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Mindfulness and Mind-Wandering: Finding Convergence Through Opposing Constructs

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Research into both mindfulness and mind-wandering has grown rapidly, yet clarification of the relationship between these two seemingly opposing constructs is still absent. A first study addresses the relationship between a dispositional measure of mindfulness (Mindful Attention and Awareness Scale, MAAS) and converging measures of both self-reported and indirect markers of mind-wandering. Negative correlations between dispositional mindfulness and 4 measures of mind-wandering confirm the opposing relationship between the 2 constructs and further validate the use of the MAAS as a dispositional measure of mindfulness. A second study demonstrated that 8 minutes of mindful breathing reduces behavioral indicators of mind-wandering during a Sustained Attention to Response Task compared with both passive relaxation and reading. Together these studies clarify the opposition between the constructs of mindfulness and mind-wandering and so should lead to greater convergence between what have been predominately separate, yet mutually relevant, lines of research.

Keywords: mindfulness, mind-wandering, attention

While the restless nature of attention has been a feature of Eastern philosophical thought for several thousand years, it has only recently become a focus of scientific research. Studies have begun to investigate the dispositional tendency to mindfully anchor attention on the here and now (Brown, 2007), while a conceptually related research domain has examined the processes which govern intermittent shifts of attention away from the task at hand (known as mind-wandering, for reviews see Smallwood & Schooler, 2006; Schooler et al., 2011). Given that mindfulness and mind-wandering appear to be opposing constructs with respect to the ability to remain undistracted, the current set of studies first review the conceptual relationship between these constructs and then examine whether mindfulness training is capable of leading to reductions in mind-wandering.

A recent special issue of *Emotion* dedicated to mindfulness was prefaced with a commentary calling for further validation of self-reported measures of dispositional mindfulness by linking such measures to existing methods for assessing mind-wandering (Davidson, 2010). Mindfulness is operationalized in a variety of ways, with ongoing disagreement as to the most privileged and useful definition of this construct (Grossman & Van Dam, 2011). One perspective defines mindfulness as sustained nondistraction (Brown & Ryan, 2003; Wallace & Shapiro, 2006; Dreyfus, 2011), whereas multifactor construals of mindfulness emphasize not only awareness of present experience but also an orientation toward one's experiences characterized by curiosity, openness, and acceptance (Bishop et al., 2004; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Amid this disagreement, there is nonetheless consensus that sustained attentiveness represents a fundamental element (if not a complete characterization) of mindfulness. Accordingly, we focused our investigation on mindfulness as nondistraction as it is operationalized by the Mindful Awareness Attention Scale (MAAS), the most widely used dispositional measure addressing the extent to which an individual attends without distraction to present experience (e.g., I find myself listening to someone with one ear, doing something else at the same time, *reverse scored*) (Brown & Ryan, 2003).

In direct contrast to mindfulness, which entails a capacity to avoid distraction, mind-wandering is characteristically described as the interruption of task focus by task-unrelated thought (TUT) (Smallwood & Schooler, 2006). Many behavioral markers of mind-wandering have a distinctly mindless quality, such as rapid and automatic responding during continuous performance tasks (Smallwood et al., 2004), absent-minded forgetting (Smallwood, Baracaia, Lowe, & Obonsawin, 2003), and eye-movements during reading that show little regard for the lexical or linguistic properties of what is being read (Reichle, Reineberg, & Schooler, 2010). Furthermore, event-related potential studies have demonstrated that instances of mind-wandering are characterized by a reduced awareness of task stimuli and the external environment (Barron et al., in press; Smallwood, Beach, Schooler, & Handy, 2008; Kam et

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al., 2011). The ability to remain mindfully focused on a task therefore appears to be in direct opposition to the tendency for attention to wander to task-unrelated concerns. Where mindfulness ends, mind-wandering begins.

