (Schmidt and Van der Linden 2009; Schmidt et al. 2011), the frequency of counterfactual thoughts and emotions at bedtime, as assessed by the BCPQ, was positively related to insomnia severity, as measured by the ISI ($r = .32$, $p < .001$). Again as expected, trait anxiety, as indexed by the STAI-T, was positively related both to the frequency of counterfactual thoughts and emotions at bedtime ($r = .59$, $p < .001$) and to insomnia severity ($r = .38$, $p < .001$). Trait anxiety was also positively

Table 3 Pearson correlations between questionnaire scores

		1	2	3	4	5	6
1	BCPQ total score	1					
2	ISI total score	.32***	1				
3	STAI-T total score	.59***	.38***	1			
4	SOL	.20**	.27***	.27***	1		
5	TWT	.13	.18*	.13	.30***	1	
6	TST	−.14	−.29***	−.18*	−.11	−.19*	1

BCPQ Bedtime Counterfactual Processing Questionnaire, *ISI* Insomnia Severity Index, *STAI-T* State-Trait Anxiety Inventory, *SOL* sleep-onset latency, *TWT* total wake time in bed, *TST* total sleep time

*** Significant at the .001 level, two-tailed; ** significant at the .01 level, two-tailed; * significant at the .05 level, two-tailed

related to sleep-onset latency ($r = .27$, $p < .001$) and, marginally, to total wake time in bed ($r = .13$, $p = .104$), whereas it was negatively related to total sleep time ($r = -.18$, $p = .021$).

Insomnia severity was related in the expected directions to the three self-report measures of sleep the night following the experimental manipulation: sleep-onset latency ($r = .27$, $p < .001$), total wake time in bed ($r = .18$, $p = .021$), and total sleep time ($r = -.29$, $p < .001$). The three latter correlations indicate that sleep disturbance during the preceding month was associated with sleep quantity during the experimental night. In view of these associations and the earlier described associations between trait anxiety and sleep during the experimental night, supplemental analyses of variance (ANOVAs) with insomnia severity and trait anxiety as covariates were performed in order to detect whether the experimental manipulation affected sleep independently of preexisting levels of sleep disturbance and anxiety (see below).

ANOVAs

In order to examine whether the three randomly created groups (regret, pride, and neutral conditions) differed on any of the variables that were assessed prior to the experiment, we computed ANOVAs with experimental condition as the between-subjects factor and the total scores of the three questionnaires (BCPQ, ISI, and STAI) as dependent variables. Results indicated that there were no significant differences between the three experimental conditions in terms of habitual levels of counterfactual thoughts and emotions at bedtime, $F(2, 173) = .27$, $p = .76$; insomnia severity, $F(2, 173) = .054$, $p = .95$; or trait anxiety, $F(2, 173) = .13$, $p = .88$.

To investigate the effects of the experimental manipulation on sleep, we computed three ANOVAs with experimental condition as the between-subjects factor and sleep latency, total wake time in bed, and total sleep time as dependent variables. Variable values at more than two standard deviations from the respective means were considered as outliers and removed from the analyses. Results indicated that there were no significant differences between the three experimental conditions in terms of sleep-onset latency, $F(2, 168) = 1.41$, $p = .25$ (regret: $M = 21.51$, $SD = 17.24$; pride: $M = 18.02$, $SD = 12.68$; neutral: $M = 17.42$, $SD = 11.82$); total wake time in bed, $F(2, 169) = .44$, $p = .65$ (regret: $M = 33.90$, $SD = 42.62$; pride: $M = 37.84$, $SD = 36.68$; neutral: $M = 31.27$, $SD = 30.04$); or total sleep time, $F(2, 175) = .48$, $p = .62$ (regret: $M = 444.70$, $SD = 78.06$; pride: $M = 448.31$, $SD = 91.53$; neutral: $M = 463.37$, $SD = 86.51$).

Given that in the regret condition we activated regrets that participants had prior to the experiment, we conducted complementary analyses to determine whether the effect of the experimental manipulation might depend on preexisting levels of regrets at bedtime. Specifically, we performed a median split on the frequency of counterfactual thoughts and emotions at bedtime as assessed by the BCPQ. We then computed another series of ANOVAs with experimental condition as the between-subjects factor and sleep latency, total wake time in bed, and total sleep time as dependent variables.

