The effects of dream rebound: Evidence for emotion-processing theories of dreaming

Running Title: Emotion-processing and dream rebound

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Summary

Suppressing thoughts often leads to a "rebound" effect, both in waking cognition (thoughts) and in sleep cognition (dreams). Rebound may be influenced by the valence of the suppressed thought, but there is currently no research on the effects of valence on dream rebound. Further, the effects of dream rebound on subsequent emotional response to a suppressed thought have not been studied before. The present experiment aimed to investigate whether emotional valence of a suppressed thought affects dream rebound, and whether dream rebound subsequently influences subjective emotional response to the suppressed thought. Participants (N=77) were randomly assigned to a pleasant or unpleasant thought suppression condition, suppressed their target thought for five minutes pre-sleep every evening, reported the extent to they successfully suppressed the thought, and reported their dreams every morning, for seven days. It was found that unpleasant thoughts were more prone to dream rebound than pleasant thoughts. There was no effect of valence on the success or failure of suppression during wakefulness. Dream rebound and successful suppression were each found to have beneficial effects for subjective emotional response to both pleasant and unpleasant thoughts. The results may lend support for an emotion-processing theory of dream function.

Keywords: ironic process theory; emotion-processing theory of sleep/dreaming; continuity hypothesis; overnight therapy

Introduction

The Ironic Process of Mental Control theory (Wegner, 1994) suggests that successful thought suppression occurs when two cognitive systems work harmoniously together: an operating system that searches for cognitions that avoid the forbidden thought, and a monitoring system that searches for cognitions inconsistent with the desired outcome. Thought suppression is most likely to fail when the monitoring system cannot function well, such as during rapid-eye-movement (REM) sleep. This "dream rebound" effect was first evidenced by Wegner et al. (2004): suppressed thoughts were more likely to be dreamt of than those that were actively concentrated upon, or freely thought about.

Individuals with high levels of trait thought suppression are particularly susceptible to dream rebound (Taylor & Bryant, 2007), and to dreaming of their waking-life emotions (Malinowski, 2015), especially negative ones (Malinowski, 2017). However, experimental dream rebound research has either not specified the emotional valence of the target thought, or has directed participants to identify specifically unpleasant thoughts. Findings regarding the effects of emotional valence on the success or failure of suppression during wakefulness are mixed (Harvey & Bryant, 1998).

Although the dream rebound effect has been widely evidenced (e.g. Kröner-Borowik et al., 2013; Taylor & Bryant, 2007; Wegner et al., 2004), its effects on waking life have rarely been researched. A dominant theory of dream function is the emotion-processing theory (e.g. Cartwright, 2011; Hartmann, 1996; Malinowski & Horton, 2015). This theory suggests that emotional experiences and thoughts that have not yet been processed appear in dream content, at which time they are transformed and integrated into the wider memory system, and this has an ameliorating effect on their emotional intensity. This theory would suggest that dreaming of an unpleasant thought that has been suppressed should have a beneficial effect on emotional response to the target thought.

In addition to the effects of dream rebound, research must take into account the success or failure of initial thought suppression. Some experiments show that attempts at suppression inadvertently result in intrusive thoughts (see Wenzlaff & Wenger, 2000, for a review), but others have found that suppression can be successful when used in conjunction with other techniques, such as focused distraction (Luciano & González, 2007).

The first aim of the experiment was to investigate the effect of emotional valence on dream rebound. Based on the results of Malinowski (2017) and some waking thought suppression research (e.g. Roemer & Borkovec, 1994), it was hypothesised that dream rebound would be more pronounced for negatively valenced suppressed thoughts than for positively valenced suppressed thoughts. The second aim of the experiment was to investigate the effects of dream rebound and failed suppression on self-reported emotional response to the target thought. Based on the emotion-processing theory of dreaming, it was hypothesised that dream rebound would have a therapeutic effect on emotional response, with participants high in dream rebound feeling more pleasantly towards their target thought than those low in dream rebound. Failed suppression was expected to have the opposite effect: it was hypothesised that participants who successfully suppressed their target thought would feel more pleasantly towards their target thought than those who failed to suppress.

