



Mindfulness versus rumination and behavioral inhibition: A perspective from research on frontal brain asymmetry

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ABSTRACT

Mindfulness represents an attribute of consciousness involving an intentional focus on the present-moment experience with a non-judgmental attitude. Due to this quality, it attenuates rumination, a maladaptive way of coping with negative mood characterized by a continuous, passive focus on particularly negative emotions. Only few studies have examined mindfulness and rumination in relation to basic notions of human motivation, such as the behavioral inhibition and activation systems (BIS/BAS), and the approach-withdrawal model of hemispheric asymmetry. We examined the indicated parameters and frontal brain asymmetry, assessed through the alpha band (8–13 Hz) in resting-state electroencephalogram. Alpha asymmetry represents a neurophysiologic marker of approach vs. withdrawal-related response dispositions. In line with previous findings, trait mindfulness and rumination were negatively related to each other. Further, rumination was positively and mindfulness negatively related to BIS, while neither parameter showed a consistent association with BAS. Frontal alpha asymmetry on the other hand was significantly associated with BAS, but not with BIS. Hence, rumination appears to be characterized by behavioral inhibition, but not by dispositions of active withdrawal. Mindfulness on the other hand is related to lower behavioral inhibition, but is not necessarily associated with behavioral activation or approach dispositions.

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1. Introduction

Mindfulness represents an attribute of consciousness involving an intentional, active focus on the present-moment experience with a non-judgmental attitude (Brown & Ryan, 2003). As a trait, it is related to various parameters of psychological well-being, including higher optimism, life satisfaction and vitality, as well as lower rumination, anxiety and depression (Brown & Ryan, 2003; Keune, Bostanov, Hautzinger, & Kotchoubey, 2011). Bishop et al. (2004) proposed an integrative model to describe the working mechanisms of mindfulness. According to this model, mindfulness involves two basic components. The first component is the self-regulation of attention in a way that keeps attention focused on the present experience. This is assumed to yield sustained attention and to inhibit further elaboration upon sensations, cognitions and emotions. The second component is an orientation toward experience which is accepting, open and curious. The suggested consequence is a reduction of avoidant behavior patterns and increased affect tolerance. In the context of contemporary theories of personality psychology, it has been suggested that the state of open awareness which characterizes mindfulness can be seen as

essential in promoting choices of behavior which are congruent with personal needs and values (Brown & Ryan, 2003; Brown, Ryan, & Creswell, 2007; Keune & Perczel-Forintos, 2010).

Rumination represents a process running contrary to mindfulness. It involves a passive focus on specifically negative emotions (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), is associated with numerous maladaptive characteristics such as dysfunctional attitudes, hopelessness and neuroticism, and represents a vulnerability factor for depression (Lam, Smith, Checkley, Rijdsdijk, & Sham, 2003; Smith, Alloy, & Abramson, 2006). Mindfulness appears to counteract these characteristics. It has been shown that mindfulness training enhances trait mindfulness and attenuates rumination, suggesting that the two are negatively associated in a dynamic fashion (Keune et al., 2011; Kingston, Dooley, Bates, Lawlor, & Malone, 2007; Ramel, Goldin, Carmona, & McQuaid, 2004). Moreover, particularly the non-judgmental component, as suggested by Bishop et al. (2004), appears to be relevant for the negative relation between mindfulness and rumination (Evans & Segerstrom, 2010).

To date, only few studies have examined mindfulness and rumination in the context of basic theories of human motivation (Sauer, Walach, & Kohls, 2011). In the reinforcement sensitivity theory, Gray and colleagues (Gray, 1982; Gray & McNaughton, 1996) proposed a model according to which two fundamental

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systems guide behavior. The behavioral activation system (BAS) drives individuals towards positive and negative reinforcement. As such, it mediates approach behavior and active avoidance, and is supposed to be related to greater general positive affectivity (Gable, Reis, & Elliot, 2000; Gray & McNaughton, 1996). The behavioral inhibition system (BIS) on the other hand implies sensitivity to signals of punishment and nonreward. This system is assumed to mediate passive avoidance, and to be associated with greater general negative affectivity (Gable et al., 2000).

Davidson, Ekman, Saron, Senulis, and Friesen (1990) suggested two dimensions of approach and withdrawal, which are partly reflected by tonic left and right frontal cortical brain activity. Individuals characterized by approach-related behavioral dispositions are assumed to display stronger relative left-hemispheric anterior cortical activity, whereas individuals characterized by withdrawal show stronger relative right-hemispheric anterior cortical activity (Allen, Coan, & Nazarian, 2004; Keune et al., 2011). Power in the alpha band (8–13 Hz) in resting-state electroencephalogram (EEG) is frequently used as an indicator of asymmetry based on the rationale that alpha power is inversely related to underlying cortical activity (Allen et al., 2004). It has been shown that 60% of the variance of the alpha asymmetry phenotype derived from resting-state assessments reflects trait components, whereas 40% can be attributed to state influences (Hagemann, Hewig, Seifert, Naumann, & Bartussek, 2005). While early studies regarded approach and withdrawal as congruent with BAS and BIS (Sutton & Davidson, 1997), respectively, the contemporarily prevailing view is that both, approach and withdrawal systems, are rather subsystems of the BAS (Coan & Allen, 2003; Hewig, Hagemann, Seifert, Naumann, & Bartussek, 2004). This is plausible since the BAS does not only mediate approach tendencies, but also realizes active avoidance driven through negative reinforcement.