For sleep-onset latency, results did not show any significant difference between the three experimental conditions in the group of participants with habitually low levels of counterfactual thoughts and emotions at bedtime, $F(2, 87) = .41$, $p = .66$. In the group with habitually high levels of counterfactual thoughts and emotions at bedtime, in contrast, results revealed a significant difference between the three experimental conditions, $F(2, 78) = 3.32$, $p = .041$. For total wake time in bed, results did not indicate any significant difference between the three experimental conditions in the group of participants with high levels of counterfactual thoughts and emotions at bedtime, $F(2, 80) = .62$, $p = .54$, or in the group with low levels, $F(2, 86) = 1.10$, $p = .34$. Likewise, for total sleep time, there was no significant difference between the three experimental conditions in the high-level, $F(2, 82) = 1.96$, $p = .15$, or the low-level group, $F(2, 90) = 1.05$, $p = .35$.

In order to examine whether the effect of experimental condition on sleep-onset latency in the high-level group was independent of trait anxiety and preexisting sleep disturbance, we conducted an analysis of covariance with experimental condition as the between-subjects factor and with STAI and ISI total scores as covariates. Results indicated a significant effect for experimental condition, $F(2, 76) = 3.22$, $p = .045$; trait anxiety, $F(1, 76) = 6.05$,

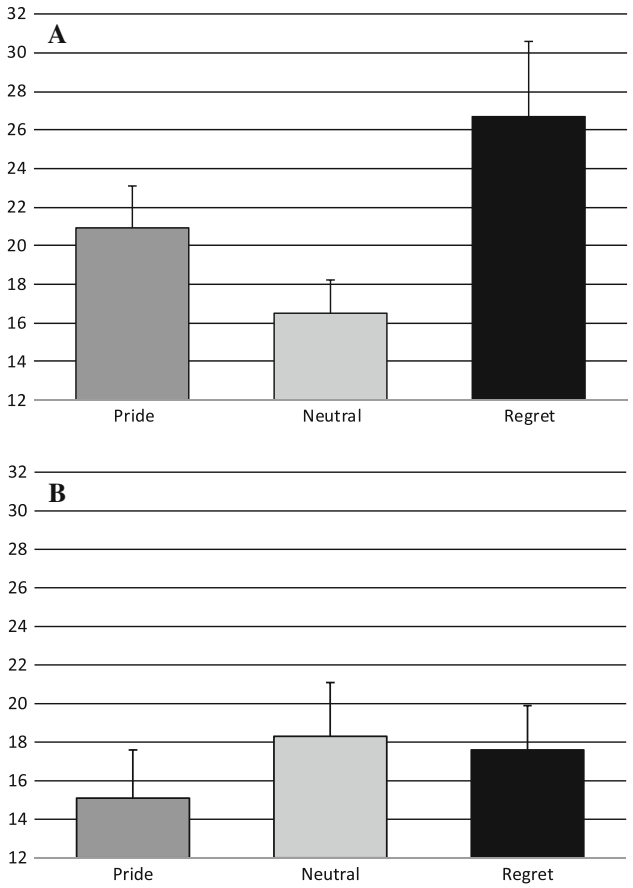

Fig. 1 Mean duration of sleep-onset latency in minutes (*y axis*) for the three experimental conditions (pride, neutral, regret): **a** Group of participants with habitually high levels of presleep counterfactual thoughts and emotions; **b** group of participants with habitually low levels of presleep counterfactual thoughts and emotions. *Error bars* represent respective standard errors

$p = .016$; and insomnia severity, $F(1, 76) = 5.21$, $p = .025$. These findings indicate that the experimental manipulation affected sleep-onset latency over and above the expected effects of trait anxiety and preexisting sleep disturbance. Follow-up *t*-tests showed that sleep-onset latency was significantly longer in the regret condition as compared with the neutral condition, $t(51) = 2.36$, $p = .02$ (regret: $M = 26.67$, $SD = 20.11$; neutral: $M = 16.54$, $SD = 8.69$). Sleep-onset latency in the pride condition ($M = 20.89$, $SD = 11.71$) did not significantly differ from latencies in the regret, $t(52) = 1.54$, $p = .13$ ($M = 26.67$, $SD = 20.11$), and neutral conditions, $t(53) = 1.31$, $p = .20$ ($M = 16.54$, $SD = 8.69$), respectively (see Fig. 1).