In order to control for potentially confounding variables, five covariates were included: 1) thought suppression, which has been found to influence dream rebound (Bryant et al., 2011); 2) rumination, as rumination may cause participants to be more prone to thinking about their forbidden thought before sleep; 3) neuroticism, which has been found to relate to dreaming of waking-life emotions (Gilchrist et al., 2007); depression, anxiety, and stress, which have been found to relate to the extent to which individuals dream of their waking-life emotions (Malinowski, 2017), and gender, because women tend be more prone to neuroticism (Schmitt et al., 2008) and depression (Piccinelli & Wilkinson, 2000).

Method

Participants

Ninety participants took part, of whom 77 participants completed the full duration (58 female), age 18-78 (*M*=34.68, *SD*=14.21). Because of the wide variability in age, age was added as a covariate. Recruitment was conducted via various methods of opportunity sampling, and psychology students beyond the first year of undergraduate were excluded from participating. Thirty-one participants were recruited from adverts at the University of East London, 18 from adverts in London newspapers, 7 from the website "Call for Participants", 5 from social media, 4 via word of mouth, and 12 from other ways (e.g. an announcement at public lecture). Thirty-three participants were employed or self-employed, 30 were full- or part-time students, and 14 were not working or studying (e.g. retired or homemakers).

We adopted the same exclusion criteria as Kröner-Borowik et al. (2013), using a self-reported eligibility questionnaire. Participants were accepted for the study if they self-reported to be over 18 years of age, have a BMI between 19 and 30 (denoting general good health), be in good physical health, sleep six or more hours per night, take no more than 30 minutes to fall asleep, recall at least 3 dreams per week, not currently be suffering from any sleep disorder, not currently be taking any medication that may interfere with sleep, not currently be suffering with frequent nightmares (>2 a week), not currently be experiencing any mental health issues (such as depression, anxiety, PTSD, bipolar disorder, or any others), not currently be studying psychology nor have ever been a psychologist (beyond first year undergraduate), not have taken psychotropic drugs within the last 6 months, and be fluent in English.

Materials

Participants completed the entire experiment online via Qualtrics, an online survey host.

Questionnaires:

1) The Thought Suppression Inventory (TSI: Rassin, 2003), which measures the extent to which individuals tend to suppress thoughts, in three subscales: Intrusions (α = 0.71), Suppression Attempts (α = 0.64), and Successful Suppression (α = 0.67).

2) The Ruminative Responses Scale (RSS: Gonzalez et al., 2003) (α = 0.72), which measures the extent to which an individual ruminates on depressive and unpleasant thoughts.

3) The 'neuroticism' subscale of the Big Five Inventory (BFI: John & Srivastava, 1999) (α = 0.85),. Neuroticism is one of the so-called "big five" personality traits, and pertains to traits such as emotional lability and nervousness.

4) The Depression, Anxiety, and Stress Scale (DASS21: Lovibond & Lovibond, 1995), which measures individuals' pre-existing levels of depression (α = 0.91), anxiety (α = 0.84), and stress (α = 0.90).

Evening task:

For the evening task, participants were asked to identify and suppress a personally-relevant thought from waking life: either a pleasant or an unpleasant thought, depending on the condition to which they were randomly assigned (using the website random.org, which uses atmospheric noise to generate true random numbers rather than pseudo-random algorithms). Participants also self-rated the thought for its level of pleasantness/unpleasantness, distress/enjoyment, and intensity (answerable on Visual Analogue Scales from 0 to 100).

The suppression task comprised spending five minutes attempting to suppress the thought whilst writing a stream-of-consciousness on a piece of paper, and making checkmarks each time the thought popped into conscious awareness. This pre-sleep thought suppression task follows Wenger et al. (2004).

Morning task:

The morning task comprised reporting any dreams participants recalled. Instructions for reporting were adapted from the Most Recent Dream method of dream report collection used in Malinowski (2015, 2017). Space was provided for up to three dreams.

Dreams were rated by independent raters for relation to the target thought on a scale of 0 (not related at all) to 4 (strongly related) (Bryant et al., 2011). The independent raters were all experienced in dream research and all were blind to both the hypotheses and conditions of the study. ICC estimates and their 95% confident intervals were calculated to assess interrater reliability, based on an average-rating (k = 3), consistency, 2-way mixed-effects model. A good degree of reliability was found between the three raters, ICC = .81, (95% CI lower bound = .77, upper bound = .83). Results are based on the mean scores across the three raters.