The conceptual relationship between mindfulness and mind-wandering clearly warrants careful empirical investigation to establish the actual relationship between these two seemingly opposing constructs (Davidson, 2010). Two prior studies have examined the association between self-reported dispositional mindfulness and indirect markers of mind-wandering during a task in which attentional lapses are problematic (the Sustained Attention to Response Task, SART). The SART is a GO/NOGO task and its performance markers are among the most carefully validated and commonly used indirect measures of mind-wandering (Smallwood et al., 2004, Smallwood, Fishman, & Schooler, 2007, Smallwood et al. 2008; McVay & Kane, 2009; Cheyne et al., 2009). Low self-reported mindfulness as measured by the MAAS is associated with fast and careless responding in the SART (Cheyne, Carriere, & Smilek, 2006). An adapted version of the MAAS called the MAAS-LO (lapses only) has also been associated with several performance markers of mind-wandering in the SART (Cheyne, Solman, Carriere, & Smilek, 2009). These studies provide preliminary evidence that mindfulness and mind-wandering are conceptually linked, yet because these indirect measures can be influenced by factors besides task-unrelated thought (McVay & Kane, 2009) it is important to validate the MAAS with direct reports of mind-wandering. Furthermore, in order to establish the relationship between these constructs, it is important to address whether measures of mind-wandering are predictive of distraction within the contexts of tasks typically associated with the application of mindfulness (e.g., meditation). Study 1 addresses these issues by embedding thought sampling into a meditation task structured to represent one way mindfulness is characteristically developed and practiced, thereby establishing a more ecologically valid paradigm for research into mindfulness.

If mindfulness and mind-wandering can be convincingly demonstrated to be opposing constructs, this insight would provide many opportunities for convergence between what have historically been largely separate lines of research. For instance, the well-established disruptive role that mind-wandering can exert on task performance (e.g., Smallwood et al., 2003, 2004, 2007, Smallwood, McSpadden, Luus, & Schooler, 2008; Reichle et al., 2010) could be reduced by exercises that increase mindfulness. While mindfulness training has been demonstrated to improve executive attention, perceptual sensitivity, and even sustained attention (Tang et al., 2007; MacLean et al., 2010), the impact of mindfulness training on mind-wandering is less clear. In fact, to date there has been little progress in developing effective strategies for reducing mind-wandering. Study 2 therefore examines whether a brief mindfulness exercise can reduce mind-wandering, thereby potentially both introducing an effective antidote to mind-wandering and establishing a causal relationship between the presence of mindfulness and the absence of mind-wandering.

Summary and Experimental Overview

Mindfulness and mind-wandering appear to be conceptually opposing constructs with respect to undistracted attention. Study 1 addresses this relationship by associating naturally occurring variation in dispositional mindfulness with four converging indicators of mind-wandering, including a novel and more ecologically valid measure of mind-wandering during mindful breathing. Building on this work, Study 2 explores whether a brief period of mindful breathing reduces indicators of mind-wandering during a subsequent task.

Study 1

Study 1 examines the association between four sets of variables: (a) self-reported dispositional mindfulness, (b) self-reported dispositional daydreaming, (c) experience sampling of mind-wandering during a mindful breathing task, and (d) two indirect performance measures of mind-wandering during the SART. Using both indirect and self-reported measures of mind-wandering, Study 1 provides a comprehensive examination of the relationship between mindfulness and mind-wandering.

Method

Participants

One hundred and seventeen (33 males) undergraduate students participated in exchange for course credit (mean age = 19, *SD* = 1.33). Four participants were excluded for failing to complete the dispositional questionnaires. One hundred thirteen participants were therefore included in the final analysis. All studies reported were approved by the University of California Santa Barbara's Institutional Review Board and informed consent was obtained from each participant at the beginning of the experimental session.

Procedure

All participants completed a 10-minute mindful breathing task with thought sampling probes, a 10-minute mindful breathing task requiring self-catching of mind-wandering, and a 10-minute SART in a counterbalanced order. Stimuli for all studies were presented via E-Prime (Version 2.1, Psychology Software Tools, Pittsburgh, PA) using Dell desktops in individual soundproof rooms.

