Mindfulness and dream quality: The inverse relationship between mindfulness and negative dream affect

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The aim of the study was to examine the relationship of mindfulness to the emotional quality of dreaming. In our questionnaire-based study, comprising the data of 587 undergraduate students we examined the association between trait anxiety, perceived stress, trait mindfulness, negative dream affect and dream anxiety. Our results indicate that mindfulness is inversely related to disturbed dreaming and predicts less severe dream disturbances after controlling for trait anxiety. Moreover, the results of the applied hierarchical regression analysis suggest that mindfulness is associated with reduced dream anxiety by moderating the extent of waking anxiety. Our findings extend previous research relating mindfulness, emotional regulation and sleep quality to the domain for trait anxiety. Moreover, the results of the applied hierarchical regression analysis suggest that mindfulness is associated with reduced dream anxiety by moderating the extent of waking anxiety. Our findings extend previous research relating mindfulness, emotional regulation and sleep quality to the domain for trait anxiety. We suggest that mindfulness is a possible protective factor against dream disturbances.

Key words: Mindfulness, dreaming, dream anxiety, emotional regulation, nightmares.

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INTRODUCTION

Originating in Far Eastern philosophies and religious practices, mindfulness is an enhanced state of awareness characterized by focused attention towards internal and external present moment experiences in an open, receptive and non-judgmental information processing style (Brown & Ryan, 2003). Since mindfulness seems to be an adaptive skill promoting self-regulation, stress reduction and positive emotional states, mindfulness-based stress reduction is an effective treatment method for different psychopathological conditions (Roemer, Lee, Salters-Pedneault, Erismann, Orsillo & Mennin, 2009). Apart from its therapeutic applications there is a mounting body of evidence linking mindfulness to a variety of mental health indices (Brown & Ryan, 2003; Weinstein, Brown & Ryan, 2009) fostering our scientific understanding of this important construct. Ultimately, mindfulness was related to positive sleep quality (Howell, Digdon, Buro & Sheptycki, 2008). Moreover, results indicated that the relationship between mindfulness and well-being was mediated by improved sleep quality (Howell, Digdon & Buro, 2010). In the present paper we aim to broaden these sleep-related findings investigating the relationship between mindfulness and the emotional aspects of dreaming.

Mindfulness and emotional regulation

There is abundant clinical and experimental research data suggesting that mindfulness is an important emotion regulatory skill promoting higher levels of well-being (Brown & Ryan, 2003; Weinstein et al., 2009; Feltman, Robinson & Ode, 2010). Even according to the first clinical reports, mindfulness seemed to be an adaptive skill promoting self-regulation, stress reduction and positive emotional states (Kabat-Zinn, Massion, Kristeller et al., 1992) and therefore the operationalization of dispositional mindfulness might have been expected to be shaped by the constraints of our preconceptions considering mindfulness as a dimension of emotional regulation. Nevertheless, the Mindful Attention Awareness Scale (MAAS), the most widely used questionnaire measuring trait mindfulness, developed by Brown and Ryan (2003) does not contain any content that relates directly to emotions or emotional regulation. Moreover, the psychometric properties of the scale suggest that the MAAS reflects a unique property of human consciousness. Since MAAS aims to measure a receptive attentional stance toward inner and outer present moment experiences it was related to the Openness to Experience Factor of the NEO-PI (Costa & McCrae 1992) and to measures of emotional intelligence (Trait Meta-Mood Scale; Salovey, Mayer, Goldman, Turvey & Palfai, 1995). But mindfulness is not a marker of self-consciousness characterized by higher-order, self-reflective thoughts. In contrast mindful states are more perceptual or pre-reflexive, “operating on, rather than within, thought, feeling, and other contents of consciousness” (Brown & Ryan, 2003, p. 823).