At the end of the experiment, participants were asked to recall their initial target thought once more, and respond on a Visual Analogue Scale (0-100) to indicate how unpleasant/pleasant the thought was to them now, as well as how enjoyable/distressing and how intense the thought was.

Procedure

Participants first received an eligibility questionnaire (see Participants) and an information sheet. If they met the criteria and agreed to take part, they received the instructions and links they needed to take part via email. All participants took part from their own homes remotely using their own personal devices such as a computer or smart phone. Participants were randomly assigned (using a random number generator) to one of two conditions: pleasant or unpleasant thought.

There were three parts to the experiment: completing a battery of questionnaires; a week-long evening suppression and morning dream report task; and some final questions about the target thought. The entire procedure took one week to complete. Participants were instructed not to drink alcohol during the course of the experiment, or caffeinated beverages late in the day, or consume any other substance that may interfere with their sleep. No other requirements were stipulated.

On the day that participants began the experiment, they first gave their informed consent to participate, and then responded to demographic questions. Next, they completed the first set of questionnaires: the Though Suppression Inventory (Rassin, 2003), the Rumination Response Scale (Gonzalez et al., 2003), the 'neuroticism' subscale of the BFI (John & Srivastava, 1999), and the Depression, Anxiety, and Stress Scale (Lovibond & Lovibond, 1995). They were then given two practice tasks to prepare them for the evening suppression task and the morning dream report task.

To practice the evening suppression task, participants were asked to suppress thoughts of a white bear for five minutes whilst writing a stream of consciousness and making checkmarks every time a thought of the white bear did crop up. To practice the morning task, participants reported their Most Recent Dream, which was the last dream they could remember having, however long ago it occurred.

Participants began the tasks of the experiment that evening before bed (Time 1). On the first night of the experiment, participants completed the thought suppression task, answered questions about it, and then went to bed as normal. The following morning, they wrote down any dreams they remembered from the night. The same procedure for the evening and morning task was following every night and every morning for seven days, with the exception of identifying the thought: this was only done once, on the first night, and the same thought was suppressed every night of the experiment.

On the final day of the experiment (Time 2), after submitting their final set of dream reports, participants rated the thought again, were thanked for their time, and finally debriefed.

Participants received a £20 high street voucher in thanks for their participation.

The study abided by the British Psychological Society's ethical guidelines, and received ethical approval from the University Research Ethics Committee at the University of East London.

Analyses

Planned analyses were two one-way ANCOVAs, one to test the effects of thought valence on dream rebound, and one to test the effects of thought valence on waking rebound, which

was measured by the average number of times the target thought cropped up during the five-minute suppression task across the seven nights of the experiment. A 2x2x2 ANCOVA assessed interaction effects between thought valence, dream rebound, and failed suppression (measured by the average number of times the target thought cropped up during the five-minute suppression task across the seven nights of the experiment) on emotional response to the target thought at Time 2.

Results

Participant characteristics

Participant characteristics are reported in Table 1. Separate Mann-Whitney U tests indicated that participants in the two conditions did not differ in terms of age, trait thought suppression (Intrusions, Attempts, or Successful), rumination, neuroticism, or their levels of depression, anxiety, and stress.

[Insert Table 1 about here]

Manipulation checks

To test that the manipulation of thought valence was successful, two Mann-Whitney U tests were conducted to assess the unpleasantness/pleasantness and the distress/enjoyment of the thoughts. As expected, the first Mann-Whitney U test indicated that the pleasantness of target thought was significantly higher for the group assigned to pleasant condition (Mean Rank = 27.65) than the group assigned to the unpleasant condition (Mean Rank = 51.97), U = 1,234, z = 4.77, p < .001. Likewise, the second Mann-Whitney U test indicated that on the scale of 0-100, where 0 = extremely distressing and 100 = extremely enjoyable, the enjoyableness of the target thought was significantly higher for the group assigned to pleasant condition (Mean Rank = 59.28) than the group assigned to the unpleasant condition (Mean Rank = 20.71), U = 1,511, z = 7.52, p < .001. However, there was no significant difference between the emotional intensity of the pleasant target (Mean Rank = 37.32) and the unpleasant thought (Mean Rank = 40.64), U = 677.00, z = -0.65 p = .51.

