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Induced ruminative and mindful attention in everyday life: An experimental ambulatory assessment study

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ABSTRACT

Background and objectives: Rumination has been proposed as a risk factor for depression, while mindful attention might be protective. Differential effects of these attention foci have so far only been examined in the laboratory. Therefore, we conducted an experimental ambulatory assessment study using ruminative and mindful attention inductions in everyday life to examine their effects in a natural context.
Methods: Fifty young adults carried palmtops over three weekdays (rumination induction day, mindful attention induction day, noninduction day; randomized cross-over design). Ten times a day, participants rated ruminative self-focus and mood. On the induction days, they were additionally subjected to 3-min inductions of ruminative or mindful attention at each assessment.
Results: The two induction modes exhibited differential immediate effects on ruminative self-focus and mood. While induced rumination immediately deteriorated valence and calmness, induced mindful attention specifically enhanced calmness. Depressive symptoms did not moderate these effects. While overall longer term effects of the inductions were missing, the mindful attention day was associated with slightly increasing positive valence over the day.
Limitations: The results need to be replicated in high-risk and patient samples to demonstrate the clinical significance of identified effects.
Conclusions: Results confirm the emotional relevance of rumination and mindful attention in real world settings. Future work may test whether adaptive attention-focusing instructions delivered in daily life can support clinical interventions.

1. Introduction

Mindfulness and rumination, two different forms of attention focusing, appear to differentially modulate the experience of negative affect and have been proposed as important emotion regulation strategies (Aldao, Nolen-Hoeksema, & Schweitzer, 2010; Kohl, Rief, & Glombiewski, 2012). Mindfulness – a quality originating from eastern meditative practices – has been described as an adaptive form of attention focusing that can be defined as purposefully paying attention to the present moment in an open-hearted way (Kabat-Zinn, 2003). Importantly, a mindful mode of processing involves refraining from judging one's experiences as good or bad and accepting unpleasant thoughts and feelings as transient phenomena. Intervention programs have incorporated mindfulness trainings to teach a functional way of regulating one's emotions (e.g., Segal, Williams, & Teasdale, 2002). Related research has revealed that mindfulness trainings effectively reduce depression (Hofmann, Sawyer, Witt, & Oh, 2010), enhance well-being in healthy individuals (Chiesa & Serretti, 2009), and increase equanimity and inner calmness (Farb, Anderson, & Segal, 2012). Other studies have addressed mindfulness as a naturally occurring trait or state. For example, ambulatory assessment (AA) studies, conducted in real life (Mehl & Conner, 2011; Trull & Ebner-Priemer, 2009), revealed that state mindfulness was associated with low negative affect (Brown & Ryan, 2003), and that mind wandering – an indirect inverse measure of mindfulness – was a better predictor of

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future unhappiness than the momentary activity (Killingsworth & Gilbert, 2010).

In contrast to mindfulness, depressive rumination is supposed to represent a dysfunctional mode of self-focused attention. According to the Response Styles Theory (RST, Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008), rumination is defined as repetitively focusing on one's symptoms of distress, and their possible causes and consequences. Rumination is supposed to prolong and exacerbate depressed moods, which has been confirmed in experimental studies with dysphoric and depressed individuals (e.g., Kuehner, Holzhauer, & Huffziger, 2007; Kuehner, Huffziger, & Liebsch, 2009). Longitudinal studies revealed that trait rumination predicted higher future depressive symptom levels, particularly in nonclinical samples (Huffziger, Reinhard, & Kuehner, 2009; Nolen-Hoeksema, 2000). Furthermore, some studies observed reduced trait rumination after mindfulness interventions (Jain et al., 2007; Shahar, Britton, Sbarra, Figueredo, & Bootzin, 2010; Van Aalderen et al., 2012).