Subsequently, mindfulness was positively related to benign stress appraisals and to a higher use of approach coping instead of avoidance coping strategies (Garland, Gaylord & Park, 2009; Weinstein et al., 2009). Mindfulness was a positive correlate of such personality traits as Conscientiousness, Agreeableness and Positive Affect, while it was a negative correlate of Neuroticism and Negative Affect (Giluk, 2009). Lower levels of mindfulness were related to emotional dysregulation and predicted symptom severity in Generalized Anxiety Disorder (Roemer et al., 2009) and in Borderline Personality Disorder (Wupperman, Neumann, Whitman & Axelrod, 2009). These findings indicate that mindfulness mitigates emotional reactivity to threatening situations (Arch &
Craske, 2010), and facilitates quicker recovery from unpleasant emotional states (Broderick, 2005). The mechanism of these benign effects on stress reduction is not fully understood, but research suggests that this unique state of awareness may provide enhanced attentional capacities and cognitive flexibility (Moore & Malinowski, 2009; Zeidan, Johnson, Diamond, David & Goel, 2010) allowing the perception of different bodily sensations and feelings as objects of attention. This mode of distanciating and mentalizing along with a non-judgmental, accepting attitude lays the bases for an adaptive mental state resulting in flexible, approaching and problem-solving responses instead of impulsive affective reactions or ruminative, negatively toned, ego-threatening thought processes.

Mindfulness and sleep quality

Since sleep quality is a relevant aspect of mental and physical well-being, Howell and colleagues (2010) examined the effects of mindfulness on sleep. Their results indicated that mindfulness was related to positive sleep quality, and these benign effects on sleep mediated higher levels of well-being. Mindfulness may promote sleep quality by attending to and accepting the bodily processes and needs of the organism, while diminishing arousal-producing and ruminative thought processes that interfere with the initiation and maintenance of non-disturbed sleep (Howell et al., 2010). Because of its sleep-related self-regulatory capacity, improving mindfulness along with the application of cognitive-behavioural therapies seems to be a promising alternative to the pharmacotherapy of insomnia (Ong, Shapiro & Manber, 2009; Shapiro, Bootzin, Figueroed, Lopez & Schwartz, 2003).

The above relationship between mindfulness and sleep quality raises the question whether trait mindfulness influences the mental experiences of sleep as well, specifically the emotional quality of the dreaming process itself.

Dreaming and emotional regulation

Different lines of research suggest that REM sleep – that is accompanied by vivid dream experiences – involve the intense functioning of a widely distributed fronto-limbic network facilitating off-line emotional information processing (Maquet, Ruby, Maudoux et al., 2005).

Although the role of REM sleep in information processing is still a topic of debate (Vertes, 2004), research data suggests that REM sleep facilitates the consolidation of emotional memories (Wagner, Gais & Born, 2001). Neuroscientific and phenomenological studies suggest that the selection of memory elements in dreaming are structured by the core emotional patterns and waking concerns of the dreamer (Nielsen & Stenstrom, 2005). These results provide support for the notion of REM sleep and dreaming as a neural and mental space for emotional regulation that is achieved by the integration of emotional memories into more distributed cortical networks and semantic representations (Hartmann, 1995; Stickgold, 2002). This emotional memory re-processing may also achieve the depotentiation of the affective tone associated with the original waking experiences that may constitute some of the “raw material” for dream narratives (Walker & Van der Helm, 2009).