The manipulation checks thus confirmed that participants in the unpleasant condition identified unpleasant and distressing thoughts to use in the experiment, while participants in the pleasant condition identified pleasant and enjoyable thoughts to use in the experiment, but the emotional intensity of the thoughts did not differ.

Dream reports

An average of 7.26 (*SD*=3.27) dream reports were submitted. Participants in the unpleasant condition submitted an average of 7.79 (*SD*=3.30) dreams, and participants in the pleasant condition submitted an average of 6.71 (*SD*=3.18) dreams. This difference was non-significant, $U = 603.50$, $z = -1.41$, $p = .16$.

Effect of suppressed thought valence on dream rebound and waking suppression

Dream rebound

Dream rebound was measured with a rating scale of 0-4 (Bryant et al., 2011), rated by three independent raters. Results are based on the mean of the three raters' scoring across all of participants' submitted dreams.

Internal consistency was good for all covariates (αs ranged between 0.68 and 0.94).

Before controlling for the covariates, there was a significant effect of thought valence on dream rebound, with unpleasant thoughts being dreamt of more often (*M*=.70, *SD*=.51) than pleasant thoughts, (*M*=.48, *SD*=.35), $F(1,75) = 4.91$, $p = .015$, $\eta_p^2 = .06$.

None of the covariates were significantly related to dream rebound (all *p*s > .05). The effect of thought valence on dream rebound remained significant after controlling for these variables, $F(1,65) = 3.87$, $p = .025$, $\eta_p^2 = .06$

Therefore, the first hypothesis was confirmed: suppressing unpleasant thoughts led to significantly more dream rebound than suppressing unpleasant thoughts, and this difference could not be accounted for by the emotional intensity of the thought, failed suppression, participants' trait thought suppression, neuroticism, rumination, their levels of depression, anxiety, or stress, or their age or gender.

Waking rebound

"Waking rebound" was measured by the average number of times the target thought cropped up during the five minute suppression task across the seven nights of the

experiment. Before controlling for the covariates, there was a non-significant effect of thought valence on waking rebound, with unpleasant thoughts being dreamt of no more often (M=4.94, SD=7.24) than pleasant thoughts, (M=5.49, SD=6.03), $F(1,75) = 0.13$, $p = .72$, $\eta_p^2 = .002$. Of the covariates, only Rumination was significantly related to waking rebound, $F(1,66)$, = 7.98, $p = .006$. The effect of thought valence on waking rebound remained non-significant after controlling covariates, $F(1,66) = 0.28$, $p = .60$, $\eta_p^2 = .004$.

Thus, participants were equally capable of supressing pleasant and unpleasant thoughts during wakefulness.

Effect of dream rebound and success/failure of suppression on emotional response to target thought

In this analysis, three independent variables were tested: 1) emotional valence of the thought (pleasant/unpleasant: participants randomly assigned to condition); 2) dream rebound (high/low: median split of the mean of dream rebound scores for all dreams submitted across the seven mornings of the experiment); and 3) failed suppression (high/low: median split of the mean number of times the forbidden thought cropped up during the five minute stream-of-consciousness task across the seven evenings of the experiment).

Tests were first carried out to ensure that there were no group differences at Time 1 between high/low dream rebound groups, and between high/low failed suppression groups, to ensure that any differences at Time 2) could be ascribed to the independent variables. At Time 1, there were non-significant differences between high and low dream rebound groups on initial unpleasantness of thought ($p = .52$), and between high and low failed suppression groups on initial unpleasantness of thought ($p = 1.00$).

A 2x2x2 ANCOVA was performed to analyse the effects of thought valence (pleasant/unpleasant), dream rebound (high/low), and failed suppression (high/low) on participants' thought unpleasantness at Time 2. Covariates were: trait thought suppression (in three factors), neuroticism, and levels of depression, anxiety, and stress. Rumination did

not meet the assumption of independence of treatment variable and covariate and so was removed from the analysis. Means are reported in Table 2.