A recent body of research has compared effects of short periods of ruminative and mindful attention that have been experimentally induced in the laboratory (e.g., using instructions to adopt a specific attention focus). These studies demonstrated that ruminative and mindful attention exhibited differential effects on cognitive and emotional variables (for a summary see Keng, Smoski, & Robins, 2011). Specifically, in contrast to induced rumination, induced mindful attention exhibited positive mood effects (Huffziger & Kuehner, 2009; Sauer & Baer, 2011; Singer & Dobson, 2007; for nonsignificant effects see Rood, Roelofs, Bögels, & Arntz, 2012), reduced dysfunctional attitudes (Kuehner et al., 2009), and increased the willingness to tolerate distress (Sauer & Baer, 2011). Furthermore, induced mindfulness appears to particularly increase positive affect (Erisman & Roemer, 2010), to successfully reduce prompted state rumination (Hilt & Pollak, 2012), and to have beneficial effects on approach behavior in spider fear (Hooper, Davies, Davies, & McHugh, 2011). Importantly, these laboratory studies provide insight into specific causal effects of rumination and mindfulness under standardized controlled conditions and confirm the internal validity of these two modes of attention focusing.

However, laboratory contexts do not resemble everyday life, thus the ecological validity of identified effects remains unclear. On the one hand, everyday life contexts might provide more distractions which could restrict participants' concentration on the experimental inductions and therefore dampen the identified effects. On the other hand, attention inductions could stimulate stronger effects in everyday life than in artificial environments; since due to the occurrence of real stressors, specific attention focusing in natural contexts might entail more realistic, personally relevant consequences. To better understand the cognitive and emotional responses to ruminative and mindful attention focusing in real life, experimental AA studies that combine the internal validity of laboratory studies with the external validity of AA studies are warranted. Few studies have applied such designs so far (e.g., Chapman, Rosenthal, & Leung, 2009; Roelofs, Peters, Patijn, Schouten, & Vlaeyen, 2006), but not within the context of self-focused attention and depression. For example, Chapman et al. (2009) manipulated emotion suppression in the daily lives of participants with high and low Borderline Personality Disorder features, and Roelofs et al. (2006) manipulated attention to pain in chronic pain patients. However, the results of both studies were in contrast to expectations and laboratory findings, with emotion suppression being linked to higher positive emotions and attention manipulations not influencing pain intensity in daily life. This indicates that it might not be straightforward to transfer laboratory results to natural contexts.

By using an experimental AA approach, we recently transferred the internationally applied rumination induction paradigm by Nolen-Hoeksema (1991) to daily life and found that repeated rumination inductions during the day immediately increased ruminative self-focus and impaired momentary mood (Huffziger, Ebner-Priemer, Koudela, Reinhard, & Kuehner, 2012), thereby demonstrating the generalizability of laboratory results on induced rumination. The present study aims to extend this approach by investigating possible *differential effects* of induced rumination and mindful attention foci in daily life in a new sample, where we transferred a study protocol for both rumination and mindfulness inductions that has previously been validated in the laboratory (Huffziger & Kuehner, 2009; Kuehner et al., 2009).

The present study has three aims. First, we investigated possible differential immediate effects of the two induction modes of rumination and mindful attention. We expected that rumination inductions would immediately increase ruminative self-focus and decrease mood, while mindful attention inductions would have immediate positive effects on these outcomes, that is, decrease ruminative self-focus and increase positive mood (valence, calmness). Second, we assessed whether depression levels would moderate these immediate effects, assuming that both induction modes would have stronger effects in more depressed individuals (Keng et al., 2011; Nolen-Hoeksema et al., 2008). And third, we investigated whether repeated rumination and mindful attention inductions would also influence *more distant* affective and cognitive states during the following hours on the respective induction day.

2. Methods

2.1. Participants

Participants were 50 undergraduates from the University of Mannheim, Germany. The sample comprised 20 men and 30 women aged 19–31 ($M = 22.9$, $SD = 3.3$) who were recruited by an electronic mailing list. Participants were consecutively included if they could adhere to the study protocol, without further exclusion criteria. The mean score for depressive symptoms on the Beck Depression Inventory-II was 7.8 ($SD = 6.7$, Range 0–26; nondepressed $n = 30$, minimal depression $n = 10$, mild depression $n = 6$, moderate depression $n = 4$ according to criteria by Hautzinger, Keller, & Kuehner, 2006). Participants gave written informed consent and were paid 40 € for participation. The study was conducted in accordance with the declaration of Helsinki and approved by the local ethics committee of the University of Heidelberg.