While the mechanism of emotional regulation in dreaming is not fully understood, research indicates that positive dream emotions and positive dream content are associated with psychological well-being (Bódizs, Simor, Csóka, Bérdi & Kopp, 2008; Pesant & Zadra, 2006). On the other hand dream disturbances, such as frequent nightmares (frightening dreams that awaken the dreamer) and dream anxiety (waking anxiety caused by frightening dreams) are associated with a variety of psychopathological conditions, such as depression (Agargün, Cilli, Kara, Tarhan, Kincir & Öz, 1998; Besiroglu, Agargun & Inci, 2005) schizophrenia (Mume, 2009), dissociative symptoms (Giesbrecht & Merckelbach, 2004), anxiety (Roberts & Lennings, 2006), indices of acute psychopathology (Chivers & Blagrove, 1999), posttraumatic stress disorder (Mellman, David, Bustamante, Torres & Fins, 2001) or borderline personality disorder (Semiz, Basoglu, Erbrinc & Cetin, 2008; Simor, Csóka & Bódizs, 2010). According to Levin and Nielsen (2007) disturbed dreaming reflects enhanced levels of affect distress (a trait-like characteristic of emotional vulnerability) and affect load (a state-like characteristic of daily levels of stress), and a dysfunctional emotion processing network that is unable to dampen amygdalar over-reactivity in REM sleep. Disturbed dreaming is conventionally characterized by two intimately related but different factors: nightmare frequency and dream anxiety, among which the latter is more predictive of psychological perturbations (Miro & Martinez, 2005). However, since unpleasant dreams without abrupt awakenings also predict lower levels of well-being (Blagrove, Farmer & Williams, 2004), it seems reasonable to characterize disturbed dreaming by (1) negative dream quality itself, characterized by unpleasant dreams with or without awakenings and by (2) waking emotional and cognitive dysfunctions provoked by negative dream experiences (dream anxiety).

While different psychopathological conditions were related to disturbed dreaming, the investigation of possible protective factors overcoming dream disturbance is less emphasized. Since mindfulness is an important skill in emotional regulation we aimed to examine its relationship with the emotional aspects of dreaming.

Hypotheses

Keeping in view the continuity hypothesis of dreaming (Domhoff, 2003) together with its presumed role in emotion regulation (Levin & Nielsen, 2007, discussed later), and suggesting that mindfulness may also be related to emotional regulation in dreaming we hypothesized that:

(1) Disturbed dreaming (negative dream quality and dream anxiety) will be positively associated with the levels of trait-like anxiety and state-like perceived stress, while mindfulness will be negatively associated with trait anxiety and perceived stress.
(2) Mindfulness will be negatively associated with negative dream quality and dream anxiety.
(3) Mindfulness will be associated with less severe dream disturbances by moderating the relation of trait anxiety on dream quality and dream anxiety, thus the interaction between mindfulness and trait anxiety will also be associated to the extent of dream disturbances.
(4) The relationship between negative dream quality and waking dream anxiety will be moderated by mindfulness.
METHOD

Participants and procedure

Participants were recruited from an introductory psychology course for undergraduate students at the Budapest University of Technology and Economics. The sample included the data of 587 persons (162 female and 425 male) whose mean age was 20.59 ± 2.20 years. They were told that the aim of the study was to investigate the relationship between sleep, dreaming and personality. The participants received partial credit points for completing the (online) questionnaires (listed below). Informed consent was obtained from the participants, and the Local Ethical Committee of the Department of Cognitive Sciences approved the study protocol.

Measures

Spielberger State Trait Anxiety Inventory (STAI). The STAI (Spielberger, Gorsuch & Lusigne, 1970) is a widely used self-report instrument that differentiates between the temporary condition of state anxiety and the longstanding quality of trait anxiety. We used the 20 item Hungarian version of STAI trait anxiety questionnaire in order to assess general levels of anxiety (Sipos, Sipos & Spielberger, 1994). The questions are scored on a four-point Likert scale. In the present work we verified the previous results showing the STAI to have an excellent internal consistency. Cronbach’s α of the STAI-trait inventory was 0.87.

Perceived Stress Scale (PSS). The Perceived Stress Scale, PSS (Cohen, Kamarck & Mermelstein, 1983) is a 14-item self-rated instrument developed to measure current levels of experienced stress. The items, scored on a five-point Likert scale refer to the past one month so that day-to-day events do not tend to modify the results in merit, while the long- and medium-term changes in the total score of the instrument are good indicators of the main alterations in the levels of chronic stress. The Hungarian version of the PSS showed excellent internal reliability (α = 0.88), test-retest reliability (r = 0.90), and proved to be a valid instrument measuring current levels of stress and anxiety (Stauder & Konkoly-Thege, 2006). In the present study, the internal consistency of the PSS was α = 0.84.