During both mindful breathing tasks, participants were instructed to continuously focus their attention on the sensations of their breath without attempting to control the rate of respiration. They were asked to keep their eyes open and gaze into the space in front of them. For the experience sampling version of this task, six thought probes occurred at quasi-random intervals on the computer screen, alerting participants to indicate whether their attention was directed to the task or task-unrelated concerns using a 5-point Likert scale (1 = *completely on task,* 5 = *completely on task-unrelated concerns*). For the self-catching version of this task, participants were asked to press the spacebar anytime they noticed their attention had drifted to task-unrelated concerns.

The SART is a GO/NOGO task that has been repeatedly used as an indirect measure of mind-wandering (Smallwood et al., 2004; Cheyne et al., 2009). Participants were asked to respond as quickly as possible to frequent nontargets (O's) by pressing the spacebar and to refrain from responding to rare targets (Q's). A total of 240 stimuli were presented, including 216 nontargets and 24 targets that occurred at unpredictable quasi-random intervals. Stimuli were presented for 2 s with an interstimulus interval of 500 ms.

Different performance markers in this task have been associated with varying degrees of task disengagement, with failures of omission to targets (SART errors) generally indicating a more pronounced distraction than a large response time coefficient of variability (reaction time [RT] CV). RT CV has been shown to indicate a qualitatively distinct state of mind-wandering that emerges from a minimally disruptive disengagement of attention (Cheyne et al., 2009). This state is characterized by a periodic speeding and slowing of response times as attention fluctuates slightly (Smallwood et al., 2008). RT CV complements SART errors by addressing minimally pronounced occurrences of mind-wandering.

Following these tasks, mood was measured using the Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988). This measure consists of two 10-item scales measuring positive and negative affect. Participants were asked to rate to what extent they felt a certain way right now from 1 (*very slightly* or *not at all*) to 5 (*extremely*). Participants also completed dispositional measures of mindfulness (MAAS) and daydreaming (Imaginal Processes Inventory (IPI), Daydreaming Subscale). The MAAS-LO scores were calculated by dropping three items from the MAAS—two relating to the consequences of attention lapses rather than the lapses themselves and one addressing lapses while driving, which may have limited applicability to college undergraduates (Carriere, Cheyne, & Smilek, 2008).

Results

Table 1 presents the correlations between measures as well as interitem reliability for the three questionnaires. Analysis of variance (ANOVA) indicated no effect of gender was observed on any of the variables. MAAS scores indicating high levels of mindfulness were negatively correlated with self-reported trait mind-wandering. Furthermore, high levels of trait mindfulness were also associated with less mind-wandering as measured by self-reported TUT during mindful breathing, SART errors, and RT CV. These results provide converging evidence suggesting that mindfulness and mind-wandering are roughly opposing constructs.

The only measure of mind-wandering which was not associated with mindfulness, was self-caught TUT during mindful breathing. One explanation for this finding is that self-catching measures both distraction and subsequent metaawareness of the distraction (Schooler, Reichle, & Halpern, 2004), two dimensions which may have inverse associations with mindfulness (see Mason et al., 2007 for a discussion of this issue).

We next ensured that the meditation task was not influencing SART performance in a way that would invalidate the observed association between the MAAS and SART performance by examining the effect of task order on SART errors. No significant differences were found between those who completed the SART first (M = 2.97), after one meditation task (M = 2.84), or after two meditation tasks (M = 3.63), $F(2, 110) = 1.142$, $p = .32$. Nonetheless, these small numerical differences suggest that a targeted mindfulness exercise designed to reduce mind-wandering may be most effective when of short duration.

As shown in Table 1, high levels of negative affect measured by the PANAS were associated with more SART errors. This finding is consistent with a large body of evidence indicating that negative affect is associated with SART errors (Smallwood et al., 2005, 2007, Smallwood, Fitzgerald, Miles, & Phillips, 2009; Seibert & Ellis, 1991). In the present study, negative affect was unassociated with MAAS scores, suggesting that trait mindfulness and negative affect may make unique contributions to an individual's tendency to make errors in tasks of sustained attention. To test this possibility, we conducted a simultaneous regression analysis predicting SART errors from MAAS scores and negative affect. Together the two predictors explained approximately 9% of the variance in SART errors, $R^2 = .089$, $F(1, 110) = 5.364$, $p < .01$. An inspection of the standardized partial regression coefficients (β) and semipartial correlations (sr^2) revealed that both variables explained a significant amount of unique variance in SART errors, with MAAS scores being the strongest individual predictor. These findings revealed that SART errors were fewer for those with high dispositional mindfulness ($\beta = -.24$, $p < .05$, $sr^2 = .06$) and greater for those experiencing more negative affect ($\beta = .19$, $p < .001$, $sr^2 = .04$).