Quantitative Content Analysis

In descending order of frequency, participants' reports in the regret and pride conditions referred to the following life domains: (1) education: 23.7 % (e.g., "I regret having repeated my 4th year of college"); (2) family: 14.5 % (e.g., "I'm proud that I told my family, after all those years, that I loved them"); (3) self: 13.0 % (e.g., "I'm proud that I could prove to myself that I was able to live on my own in an apartment"); (4) friends: 10.7 % (e.g., "I regret not having told my friend how important he was for me before he left"); (5) leisure: 10.0 % (e.g., "I participated in the European junior diving championships and I qualified for the World championships [pride]"); (6) romance: 10.0 % (e.g., "My most burdensome regret is having lied to my boyfriend, while he's so important to me"); (7) community: 4.6 % (e.g., "I was able, with my host family, to help homeless people by providing them with food and clothes [pride]"); (8) health: 3.0 % (e.g., "I had to fight a disease and I'm proud not to have given in"); (9) parenting: 3.0 % (e.g., "The action I'm most proud of is to have given birth to my son"); (10) career: 2.2 % (e.g., "I'm proud to have worked in the center all through the month of July"); (11 and 12) finance and spirituality: one report (respectively: "I regret having spent all the money I was given for my birthday"; "I completed a missionary journey abroad which lasted 4 months [pride]"). A small number of reports (3.8 %) could not be assigned to any of these categories for lack of precision.

Discussion

In this study, we examined whether focusing on regret in the evening may impair sleep the following night, as compared with focusing on pride or on a neutral working day schedule. The main finding was that experimental activation of regret in participants with habitually high levels of counterfactual thoughts and emotions significantly delayed sleep onset: It took participants in the regret condition on average 26 min to fall asleep, whereas participants in the neutral condition did so in only about 16 min. Of note, this effect was independent of preexisting levels of anxiety and insomnia, suggesting that acute feelings of regret may exacerbate sleep disturbance over and above the well-established impact of habitual anxious arousal (e.g., Mitchell et al. 2012). This experimental evidence extends previous correlational data from a study (Schmidt et al. 2011) suggesting that nocturnal regrets can contribute to sleep difficulties independently of another well-known risk factor for insomnia, namely, depression (e.g., Taylor et al. 2005).

As outlined in the introduction, cognitive models of insomnia assume that arousal plays a central role in sleep disturbance and, in a further refinement, it has been proposed to differentiate between cognitive, emotional, and physiological arousal (e.g., Espie 2007; Harvey 2002).

Cognitive arousal refers to mental activation, which can take the form of thoughts and images (Harvey 2000). Poor sleepers typically complain of cognitive hyperarousal in the form of intrusive thoughts, worry, and rumination (e.g., Harvey 2002), which can be subsumed under the term repetitive thought (Watkins 2008). Emotional arousal refers to the intensity of the emotional experience (e.g., Canli et al. 2000), for example, the intensity of feelings of regret. Physiological arousal, finally, refers to the activation of the sympathetic nervous system, which may manifest itself across different parameters, such as heart rate or skin conductance level (e.g., Harvey 2002).

Regarding the emotion of regret, empirical evidence from outside of insomnia research supports the distinction between the dimensions of cognitive and emotional arousal. For instance, Roese and colleagues (Roese et al. 2009) found that both repetitive thought (cognitive arousal) and regret (emotional arousal) correlated with depression. However, when repetitive thought and regret were simultaneously used as predictors of depression in a multiple regression, only regret emerged as a significant predictor, suggesting that regret-related emotional arousal may contribute to mental health problems independently of cognitive arousal. Taken together, the findings of Roese and colleagues and of the present study suggest that in the context of insomnia, emotional arousal should be considered as an etiological factor that is partly independent of cognitive arousal.