Recently, the capability model of EEG alpha asymmetry has been suggested as an extension of the classic approach-withdrawal model (Coan, Allen, & McKnight, 2006). This model extends the notion of alpha asymmetry as a static indicator of response dispositions, by considering the interaction of emotional demands and the capability to regulate emotions during challenging situations. Individual differences in alpha asymmetry during emotional challenges are assumed to be more reliable and more strongly associated with relevant criterion variables than during neutral resting-conditions. Several studies have provided support for the capability model (Keune et al., 2011; Steiner & Coan, 2011; Stewart, Coan, Towers, & Allen, 2011).

The purpose of the current study was to examine the relation of trait mindfulness and rumination to notions of BIS/BAS and the approach-withdrawal model. To this aim, healthy participants completed relevant trait self-report measures and two resting-state EEG assessments, one during a neutral condition, and a second one following the induction of a sad mood. The latter condition was included in relation to the capability model of EEG alpha asymmetry (Coan et al., 2006).

Several hypotheses can be derived from the characteristics of mindfulness and rumination as described above. Firstly, since rumination represents a passive approach to coping with negative emotions and is related to negative affectivity, it can be assumed to be associated with higher behavioral inhibition, i.e. higher BIS scores. Complementarily, it may also be related to lower BAS scores. Since mindfulness is inversely related to rumination, the respective opposite relations to BIS/BAS can be expected for mindfulness. At this stage, depending on the observed pattern of associations between rumination, mindfulness and BIS/BAS, further assumptions can be derived: If mindfulness and rumination are related to BAS, they may also be expected to be associated with alpha asymmetry, as the approach and withdrawal systems are subcomponents of the BAS. For mindfulness an association with stronger

relative left-hemispheric anterior cortical activity, indicative of approach could be expected. In case of rumination, a pattern indicative of withdrawal would be likely. If these associations are observed, they may be assumed to be particularly pronounced for alpha asymmetry scores derived from a negative mood condition, according to the capability model of EEG alpha asymmetry. Alternatively, if mindfulness and rumination are only associated with BIS, no association with alpha asymmetry can be expected, as the approach and withdrawal systems represent subcomponents of the BAS only. With regard to both possibilities, a secondary hypothesis refers to the replication of previous findings, according to which BAS but not BIS scores are related to frontal alpha asymmetry.

2. Methods

2.1. Participants

The sample consisted of thirty-five participants (24 female, 11 male; age: $M = 24.14$, $SD = 3.73$) who were recruited from the student population of the University of Tübingen, Germany. Participants had to be between 18 and 65 years of age, right-handed and native German speakers. Exclusion occurred in case of a neurological or a psychiatric history, according to the Structured Clinical Interview for DSM-IV (Wittchen, Zaudig, & Fydrich, 1997), which was administered by a trained clinical psychologist.

2.2. Self-report measures

Administered self-report measures involved German versions of the Beck Depression Inventory (BDI-II; Hautzinger, Keller, & Kühner, 2007), the Response Styles Questionnaire (RSQ-D; Kühner, Huffziger, & Nolen-Hoeksema, 2007), and the Freiburger Fragebogen zur Achtsamkeit (English: Freiburg Mindfulness Inventory, FMI; Walach, Buchheld, Buttenmuller, Kleinknecht, & Schmidt, 2006). The RSQ-D includes two scales of rumination, i.e. symptom-focused and self-focused rumination, and the FMI includes a single scale of trait mindfulness. Further, a German version of the BIS/BAS scales was administered (Hewig et al., 2004), involving a single measure of BIS and three measures of BAS, i.e. Drive, Fun Seeking and Reward Responsiveness. In addition, a state-version of the Positive and Negative Affect Schedule (PANAS; Krohne, Egloff, Kohlmann, & Tausch, 1996) was administered.

2.3. Procedure

The current study was conducted with consent of each participant and approval of the ethical committee of the medical faculty of the University of Tübingen. Participants were assessed individually. Upon arrival, the clinical interview was conducted and subsequently, BDI and trait questionnaires were administered. Afterwards, EEG activity was recorded during two resting conditions. The first recording occurred during a neutral condition, which was not preceded by any stimuli. The second occurred after the induction of a negative mood. Respective measurements consisted of eight one-minute resting trials, four with eyes open (O) and four with eyes closed (C), presented in counterbalanced order (COCO-Pause-OCOC). During the pause between the first and second half of each condition, participants completed the PANAS.

The negative mood induction has been described elsewhere in detail (Keune et al., 2011). It lasted approximately 15 min and was a combination of listening to sad music and negative self-referential statements. It should be noted that in the context of the capability model of alpha asymmetry, the purpose of mood inductions is not necessarily to alter the mean value of asymmetry as a

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