2.2. Ambulatory assessment (AA)

AA took place on three consecutive weekdays using PDAs (Palm Tungsten E2, Palm Inc.). There were ten assessments over a 12-h sampling period per day, starting at 8 a.m. Assessments were signaled by a beep, with an interval length between assessments of 80 min. Participants could delay assessments by up to 15 min, therefore intervals actually varied between 65 and 95 min. Of the three assessment days, one day included repeated rumination inductions (rumination day = rum-day), one day repeated mindful attention inductions (mindful attention day = mf-day), and one day was a noninduction day (noninduction day). At each beep, participants rated the extent of momentary ruminative self-focus and mood. On the induction days, there was a subsequent 3-min induction of either rumination (rum-day) or mindful attention (mf-day) which was followed by a

second rating of momentary ruminative self-focus and mood. The order of the three days was permuted, resulting in six different conditions which participants were randomly allocated to (cross-over design).

2.2.1. Assessment of momentary ruminative self-focus

The two items "At the moment, I am thinking about my feelings" and "At the moment, I am thinking about my problems" were used, which were adapted from Moberly and Watkins (2008; see also Huffziger et al., 2012). Items were answered on a scale from 0 (not at all) to 7 (very much) and a mean score was calculated for each assessment. Based on a three-level random effects model with items at level 1, assessments at level 2, and persons at level 3 calculated with HLM 7 (SSI Inc.), a within-person reliability coefficient of 0.67 for the preinduction scores was retrieved (calculated according to Wilhelm & Schoebi, 2007).

2.2.2. Assessment of momentary mood

To assess momentary mood the two subscales "valence" and "calmness" from an original six-item scale by Wilhelm and Schoebi (2007) were employed. The scale includes the four bipolar items "content-discontent", "unwell-well", "agitated-calm", and "relaxed-tense", for which the first two items were collapsed into the subscale valence and the last two items into the subscale calmness. Item scores ranged from 0 to 6. The items are particularly recommended for use in AA research with good reliability and sensitivity for change (Wilhelm & Schoebi, 2007). In the present study, within-person reliabilities for the preinduction scores were 0.69 for valence and 0.71 for calmness.

2.2.3. Inductions

We adapted the laboratory paradigm for rumination and mindful attention induction by Huffziger and Kuehner (2009; Kuehner et al., 2009), which involves short statements to prompt either a ruminative or mindful attention focus. The rumination statements include neutrally valenced emotion- and symptom-focused thoughts (e.g., "think about the way you feel inside", "think about the possible consequences of the way you feel", "think about your current level of energy"), while the mindfulness-related statements reflect an attitude of non-judgmental acceptance toward one's experiences and moment-to-moment awareness to the breath (e.g., "as best you can, accept all your feelings, also unpleasant ones", "take note of your thoughts and feelings without judging them", "consciously attend to your breath for some seconds"). To transfer the procedure into the present AA design, ten statements of each induction mode were selected and presented on the PDA for 3 min. Statements were grouped into three parts with each part being displayed on the screen for 1 min. The instruction for participants was to concentrate and focus their attention on the statements and a beep indicated that they should proceed to the next screen. To perform compliance checks, the total duration of each assessment was recorded. If a total assessment on an induction day took less than 220 s (including the time for the pre- and post-induction ratings), the respective post-induction rating was judged as missing.

2.3. Questionnaire

2.3.1. Beck depression inventory II (BDI-II, German version; Hautzinger et al., 2006)

The BDI-II is a self-rating instrument to assess severity of depressive symptoms during the previous two weeks. The German version of the BDI-II has demonstrated good psychometric properties (Hautzinger et al., 2006). Cronbach's α in the present sample was 0.88.

2.4. Procedure

Before the AA, participants completed the BDI-II and received detailed instructions for the AA procedure and the use of the PDA. Participants were also provided with a respective information sheet and the telephone number of a study co-worker whom they should call if any problems during the assessment would arise.