The question of why regrets delayed sleep onset only in participants with habitually high levels of counterfactual thoughts and emotions may essentially be explained by the nature of our experimental manipulation. Specifically, we did not induce new regrets prior to sleep, for example, by having participants play a game and then ruminate on missed monetary gains, but we activated preexisting regrets by instructing participants to describe their "most burdensome regret." Thus, the success of our manipulation hinged on the existence of noteworthy regrets, in the absence of which there was little or nothing to activate.

Although activation of regret delayed sleep onset in participants with preexisting regrets, it did not have any effect on the other two sleep parameters. As hypothesized, total wake time in bed was longer and total sleep time shorter in the regret condition as compared with the neutral condition, but these differences did not reach statistical significance. In view of the temporal proximity between the experimental manipulation just prior to sleep and sleep-onset latency, a comparatively stronger effect for this sleep parameter might have been expected. However, additional factors may account for the disparity of effects on the three sleep parameters. Given that processes of emotion regulation occur during sleep (e.g., Walker and van der Helm 2009), it is, for example, conceivable that the effects of acute regret are down-regulated across the night. Alternatively, regret-related processing may continue during sleep and manifest itself in dreams (e.g., McNamara et al. 2002; Schmidt and Van der Linden 2009), but such processing may not elicit enough arousal to interrupt sleep.

Regarding the presleep activation of pride, we did not find any significant effect on the three sleep parameters. In view of evidence suggesting that positive affective states, such as gratitude, may have beneficial effects on sleep (Emmons and McCullough 2003, Study 3; Wood et al. 2009), we expected that activation of pride might facilitate sleep as compared with the neutral condition. However, recent empirical findings caution against too simplistic a view that would equate positive affect with good sleep and negative affect with bad sleep (for a detailed discussion, see Schmidt et al. 2011). For instance, it has been found that happy mood induction in individuals with interepisode bipolar disorder may delay sleep onset, possibly because these individuals react to happy mood with an activating focus on the pursuit of goals and rewards (Talbot et al. 2009).

The absence of any sleep-promoting effect of the positive emotion of pride may similarly be explained on the basis of arousal. In contrast to gratitude, which has been shown to facilitate sleep (Emmons and McCullough 2003, Study 3; Wood et al. 2009), pride seems to be more closely associated with the pursuit of goals and reward (e.g., Carver et al. 2010), thereby possibly augmenting the level of arousal. For example, some participants in the pride condition described winning a competition in a sport they were still practicing, which might have activated motivational processes geared toward future competitions, thereby lifting arousal levels. This illustration highlights the importance of analyzing affective states in terms of arousal in order to clarify their potential impact on sleep.

Regarding treatment implications, it is of note that in response to regret, people often use maladaptive emotion regulation strategies, such as self-attacking, which exacerbate emotional arousal and sleep disturbance (e.g., Schmidt et al. 2011). Given that fostering self-compassion and self-forgiveness have been shown to counteract adverse effects of self-attacking (e.g., Gilbert and Procter 2006; Ingersoll-Dayton and Krause 2005), a promising line for future research will be to evaluate these emotion regulation strategies in the context of insomnia.

To provide further guidelines for future research, three limitations of the current study should be mentioned. First, sleep was evaluated using self-reports. Future investigations might include objective measures, such as actigraphy (e.g., Vallières and Morin 2003), to complement and corroborate subjective self-report data. Second, participants in the present study were undergraduates. An interesting avenue for future research will be to explore whether similar effects of regret activation on sleep may be

observed in samples of the general population and in older adults. Indeed, the existing literature on regrets and sleep suggests that the intensity of regrets is liable to increase across the life span and to have increasingly stronger effects on sleep because opportunities to undo regrets generally decline with age (Schmidt et al. 2011; Wrosch et al. 2005). A final limitation of this study is that participants' compliance with the instructions to complete the documents just before going to bed in the evening and upon awakening the next morning was not controlled for. The computer-based collection of self-reports, for example, via cell phones, may represent a useful method to ensure compliance in future experiments.

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