[Insert Table 2 about here]

Unsurprisingly, there was a main effect of initial thought valence on thought unpleasantness at Time 2, $F(1,61)$, = 95.33, $p < .001$, $\eta_p^2 = .61$, with participants in the unpleasant thought condition having much more unpleasant feelings towards their target thought at Time 2 than participants in the pleasant thought condition. There was a marginal main effect of failed suppression on thought unpleasantness at Time 2, $F(1,61) = 3.99$, $p = .05$, $\eta_p^2 = .06$. There was no main effect of dream rebound ($p = .10$).

Several significant interaction effects were found.

A significant interaction effect was found between initial thought valence and failed suppression, $F(1,61) = 4.69$, $p = .03$, $\eta_p^2 = .07$. As Graph 1 shows, participants in the pleasant condition reported the same level of thought pleasantness irrespective of how successfully they suppressed their thought. Conversely, for participants in the unpleasant condition, those who had low levels of failed suppression felt more pleasantly towards their thought than participants who had high levels of failed suppression. This supports the second hypothesis, that participants high in failed suppression would have a more negative response to their target thought than those low in failed suppression.

[Insert Graph 1 about here]

A similar interaction pattern emerged between dream rebound and failed suppression, $F(1,61) = 4.24$, $p = .04$ $\eta_p^2 = .07$. As shown in Graph 2, participants who had low levels of failed suppression had a similar level of thought pleasantness at Time 2, irrespective of dream rebound. However, for participants high in failed suppression, those with high levels of dream rebound had a similar level of pleasantness at Time 2 to participants with low

failed suppression. But for participants high in failed suppression and low in dream rebound, their reported pleasantness was much lower. This supports the hypothesis that dream rebound offers a therapeutic effect: when waking suppression fails but dream rebound is high, the thought is experienced as more pleasant than when waking suppression failed but dream rebound is low.

[Insert Graph 2 about here]

Finally, there was a significant interaction effect between thought valence, dream rebound, and failed suppression, $F(1,61) = 5.13$, $p = .03$, $\eta_p^2 = .08$. Graphs 3 and 4 illustrate this interaction.

Graph 3 indicates that when the initial thought was unpleasant, participants high in dream rebound reported the same level of pleasantness for their thought at Time 2 irrespective of whether they were successful or not in suppressing that thought. However, participants low in dream rebound reported much more unpleasantness of their target thought at Time 2 if they were also high in failed suppression, whereas their pleasantness exceeded those of the high dream rebound group if they were also low in failed suppression.

Graph 4 indicates that a different pattern was observed for initially pleasant thoughts. In this condition, participants high in dream rebound reported similarly high levels of thought pleasantness at Time 2 irrespective of whether they were successful or not in suppressing the thought. Participants low in dream rebound also experienced similar levels of pleasantness irrespective of successful suppression, but their pleasantness was lower than that of the high dream rebound group. Again, this implies that dream rebound offers a therapeutic effect: initially pleasant thoughts were experienced as more pleasant following high levels of dream rebound than following low levels of dream rebound, irrespective of the success or failure of waking suppression.

[Insert Graphs 3 and 4 about here]

Discussion

Suppressing an unpleasant thought led to more dream rebound than suppressing a pleasant thought, after controlling for the emotional intensity of the thought, failed waking suppression, trait thought suppression, neuroticism, and rumination, and levels of depression, anxiety, and stress. Conversely, the emotional valence of the thought had no effect on success or failure of waking suppression. Subsequent effects of dream rebound and failed suppression were dependent on the valence of the initial thought.

When the target thought was unpleasant, dream rebound and successful suppression both had a beneficial effect on subjective emotional response to the thought. Participants with high levels of dream rebound reported similar levels of pleasantness, irrespective of how well they suppressed the thought. Participants low in dream rebound and low in failed suppression had the highest pleasantness scores, suggesting that successful waking suppression negated the need for subsequent dream rebound. However, participants low in dream rebound and high in failed suppression had comparatively very negative responses to their target thought – close to zero on the unpleasant-pleasant scale. Thus, failure to suppress *and* failure to dream of the target thought led to the lowest levels of pleasantness.