2.5. Statistical analyses

Analyses were performed with multilevel models (assessments at level 1, day at level 2, persons at level 3). The day level comprised the two induction days in the analyses on the immediate induction effects and all three days in the analyses on the more distant effects. All models included random intercepts at level 2 and 3, allowing individual baseline levels of the dependent variable to differ between persons and between days. The variable time ranged from 0 to 9 corresponding to the single assessments. Since BDI-II raw scores were right-skewed, we used their logarithmically (ln-) transformed scores to approximate normality (BDI-II-ln). All analyses were performed with IBM SPSS version 20. To estimate multilevel mixed models, we used the mixed model procedure with maximum likelihood estimation and two random statements to account for the three levels.

3. Results

3.1. Compliance with AA

Altogether, 1412 of 1500 possible assessments were recorded, corresponding to an overall response rate across participants of 94.1%. The response rates of the three days were similar (95.6% for nonind-day, 92.8% for rum-day, 94.0% for mf-day). On average, each participant fully completed 28.24 (SD = 1.63, range 22–30) of 30 possible assessments. At least 6 assessments were completed per day. For four assessments on the two induction days (0.4%), a total duration of less than 220 s was recorded. These assessments were excluded from the analyses on post-induction scores.

3.2. Course of momentary ruminative self-focus and mood

Momentary ruminative self-focus and mood (valence, calmness) were measured in five series (on the noninduction day = nonind, pre-induction on the rumination day = rum-pre, post-induction on the rumination day = rum-post, pre-induction on the mindful attention day = mf-pre, post-induction on the mindful attention day = mf-post). Fig. 1 shows respective mean scores across persons for the ten time points in each series.

3.3. Immediate effects of the two induction modes and depression levels as moderator

To investigate whether the two induction modes would exhibit differential immediate effects, we performed multilevel models with pre-post induction change scores of ruminative self-focus, valence, or calmness as dependent variable. Change scores were calculated by subtracting the pre-induction from the post-induction scores. Models included induction day (IndDay; 0 = rum-day, 1 = mf-day), BDI-II-ln, and the interaction of IndDay*BDI-II-ln as predictors.

Results are displayed in Table 1. Analyses revealed main effects of IndDay, indicating significantly different change scores of ruminative self-focus, valence, and calmness on the two induction