Discussion

Study 1 demonstrates that mindfulness and mind-wandering can reasonably be thought of as opposite sides of the same coin. High self-reported dispositional mindfulness was associated with less

Table 1
Correlations Among Trait Mindfulness, Task Performance, and Mind-Wandering

Variable	1	2	3	4	5	6	7	8
1. MAAS	*.849*							
2. MAAS-LO	.961***	*.839*						
3. RT CV	−.188*	−.186*	—					
4. SART errors	−.234*	−.228*	.449***	—				
5. TUT	−.220*	−.253*	.252**	.088	—			
6. IPI	−.237**	−.242**	.216*	.060	.258**	*.950*		
7. Self-caught TUT	−.086	−.107	.227*	.176	.255**	.268**	—	
8. Negative affect	.005	.002	−.025	.184*	.014	.018	−.018	—
9. Positive affect	.054	.082	−.076	−.091	−.027	.001	−.091	−.088

Note. $N = 113$. MAAS = Mindful Attention Awareness Scale; MAAS-LO = Mindful Attention Awareness Scale - Lapses Only; RT CV = Response Time Coefficient of Variability (SD/Mean); TUT = self-reported task-unrelated thought; IPI = Imaginal Processes Inventory Daydreaming Subscale. Cronbach's alpha measure of reliability for the three questionnaires measures are presented in italics.
* $p < .05$. ** $p < .01$. *** $p < .001$.

mind-wandering using four converging indicators. This finding lends support to the use of the MAAS as an operationalization of mindfulness (e.g., Way et al., 2010) and clarifies the relationship between two intuitively related and increasingly studied psychological constructs. Future research should examine whether completing attention tasks like the ones used in this study alters participants' responses on self-report scales like the MAAS, perhaps by increasing their familiarity with their attentional performance. Future work could also extend the association between mindfulness and mind-wandering using event-related potential and functional magnetic resonance imaging (fMRI) measures of mind-wandering which have themselves been validated using the self-report and behavioral measures used in the present study (Barron et al., 2011; Smallwood et al., 2008; Kam et al., 2011; Christoff, Gordon, Smallwood, Smith, & Schooler, 2009).

Study 2

Study 1 established an association between the constructs of mind-wandering and mindfulness using a correlational design. Study 2 examines this issue in greater detail by examining whether inducing mindfulness can attenuate mind-wandering. This expectation is consistent with the many well-documented benefits of mindfulness training (see Brown, 2007 for a review). However, many prior studies have utilized intensive meditation training lasting months or years, limiting the applicability of observed improvements for most societal and educational contexts (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; MacLean et al., 2010). Other encouraging studies have found beneficial results from training as brief as two weeks to four days (Tang et al., 2007; Zeidan, Johnson, Diamond, David, & Goolkasian, 2010), However, to date, no published mindfulness training study has specifically examined its impact on mind-wandering.[1] Furthermore, from a methodological perspective, meditation intervention studies typically include so many different aspects in their intervention that it is difficult to discern which specific element is responsible for any observed changes. What is needed in order to discern the causal role of mindfulness in mitigating mind-wandering is a simple manipulation that directly and specifically targets individuals' ability to remain mindful. Using such an approach, one recent study found improvement in emotional responding to emotion-inducing videos following an 8 minute mindfulness exercise (Erisman & Roemer, 2010). Given that an 8-minute intervention would provide the simplest and most accessible mindfulness exercise while also allowing for a high degree of experimental control, Study 2 examined whether a brief mindful breathing exercise can decrease mind wandering.

Method

Participants

Sixty (22 males) undergraduate students participated in exchange for course credit (mean age = 19, $SD = 1.17$). Participants were recruited to a study entitled "Relaxation & Attention" through the University of California Santa Barbara subject pool.