When the target thought was pleasant, the differences were much smaller, but a pattern emerged. Participants high in dream rebound had the highest pleasantness ratings, irrespective of their failed suppression levels. Participants low in dream rebound had slightly lower pleasantness scores, also irrespective of their failed suppression levels. Thus, failed suppression seems to have had little effect in this condition, whereas dream rebound offered a small benefit to subjective emotional response to the initially pleasant thoughts.

Together, these results indicate a beneficial role of dreaming of the suppressed target thought: dream rebound both in the unpleasant and pleasant conditions were associated with high levels of thought pleasantness. In particular, dream rebound appeared to offer a

therapeutic effect to participants who failed to successfully suppress their unpleasant thoughts.

The findings have implications for dream theory. A dominant functional theory of sleep and dreaming is that they offer benefits for consolidating and processing emotional thoughts and experiences (e.g. Cartwright, 2011; Hartmann, 1996; Malinowski & Horton, 2015; Walker & van der Helm, 2009). We found that dreaming of a suppressed thought offered beneficial effects for subjective emotional response to the target thought, both for initially unpleasant and initially pleasant thoughts. In particular, we found that dream rebound was especially important for participants who were unable to suppress their unpleasant thought during wakefulness. That dream rebound led to higher pleasantness scores in both conditions, and especially for those that failed to suppress unpleasant thoughts, suggests that dreaming of the thought led to amelioration of unpleasantness and/or increased pleasantness. This is in line with Fading Affect Bias theory; the reduction in negative response to unpleasant memories may occur during sleep, as reflected in dream content (Horton & Malinowski, 2015). When this does not take place during sleep, affect may remain negative.

Findings also have implications for treating nightmare disorder and other psychiatric disorders in which dream content is known to be negatively affected, such as depression and Post-Traumatic Stress Disorder. Since suppressing unpleasant thoughts has an effect on dreams, alternative methods of coping with unpleasant thoughts, such as mindfulness or thought acceptance techniques, may be preferable to individuals suffering with a psychiatric disorder and who also have high trait thought suppression. Additionally, since dream content may directly reflect suppressed unpleasant thoughts, it is possible that future research will be able to find ways of identifying problematic thoughts in dreams, perhaps in recurrent dreams or repetitive nightmares.

Some limitations to the experiment must be noted. Control conditions were not used in the experiment, in order to retain power, and because suppression vs no-suppression dream rebound effects are now well-demonstrated. As such, an argument could be made that the effect of valence was not due to a more pronounced dream rebound effect for negatively toned target thoughts, but to a *waking* rebound for negatively toned stimuli, leading to greater conscious accessibility of the unpleasant thought pre-sleep. However, this is unlikely

to explain the effect: even after controlling for participants' failed suppression scores, the difference between the unpleasant and pleasant conditions remained. This indicates that it was the valence of the supressed thought, and not the success or failure with which the thought was suppressed during wakefulness, that influenced the amount of dream rebound.

A second limitation is that we cannot be certain that it is the effect of having dreamt of the suppressed thought, as opposed to the effect of remembering the dream of the suppressed thought and continuing to process it during the waking state, that leads to more positive and less negative reactions to it subsequently. Alternatively, it could be that both dreaming of *and* remembering and continuing to process the suppressed thought in the waking state are crucial.

Discussion around the effect of dream rebound is limited by the fact that dream rebound is a naturally-occurring variable. Until researchers develop methods to reliably influence dream content, discussion of dream function remains speculative, based on quasi-experimental and correlational research. Dream content is notoriously difficult to experimentally manipulate (Schredl, 2002), but the Targeted Memory Reactivation protocol used for memory enhancement in sleep science (Schouten et al., 2016) may offer a way forward.

A final limitation to the experiment is that participants self-reported on their physical and mental well-being rather than being interviewed by a clinician. For this reason we cannot be certain that all participants were in good physical and mental health. Future research should aim to replicate these results using clinical interviews.

Conclusion

Dream rebound was found to be more pronounced for unpleasant thoughts than pleasant thoughts, and appeared to offer a beneficial effect for subjective emotional response to both pleasant and unpleasant thoughts. Success or failure of waking suppression was not dependent on valence. Successful waking suppression negated the need for the therapeutic effect of dream rebound. Results lend support for emotion-processing theories of dream function.

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