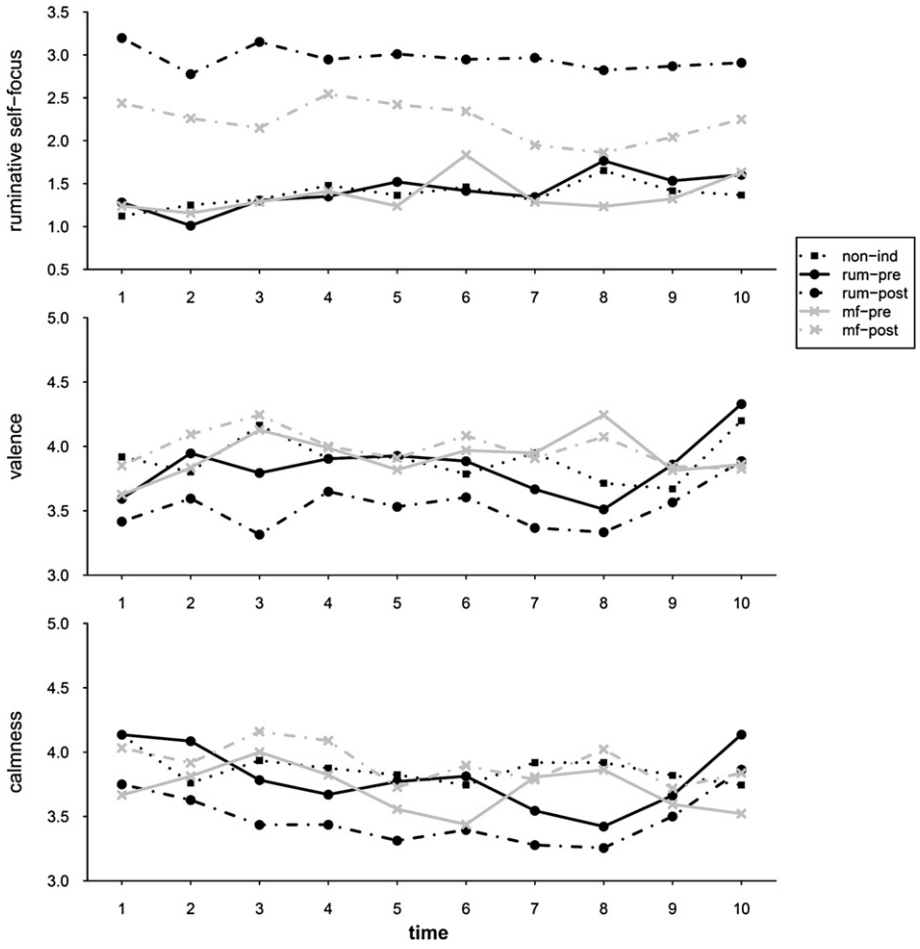

Fig. 1. Course of momentary ruminative self-focus, valence, and calmness measured on the noninduction day (non-ind), pre-induction (rum-pre) and post-induction (rum-post) on the rumination induction day, and pre-induction (mf-pre) and post-induction (mf-post) on the mindful attention induction day. Higher scores of valence and calmness refer to more positive states.

Table 1
Results of multilevel models for the immediate induction-related changes in momentary ruminative self-focus, valence, and calmness on the two induction days.

	Ruminative self-focus		Valence		Calmness	
Predictor	*B* (SE)	*t*	*B* (SE)	*t*	*B* (SE)	*t*
Intercept	1.80 (0.28)	6.46***	−0.25 (0.15)	−1.74	−0.43 (0.17)	−2.58*
BDI-II-ln	−0.14 (0.14)	−1.00	−0.03 (0.07)	−0.49	0.06 (0.08)	0.72
IndDay	−0.95 (0.29)	−3.33**	0.57 (0.16)	3.58**	0.81 (0.20)	4.15***
IndDay*						
BDI-II-ln	0.14 (0.14)	0.98	−0.11 (0.08)	−1.36	−0.16 (0.10)	−1.63

Note. $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$. Difference scores of post-induction minus pre-induction scores were included as outcomes. All models included 933 observations as well as random intercepts at the day and the person level. IndDay = induction day (0 = rumination day, 1 = mindful attention day), BDI-II-ln = Beck Depression Inventory II, ln-transformed.

days. The interactions of IndDay*BDI-II-ln did not significantly influence change scores in ruminative self-focus, valence, and calmness. That is, the differential effects of the two induction modes were not moderated by levels of depressive symptoms.[1]

To follow-up the significant main effects of IndDay and to display the effects of each induction mode, we conducted separate analyses for each day. These analyses revealed that the rumination inductions led to significant immediate increases in ruminative self-focus ($B = 1.55$, SE = 0.13, $t(50.11) = 12.09$, $P < 0.001$), and that, opposite to our hypothesis, mindful attention inductions also immediately increased ruminative self-focus ($B = 0.85$, SE = 0.11 $t(49.66) = 7.63$, $P < 0.001$), albeit with a significantly weaker effect (see Table 1 and Fig. 1). Moreover, rumination inductions were linked to significant immediate decreases in valence ($B = -0.32$, SE = 0.06, $t(49.53) = -4.92$, $P < 0.001$) and calmness ($B = -0.32$,

[1] In additional analyses, we checked for a possible influence of "day order" (the specific sequence of the study days) on the immediate induction-related changes. Analyses revealed nonsignificant effects on all three outcomes (for ruminative self-focus $F(5,50.00) = 1.00$, $P = 0.43$; for valence $F(5,50.18) = 0.31$, $P = 1.00$; for calmness $F(5,50.40) = 0.72$, $P = 0.62$).

Table 2
Results of multilevel models for the more distant effects of the rumination and mindful attention inductions on momentary ruminative self-focus, valence, and calmness over the day.