Procedure

After 20 practice trials in the SART, participants were randomly assigned to conditions and completed 8 minutes of either mindful breathing, passive relaxation, or reading. Expectation effects and demand characteristics were minimized by informing all participants that they were participating in a study designed to examine the effect of relaxation on attention. The mindful breathing condition provided participants with the simple instruction to sit in an upright position while focusing their attention on the sensations of their breath without trying to control the rate of respiration and to return their attention to the breath anytime they became distracted. Unlike Study 1, participants were not asked to keep their eyes open and were not required to make any responses during the exercise. Participants in the reading condition were asked to browse a popular local newspaper. Those in the passive rest condition were asked to relax without falling asleep. Following this manipulation, all participants immediately completed the same 10-minute SART used in Study 1. Mood was measured before and after the manipulation by asking participants to rate their current degree of energy, pleasantness, and relaxation using a 9-point Likert scale.

Results

We first examined the effects of mindful breathing on two indirect measures of mind-wandering: SART errors and RT CV. Univariate ANOVA revealed an effect of condition on both SART errors, $F(2, 57) = 3.80$, $p < .05$, and RT CV, $F(2, 57) = 3.10$, $p = .05$. As displayed in Figure 1, follow-up post hoc tests indicated that both SART errors and RT CV in the mindful breathing condition were significantly less than in either comparison group (p's $< .05$). As predicted, 8 minutes of mindful breathing reduced mind-wandering as compared with passive relaxation or reading.

We next analyzed the decay curve to see whether mindful breathing had an equivalent effect on performance throughout the duration of the task. The SART was divided into four equal task blocks, each corresponding to 60 trials and six targets. Mind-wandering increased over the duration of the task as indicated by a main effect of task block in a repeated-measures ANOVA, $F(3, 171) = 2.857$, $p = .039$. However, there was no interaction between condition and task block, $F(6, 171) = .976$, $p = .443$. The relative reduction in mind-wandering following mindful breathing therefore appears to have been stable across the 10-minute task.

We next examined the effect of condition separately on each of the three measures on mood. A repeated-measures ANOVA revealed a main effect of session indicating that participants reported feeling more relaxed after the manipulation, $F(2, 57) = 6.74$, $p = .01$. A marginally significant Time × Condition interaction suggests that this effect was strongest among those in the mindful breathing condition, $F(2, 57) = 2.643$, $p = .08$. However, no main effects or interactions were observed for pleasantness or energy (p's $> .05$).

Finally, we examined the effect of mood measured prior to the attention task on SART errors and RT CV. Consistent with Study 1, SART errors were negatively correlated with high energy ($r = –.267$, $p < .05$), pleasantness ($r = –.304$, $p < .05$), and relaxation ($r = –.266$, $p < .05$), whereas RT CV was not associated with mood (p's $> .05$). Although SART errors and RT CV were

[1] Two unpublished studies have found evidence that meditation training courses are associated with a reduction in SART errors (Wong et al., 2008; Jha, Stanley, Kiyonaga, Wong, & Gelfand , 2009).