Dream Quality Questionnaire (DQQ). To measure the clinically relevant aspects of dreaming, the Dream Quality Questionnaire (Bódizs et al., 2008) was used; this poses 11 items to assess the tendency of experiencing nightmares with recurrent or non-recurrent content, the vividness, bizarreness and emotional load of dreams, the effect of dreams on daytime mood and the frequency of having night-terror-like symptoms. The measure contains three main components, the vividness, the positive and the neutral emotional aspects of dreams. According to previous results the DQQ proved to be a valid instrument measuring the above qualities of dreaming (Bódizs et al., 2008). Since the present study focused on the aspects of disturbed dreaming, we only analyzed the data regarding the negative emotional aspects of dreaming (DQQ−). We measured a moderate internal consistency for the DQQ− (α = 0.55).

Van Dream Anxiety Scale (VDAS). The Van Dream Anxiety Scale (VDAS) (Agargün, Kara, Bilici et al., 1999) provides the assessment of nightmare frequency and dream anxiety caused by frightening dreams. The items of the self-rating scale are concerned with nightmare frequency and the maleficent effects of nightmares on daytime functioning. Items are weighted on a 0–4 scale and summed to yield a global VDAS score of 0–52. The Hungarian version of the scale proved to be a reliable (α = 0.96) and valid instrument in order to measure dream anxiety (Simor, Kovács, Vargha, Csóka, Mangel & Bódizs, 2009). In the present study the internal consistency of the VDAS was excellent (α = 0.91).

Mindful Attention Awareness Scale (MAAS). To assess mindfulness we used the MAAS (Brown & Ryan, 2003) which employs 15 items measuring the extent to which one is able to pay attention to the present moment in an open and non-judgemental way. The questions include both general and situation specific elements to weight the frequency of mindful states. Each of the items is stated inversely using a six-point Likert scale (from almost always to almost never) asking the respondents how often they find themselves acting automatically, inattentively or being preoccupied. The scale has a single factor structure and yields a single total score with higher scores indicating greater mindfulness. Brown and Ryan reported the internal consistency of the measure (α = 0.82), its test-retest reliability (r = 0.81) and its convergent validity with related measures (e.g. positive correlations with well-being). The Hungarian version was back-translated into English and was checked by a native speaker. Our preliminary findings, based on the data of 250 university students, showed that the Hungarian version of the MAAS correlated with the related measures of convergent validity (with well-being: r = 0.26, with the Beck depression score: r = −0.53 and with anxiety (STAI): r = −0.44, p < 0.001 in all cases). In the present study the internal consistency of the scale was α = 0.78.

RESULTS

Descriptive statistics and associations among variables

In order to test the hypothesized association between trait anxiety, perceived stress, disturbed dreaming and mindfulness, we conducted a correlational analysis. Descriptive statistics and correlation coefficients for all variables are summarized in Table 1. As data were non-normally distributed in two scales, a rank correlation method (Kendall’s τ) was used to estimate associations among all variables. In accordance to previous research data, trait anxiety and perceived stress was positively correlated with dream disturbances. As predicted, mindfulness was a negative correlate of trait anxiety, perceived stress, negative dream quality and dream anxiety.

Regression analyses

In order to measure the association (main effect and moderation) between mindfulness and negative dream quality, we applied a hierarchical linear regression analysis. Following the method

Table 1. Descriptive statistics for all variables

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MAAS</td>
<td>56.87</td>
<td>9.182</td>
<td>(0.78)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. VDAS</td>
<td>6.05</td>
<td>7.156</td>
<td>−0.20</td>
<td>(0.91)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. DQQ−</td>
<td>6.61</td>
<td>1.310</td>
<td>−0.17</td>
<td>0.40</td>
<td>(0.55)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. STAI-T</td>
<td>42.88</td>
<td>9.186</td>
<td>−0.38</td>
<td>0.20</td>
<td>0.21</td>
<td>(0.87)</td>
<td></td>
</tr>
<tr>
<td>5. Perceived stress</td>
<td>26.71</td>
<td>7.260</td>
<td>−0.29</td>
<td>0.17</td>
<td>0.19</td>
<td>0.51</td>
<td>(0.84)</td>
</tr>
</tbody>
</table>