Predictor	Ruminative self-focus		Valence		Calmness	
	B (SE)	*t*	*B* (SE)	*t*	*B* (SE)	*t*
Intercept	0.60 (0.30)	2.02*	4.41 (0.26)	17.13***	4.34 (0.26)	16.45***
Time	0.10 (0.07)	1.41	−0.06 (0.06)	−0.98	−0.06 (0.07)	−0.87
Time^2	−0.01 (0.01)	−1.07	0.01 (0.01)	0.96	0.004 (0.01)	0.62
BDI-II-ln	0.30 (0.12)	2.46*	−0.23 (0.11)	−2.12*	−0.19 (0.11)	−1.70
Rum-day	−0.02 (0.24)	−0.08	−0.15 (0.18)	−0.84	0.22 (0.20)	1.13
mf-day	0.03 (0.24)	0.12	−0.25 (0.18)	−1.35	−0.18 (0.19)	−0.94
Rum-day*time	−0.02 (0.11)	−0.20	0.01 (0.09)	0.17	−0.18 (0.09)	−1.95
mf-day*time	−0.03 (0.11)	−0.32	0.18 (0.09)	2.07*	0.05 (0.09)	0.50
Rum-day*time^2	0.005 (0.01)	0.41	0.001 (0.01)	0.16	0.02 (0.01)	1.91
mf-day*time^2	0.004 (0.01)	0.37	−0.02 (0.01)	−1.96	−0.01 (0.01)	−0.61

Note. *$p < 0.05$, ***$p < 0.001$. Models included 1412 observations as well as random intercepts at the day and person level. Rum-day = rumination induction day, mf-day = mindful attention induction day, the non-induction day was used as reference category. BDI-II-ln = Beck Depression Inventory II, ln-transformed.

SE = 0.05, $t(49.42) = -6.29$, $P < 0.001$), while mindful attention inductions were linked to nonsignificant immediate increases in valence ($B = 0.05$, SE = 0.06, $t(50.36) = 0.87$, $P = 0.391$) and significant immediate increases in calmness ($B = 0.20$, SE = 0.09, $t(50.52) = 2.28$, $P < 0.027$; see Fig. 1).

3.4. More distant effects of the inductions on subsequent pre-induction measures on the induction days

To analyze possible longer-term effects of the two induction modes on the same day, we tested whether the inductions would also influence subsequent pre-induction measures on the induction days. Therefore, we analyzed whether the time slopes of the pre-induction spontaneous measures on the two induction days (rum-pre, mf-pre) differed from respective slopes of spontaneous measures on the noninduction day (nonind). Scores of spontaneous ruminative self-focus, valence, and calmness were entered as dependent variables in the models. The included predictors were linear and quadratic effects of time, BDI-II-ln, induction day (since the noninduction day was used as reference category, there were separate coefficients for the two induction days, i.e. rum-day, mf-day), and the interactions of rum-day and mf-day with time and time.[2]

Results are presented in Table 2. For *ruminative self-focus*, the analysis revealed a significant main effect for BDI-II-ln, but more importantly, nonsignificant interactions of rum-day respective mf-day with time and time.[2] This indicates that the course of spontaneous ruminative self-focus did not differ between the induction and noninduction days (Fig. 1). For *valence*, the analysis revealed a significant main effect of BDI-II-ln and a significant mf-day*time interaction. The coefficient of the interaction revealed a greater linear slope on the mf-day than on the noninduction day. As can be seen in Fig. 1, preinduction valence scores on the mf-day slightly linearly increased compared to spontaneous scores on the non-induction day; however, this difference was small. The significant main effects for BDI-II-ln in this and the previous analysis indicate that higher depressive symptoms were associated with overall stronger ruminative self-focus and reduced valence. For *calmness*, the analysis revealed that all main and interaction effects were nonsignificant, indicating that the course of spontaneous calmness did not differ between induction and noninduction days (Fig. 1). Thus, our analyses showed that the longer-term course of ruminative self-focus and calmness over the day was not affected by the two induction modes, while there was a slightly more favorable course of spontaneous valence on the mindful attention day.[2]