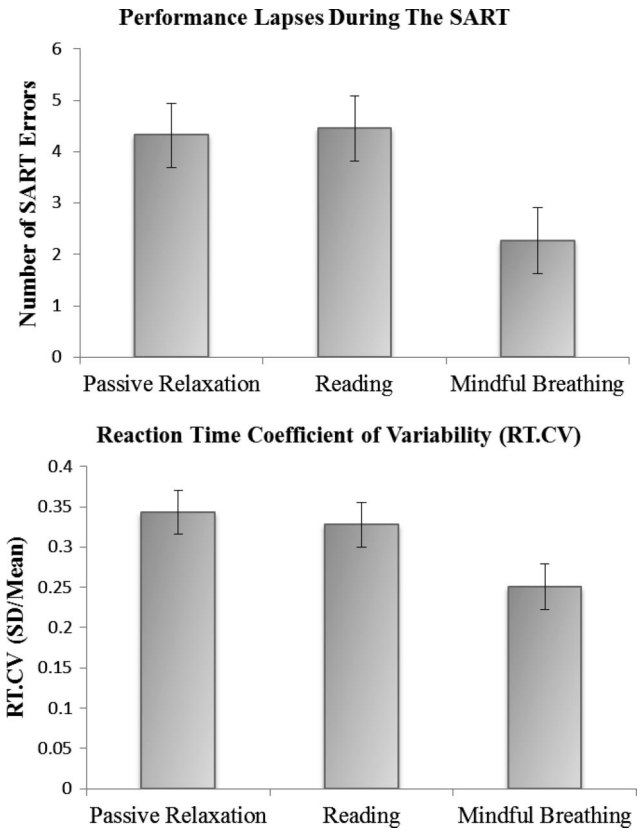

Figure 1. Reduction of mind-wandering following mindful breathing. Note: $n = 60$. Two performance markers during the SART indicated that 8 minutes of mindful breathing led to a reduction in mind-wandering. SART Errors refer to errors of commission when a participant fails to withhold a response to rare nontargets. Reaction Time Coefficient of Variability is calculated as the standard deviation of RT divided by the mean RT.

strongly correlated in this study ($r = .400$, $p < .001$) and in Study 1 ($r = .449$, $p < .001$), negative affect was uniquely associated with SART errors. Given that SART errors are considered an indicator of more pronounced mind-wandering than RT CV (Cheyne et al., 2009), one possible interpretation is that negative affect leads to a particularly engrossing form of mind-wandering.

Discussion

Study 2 demonstrates that 8 minutes of mindful breathing can attenuate indirect performance markers of mind-wandering in a task of sustained attention. Only brief written instructions of the technique and 8 minutes of mindful breathing were necessary to achieve the observed improvement, indicating that further investigation into the utility of brief interventions is warranted.

Although we cannot determine the precise mechanism by which the mindfulness exercise reduced mind-wandering, at least two possibilities warrant further consideration. First, mindfulness exercises may reduce the actual occurrence of task-unrelated thoughts. Attending to a simple stimulus, such as the breath, provides fertile ground for distracting thoughts to arise, but such thoughts may lose their disruptive salience when they are continually ignored. A second possibility is that mindfulness exercises improve metacognitive regulation, perhaps increasing awareness of mind-wandering and thereby allowing attention to be redirected from off-task thoughts more quickly. These differing explanations—which are not mutually exclusive—provide direction for future research.

Although not the primary focus of the present investigation, one interesting pattern of findings observed in Study 1 and replicated in Study 2 is the relationship between mood and mind-wandering. Intriguingly, the two experiments used different measures of mood and yet both found that negative affect correlated with SART errors but not with other indirect and self-reported measures of mind-wandering. The association between negative affect and SART errors is now well-established (Smallwood et al., 2005, 2007, 2009), yet the present studies indicate that this association is not true for all markers of mind-wandering. The unique association between mood and SART errors in the present studies may suggest that the association between mind-wandering and negative affect emerges only during pronounced task-disengagement. Future research should further clarify the circumstances in which mind-wandering and mood interact.

General Discussion

By clarifying the opposing relationship between mindfulness and mind-wandering, the present studies make several contributions to the understanding of these constructs. First, Study 1 demonstrated a reliable negative correlation between an existing measure of mindfulness and multiples markers of mind-wandering. Study 2 further underlined this conceptual relationship by demonstrating that mindful breathing reduces behavioral indicators of mind-wandering in a subsequent task. The effectiveness of this intervention establishes a causal relationship between the cultivation of mindfulness and subsequent reduction in mind-wandering. Given the robust relationship between mind-wandering and impaired task performance (for reviews see Smallwood & Schooler, 2006; Smallwood et al., 2007), the benefits of a straightforward and simple activity to reduce mind-wandering has great practical significance. Future research should investigate the impact of mindful breathing exercises on other activities that are known to be disrupted by mind-wandering.