Notes: Values in parentheses are alpha coefficients. All correlations are Kendall’s τ coefficients, p < 0.001 in all cases. MAAS: Mindful Attention Awareness Scale; VDAS: Van Dream Anxiety Scale; DQQ−: Negative Dream Quality; STAI-T: Spielberger Trait-Anxiety Inventory.

of mindfulness are related to decreased dream anxiety if all other variables are equal. Summary of the regression analysis is presented in Table 3.

The hypothesized moderator effect of MAAS between negative dream quality and dream anxiety was investigated using a third linear regression analysis. Predictor variables (DQQ- and MAAS scores) were centered, an interaction term was calculated, and then variables were entered into the regression equation in three steps (see Table 4). Significant predictors of dream anxiety in the final equation were negative dream quality (DQQ-) and mindfulness (MAAS) scores, but not their interaction.

DISCUSSION

Supporting our first hypothesis, and in concordance with previous findings showing reduced mindfulness in patients with generalized anxiety disorder (Roemer et al., 2009), mindfulness was negatively associated with waking levels of trait anxiety and perceived stress in our study. Moreover, mindfulness was a negative correlate of dream disturbances, such as the negative emotional quality of dreaming and dream anxiety, extending previous findings concerning the relation between sleep and mindfulness to the domain of dream research. The hierarchical regression analysis showed that gender and trait anxiety did, but perceived stress did not predict negative emotionality in dreaming (DQQ-), while mindfulness predicted less negative dream quality, even after controlling for trait anxiety. The higher rate of dysphoric dreaming in females replicates previous findings regarding gender differences.

Table 2. Summary of hierarchical linear regression analysis. Dependent variable: Negative Dream Quality (DQQ-). Predictor variables: Gender, Perceived Stress, Trait Anxiety (STAI-T), Mindfulness (MAAS) and the interaction between Mindfulness and Trait Anxiety (STAI-T*MAAS).

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>Standardized beta coefficients</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$R^2 = 0.048; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.218</td>
</tr>
<tr>
<td>2</td>
<td>$R^2 = 0.064; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.190</td>
</tr>
<tr>
<td>3</td>
<td>$R^2 = 0.024; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.184</td>
</tr>
<tr>
<td>4</td>
<td>$R^2 = 0.012; p &lt; 0.005$</td>
<td>Gender</td>
<td>-0.192</td>
</tr>
<tr>
<td>5</td>
<td>$R^2 = 0.00; p = 0.63$</td>
<td>Gender</td>
<td>-0.192</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived stress</td>
<td>0.077</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STAI-T</td>
<td>0.175</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAAS</td>
<td>-0.126</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STAI-T*MAAS</td>
<td>-0.018</td>
</tr>
</tbody>
</table>

Table 3. Summary of hierarchical linear regression analysis. Dependent variable: Dream Anxiety (VDAS). Predictor variables: Gender, Perceived Stress, Trait Anxiety (STAI-T), Mindfulness (MAAS) and the interaction between Mindfulness and Trait Anxiety (STAI-T*MAAS).