4. Discussion

To our knowledge, this is the first experimental ambulatory assessment (AA) study to compare effects of induced ruminative and mindful attention in everyday life. Consistent with our hypotheses, we identified significant *immediate* differential effects of the two induction modes on momentary ruminative self-focus and mood. Specifically, rumination inductions in daily life led to an immediate increase in ruminative self-focus and a parallel mood deterioration, as indicated by decreases in valence and calmness. Importantly, the present results were identified on weekdays and completely replicate our previous findings identified on weekends (Huffziger et al., 2012). This indicates that the effects of induced rumination in daily life are robust and independent of specific daily routines. For mindful attention inductions in daily life, our analyses revealed that mindful attention unexpectedly also increased momentary ruminative self-focus – albeit to a significantly lesser extent than the rumination inductions. Furthermore, mindful attention was not associated with immediate changes in mood valence, but immediately enhanced momentary calmness. The latter result shows that short periods of mindful attention have the potential to adaptively alter specific mood components in everyday life. Here, mindful attention seems to selectively improve the mood component calmness, which parallels the idea of many meditative practices to primarily enhance equanimity rather than happiness (Farb et al., 2012).

The observed differential immediate mood effects of the two induction modes imply another important conclusion. Although we employed an equally demanding AA procedure, instructions to adopt self-focused attention did not generally lower mood across the different induction days. Instead, it was the specific kind of self-focused attention that determined upon its immediate consequences. This is in line with a body of evidence showing that not all forms of self-focused attention or repetitive thoughts have maladaptive effects (Takano & Tanno, 2011; Watkins, 2008). Specifically, adaptive self-focusing involves mindful qualities such as acceptance and metacognitive awareness, while maladaptive self-focusing exhibits characteristics of ruminative processes, that is, analytic and abstract thinking and focusing on one's current distress (cf. Baer, 2009).

The unexpected increase in momentary ruminative self-focus after induced mindful attention deserves further discussion. Reductions in rumination have been proposed as a potential

[2] We again checked for a possible influence of "day order" (the specific sequence of the study days) on the more distant induction-related effects. Analyses revealed nonsignificant effects on all three outcomes (for ruminative self-focus $F(5,50.03) = 1.08$, $P = 0.38$; for valence $F(5,50.01) = 0.57$, $P = 0.72$; for calmness $F(5,50.12) = 0.81$, $P = 0.55$).

mechanism by which mindfulness trainings exert their beneficial effects (Segal et al., 2002). This has been confirmed by a range of intervention studies (Jain et al., 2007; Shahar et al., 2010; Van Aalderen et al., 2012). However, there is also evidence that mindfulness trainings were not linked to reduced rumination (Bieling et al., 2012; Robins, Keng, Ekblad, & Brantley, 2012), and Manicavasagar, Perich, and Parker (2011) showed that reductions in trait rumination were not necessarily specific for a mindfulness training. Furthermore, while the reviewed intervention studies addressed trait rumination after several weeks of training, the present study examined effects of short mindful self-focus inductions on state rumination. It can now be speculated that briefly induced mindful self-focusing is associated with a transient increase in state rumination since purposefully bringing attention toward one's experiences might initially trigger ruminative thinking. In contrast, reductions in trait rumination might only emerge after longer lasting mindfulness trainings (see also Feldman, Greeson, & Senville, 2010; Robins et al., 2012).

Another possible explanation for the identified increase in ruminative self-focus after induced mindful attention relates to the state rumination measure in our study. The 2-item measure was specifically developed for economic assessment in AA research. It captures an attention focus on one's momentary feelings and problems, while other aspects of rumination such as the repetitive quality, level of abstractness, or uncontrollability of ruminative processes (Ehring et al., 2011; Watkins, 2008) are not assessed (cf. Moberly & Watkins, 2008). Relatedly, Raes and Williams (2010) found that trait mindfulness was negatively correlated with the rumination facet of uncontrollability, but not with global levels of rumination. Thus, as it has been done for trait measures of rumination (e.g. Ehring et al., 2011), it is important to also develop further AA-suitable state measures that capture specific dysfunctional rumination aspects such as uncontrollability (cf. Takano & Tanno, 2011) or abstractness. It could then be tested whether brief mindful attention inductions exhibit differential effects on different facets of ruminative self-focus.