<table>
<thead>
<tr>
<th>Step</th>
<th>Variable</th>
<th>Standardized beta coefficients</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$R^2 = 0.019; p &lt; 0.005$</td>
<td>Gender</td>
<td>-0.137</td>
</tr>
<tr>
<td>2</td>
<td>$R^2 = 0.047; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.113</td>
</tr>
<tr>
<td>3</td>
<td>$R^2 = 0.044; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.105</td>
</tr>
<tr>
<td>4</td>
<td>$R^2 = 0.031; p &lt; 0.001$</td>
<td>Gender</td>
<td>-0.118</td>
</tr>
<tr>
<td>5</td>
<td>$R^2 = 0.007; p &lt; 0.05$</td>
<td>Gender</td>
<td>-0.120</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perceived stress</td>
<td>-0.026</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STAI-T</td>
<td>0.217</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MAAS</td>
<td>-0.210</td>
</tr>
<tr>
<td></td>
<td></td>
<td>STAI-T*MAAS</td>
<td>-0.084</td>
</tr>
</tbody>
</table>
in the emotional aspects of dreaming (Levin & Nielsen, 2007). Our findings relating waking anxiety to disturbed dreaming also coheres with previous studies indicating a close relationship between disturbed dreaming and waking psychopathology (see Levin & Nielsen 2007 for an extensive review). Moreover, our results indicate that mindfulness is inversely associated with negative dream quality. Since the effect of the interaction between mindfulness and anxiety on dream quality was not significant, our findings suggest that higher levels of mindfulness predict less negative dream quality independently of the detrimental effects of trait anxiety.

The results of the second regression analysis suggested that mindfulness also predicted lower levels of dream anxiety even when controlling for trait anxiety. Moreover, in this case the interaction between mindfulness and anxiety also predicted dream anxiety. This finding suggests that increased mindfulness may moderate the influences of anxiety and thus results in reduced dream anxiety.

These findings support our second hypothesis claiming that mindfulness predicts lower levels of disturbed dreaming. Since dysphoric dreaming was proposed to be a reflection of mental imbalance (Levin & Nielsen, 2007; Bódizs et al., 2008), this finding coheres with previous studies relating mindfulness to various indices of mental health (Brown and Ryan, 2003; Giluk, 2009). Nevertheless, our third hypothesis claiming that mindfulness may predict less disturbed dreaming by moderating waking anxiety, only gained partial support. The interaction between mindfulness and trait anxiety was only predictive to dream anxiety and not to negative dream quality. Anxiety relieving effects of mindfulness seem to be only one aspect of this intriguing mental skill, and the complex relation between mindfulness and dream quality remains unresolved.

Our fourth hypothesis, that mindfulness may moderate the association of negative dream quality with waking dream anxiety was not supported by the results. Negative dream quality and dream anxiety are two intimately related but not equivalent constructs. Negative dream quality enhances dream anxiety; however, there are individual variations in the levels that people are affected and self-absorbed by recalling their negative dream experiences. Nonetheless our findings did not support the hypothesis that mindfulness may moderate the waking effects of disturbed dreaming.

In sum, our results indicate that mindfulness is negatively related to and predicts disturbed dreaming even after controlling for waking anxiety, and predicts lower dream anxiety also by moderating the association between waking anxiety and dream anxiety. Recently, Howell and colleagues (2008, 2010) showed that the relation between mindfulness and well-being is partly mediated by the positive association between mindfulness and sleep-quality. Since the quality of oneric experiences is an integral part of sleep quality, our results indicating the inverse relation between mindfulness and disturbed dreaming are in line with the above findings.

But what may be the mechanism underlying the inverse association between mindfulness and disturbed dreaming? Mindfulness may help individuals distancing the dream experience, by attending to it in an accepting way without ego-threatening self-judgements. Distentiation from and mentalization of the dream experience may enhance further emotional elaboration, fostering the awareness of the “latent” emotional concerns of the dreamer. Mindful individuals may regulate their emotional states more effectively, resulting in less unpleasant dream experiences. Attending mindful to recalled negative dream experiences may also diminish the self-absorbing, negative effects of disturbed dreaming.

Since mindfulness predicted negative dream quality and dream anxiety above and beyond waking anxiety, mindfulness-based stress reduction may contribute to the treatment of dream disturbances in different clinical populations.

Apart from these novel and promising results several questions remain to be answered. Our study design does not allow us to examine if mindfulness “acts” only in waking or even during the dreaming process itself. Emotional regulation by mindful attention in dreaming seems to be a contradiction, because of the single-minded, distracted, dissociated and self-absorbing state of dreaming (Hobson, 2009), nevertheless one particular dream experience, called lucid dreaming, may be a potential state when mindfulness might occur. Lucid dreaming is associated with enhanced awareness and cognitive control, as well as an emotionally positive and open state that allows the perception of vivid dream images from an outer point of view (LaBerge, 1985). Since meditation practice was related to the frequency of lucidity during sleep (Mason & Orme-Johnson, 2010), the relation between lucid dreaming and mindfulness worth further attention. Moreover, recent studies examining the neuropsychological (Neider, Pace-Schott, Forsellius, Pittman & Morgan) and neurophysiological (Voss, Holzmann, Tuin & Hobson, 2009) correlates of lucid dreaming, point to the involvement of prefrontal structures, areas overlapping with the neural correlates of mindfulness.

But neuroscientific research may also foster the relationship between mindfulness and emotion processing in dreaming. Mindfulness was correlated with enhanced activation in the Ventromedial Prefrontal Cortex (VMPFC), and reduced activation in the amygdala according to an fMRI study (Creswell, Way, Eisenberger & Lieberman, 2007), moreover in an EEG study, mindfulness practice was related to enhanced frontal midline theta activity, reflecting elevated activation in the Anterior Cingulate Cortex.

### Table 4. Summary of hierarchical linear regression analysis. Dependent variable: Dream Anxiety (VDAS). Predictor variables: Negative Dream Quality (DQQ-), Mindfulness (MAAS), and the interaction between Mindfulness and Negative Dream Quality (MAAS*DQQ-).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Standardized beta coefficients</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$R^2 = 0.287$</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DQQ-</td>
<td>0.536</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Step 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta R^2 = 0.030$</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DQQ-</td>
<td>0.492</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MAAS</td>
<td>-0.179</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Step 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\Delta R^2 = 0.002$</td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>DQQ-</td>
<td>0.487</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MAAS</td>
<td>-0.180</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>MAAS*DQQ-</td>
<td>-0.043</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

The heightened activation of VMPCF and ACC in REM sleep was proposed to be the neural background of emotional regulation in dreaming, mitigating the activity of the amygdala, while dysfunctional frontal inhibition was suggested to be the neural correlate of emotional dysregulation in REM, resulting in disturbed dreaming (Levin & Nielsen, 2007). Because of these overlapping neural structures, investigating mindfulness in dreaming, despite the methodological challenges, seems to be an intriguing research direction.

Regarding the further limitations of our study we should note that our results are only applicable to healthy, university students, therefore the relationship between mindfulness and dreaming should be explored in other (e.g., clinical) populations as well. Cross-sectional, questionnaire based investigations may be compromised by retrospective response biases, therefore prospective study designs, based on dream logs would provide more reliable data regarding the relation between mindfulness and dream quality. More importantly, our study design cannot reveal the causal relationship of the variables, therefore all the alternative models explaining the link of the examined variables need to be tested. It is also possible – although theoretically seems unlikely – that negative dream quality and dream anxiety may diminish mindfulness. Prospective study designs and behavioral interventions on mindfulness skills predicting long-term changes in dream quality would obviously provide a more comprehensive description about the relationship between mindfulness and dreaming. Investigating the effects of mindfulness training in specific populations suffering from disturbed dreaming – for example in PTSD patients – would shed even more light on the hypothesized relation between waking anxiety, mindfulness and dream quality. Examining whether mindfulness can reduce the intensity of intruding flashbacks and traumatic dream images in PTSD patients would not only foster our understanding about the relation between mindfulness and dreaming but probably enrich existing treatment methods for posttraumatic nightmares as well (Krakow, Hollifield, John-ness and dreaming but probably enrich existing treatment methods

this is the very first attempt in examining the possible links between mindfulness and the emotional aspects of dreaming.

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Mindfulness and dream quality


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