Contrary to expectations, the immediate induction effects of both ruminative and mindful attention were not moderated by baseline levels of depressive symptoms. This might indicate that compared to artificial settings, attention inductions in real life exhibit stronger immediate effects that also affect participants with low levels of depressive symptoms (see also Huffziger et al., 2012). Moreover, we examined whether the repeated attention inductions would also produce more distant effects on the same day and found that for rumination inductions, such longer-term effects could not be demonstrated (see also Huffziger et al., 2012). Similarly, mindful attention inductions did also not influence more distant measures of ruminative self-focus and calmness, while there was a slightly more favorable course of spontaneous valence on the mindful attention induction day compared to the noninduction day. However, the latter effect was not profound. Nevertheless, the present study revealed that in the short-term, mindful attention specifically increased calmness, while slight increases in valence seem to only gradually emerge. In this context, it would be interesting to further examine whether the specific mood effects of mindful attention vary over time. Furthermore, detailed testing with more intense manipulations may reveal dose-dependent longer-term benefits. Importantly, the present results indicate that applications of short mindfulness manipulations could possibly be interesting for therapeutic settings. However, since beneficial effects of specific cognitive interventions in nonclinical samples might not directly be transferable to clinical samples (cf. Emmelkamp, 2012), replications of the present findings in clinical samples are clearly warranted.

Some limitations should be mentioned. First, related to the point above, a major limitation involves the use of a nonclinical student sample with rather low levels of depressive symptoms. Thus, in most instances, attention inductions were provided in the absence of negative mood. This could be responsible for the largely nonsignificant longer-term effects, particularly since previous laboratory studies demonstrated negative effects of induced rumination only in dysphoric individuals or after negative mood induction (Nolen-Hoeksema et al., 2008). On a related note, the overall low levels of depressive symptoms could also be responsible for the finding that depressive symptoms did not moderate the induction effects. Thus, we need to be cautious to conclude that moderator effects would be generally absent. Further experimental AA studies should therefore examine samples with a broader range of depressed symptoms to further investigate longer-term effects of induced attention foci and possible moderating influences of depression levels in more detail.

A second limitation refers to the assessment of only three days that limits the generalizability of the present findings. On the other hand, our study yielded an excellent compliance rate, probably indicating that shorter assessment periods promote adherence to the induction instructions and prevent habituation and reactivity effects (Huffziger et al., 2012). Third, the 80-min intervals in our AA schedule might be problematic if individuals anticipate upcoming assessments. However, since 80-min intervals do not fit to a full- or half-hour sampling schedule and due to the possibility to postpone assessments, the sampling was hardly predictable. Fourth, we did not measure the extent of social desirability or the intensity of the students' concentration on the induction statements. While particularly the latter shortcoming is shared with most laboratory studies on the topic, it might be more problematic in an AA-study with distracting everyday environments. However, since we identified differential immediate effects of the two induction modes that were consistent with our hypotheses, there is at least indirect evidence that the participants had concentrated on the statements as expected. A further limitation includes that we did not assess prior meditation or yoga experience which will likely influence responses to the mindful attention inductions.

Finally, it is important to stress that short periods of mindful attention induced by a series of statements do not resemble genuinely trained mindfulness as achieved through several weeks of training. Likewise, our inductions particularly focused on awareness of the breath and non-judgmental acceptance of one's thoughts, emotions, and experiences, but did not fully capture the multifaceted principle of mindfulness. Nonetheless, experimental investigations of mindfulness facets allow to identify specific effects of this mental capacity on the microlevel and help to better understand its beneficial qualities.

To conclude, our study is the first to demonstrate the ecological validity of differential mood-modulating effects of induced ruminative and mindful attention in daily life. Importantly, these effects were observable despite potentially distracting influences in the natural environment and confirm the importance of these attention foci for emotion regulation. Given the replication of the present findings in clinical samples, adaptations of the present method might augment specific interventions focusing on redirecting attention which becomes increasingly important in the therapy for depression and other emotion regulation disorders (Wadlinger & Isaacowitz, 2011).

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