By specifying the relationship between mindfulness and mind-wandering, the present study also helps to bridge two rapidly growing streams of research into an integrated understanding of undistracted attention. For example, existing research indicates that training in mindfulness can reduce activation of the default-mode network, a collection of brain regions that typically show greater activation at rest than during externally directed cognitive tasks. Both long-term meditators and individuals who have completed a 2-week meditation program show reduced activation of the default-mode network (Brefczynski-Lewis et al., 2007; Tang et al., 2009). Given that this network has been repeatedly associated with markers of mind-wandering (Christoff et al., 2009; Mason et al., 2007), the improvement in sustained attention following mindful breathing observed in Study 2 may be mediated by diminished default-mode activation. Future research should directly test whether mindfulness training reduces mind-wandering by dampening activation of the default mode network.

We focused our investigation on mindfulness as nondistraction, which we believe represents the element most central to mindfulness and also most directly linked to mind-wandering (Brown & Ryan, 2003; Wallace & Shapiro, 2006). However, more complex operational definitions of mindfulness emphasize additional features of the experience that may also be associated with mind-wandering. For example, Bishop & colleagues (2004) have formalized a two-factor construal of mindfulness that emphasizes not only nondistraction, but also a curious, open, and accepting orientation toward one's experience. One possibility is that mind-wandering has a similar relationship to this nonjudgmental orientation: being fully attentive to a given sensation may preclude the possibility of being closed or intolerant toward it. Yet it is also possible that it is the *content* of mind-wandering that is most strongly associated with the nonjudgmental orientation toward one's experience. Future research could profitably investigate how the actual content of mind-wandering episodes relates to the various subprocesses of multifaceted frameworks for mindfulness.

Perhaps the most compelling question for future research is to untangle the relationship between the benefits of mindfulness and the potential benefits of mind-wandering. After all, the human capacity to plan the future and reflect on past experience has clear adaptive value (Smallwood, 2010; Baars, 2010). There may be many circumstances in which diverting attention away from a simple primary task is beneficial. Yet the accumulating evidence for the positive outcomes of mindfulness could be interpreted by some to suggest that mind-wandering is of little or no benefit. Future research should address this issue, perhaps by examining whether the practice of mindfulness affords a degree of control over mind-wandering that allows for its benefits while minimizing its costs.

References

Baars, B. (2010). Spontaneous repetitive thought can be adaptive: Postscript on "mind wandering". *Psychological Bulletin, 136,* 208–210. doi:10.1037/a0018726

Baer, R. G., Smith, G., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment, 15,* 329–342. doi:10.1177/1073191107313003

Barron, E., Riby, L. M., Greer, J., & Smallwood, J. (2011). Absorbed in thought: The effect of mind wandering on the processing of relevant and irrelevant events. *Psychological Science, 22,* 596–601.

Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., . . . Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice, 11,* 230–241.

Brefczynski-Lewis, J. A., Lutz, A., Schaefer, H. S., Levinson, D. B., & Davidson, R. J. (2007). Neural correlates of attentional expertise in long-term meditation practitioners. *Proceedings of the National Academy of Sciences, USA, 104,* 11483–11488. doi:10.1073/pnas.0606552104

Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *Journal of Personality and Social Psychology, 84,* 822–848. doi:10.1037/0022-3514.84.4.822

Brown, K. W. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry, 18,* 211–237. doi:10.1080/10478400701598298

Carriere, J. S. A., Cheyne, J. A., & Smilek, D. (2008). Everyday attention lapses and memory failures: The affective consequences of mindlessness. *Consciousness and Cognition, 17,* 835–847. doi:10.1016/j.concog.2007.04.008

Cheyne, J. A., Carriere, J. S. A., & Smilek, D. (2006). Absent-mindedness: Lapses of conscious awareness and everyday cognitive failures. *Consciousness and Cognition, 15,* 578–592. doi:10.1016/j.concog.2005.11.009

Cheyne, J. A., Solman, G. J. F., Carriere, J. S. A., & Smilek, D. (2009). Anatomy of an error: A bidirectional state model of task engagement/disengagement and attention-related errors. *Cognition, 111,* 98–113. doi:10.1016/j.cognition.2008.12.009

Christoff, K., Gordon, A. M., Smallwood, J., Smith, R., & Schooler, J. W. (2009). Experience sampling during fMRI reveals default network and executive system contributions in mind wandering. *Proceedings of the National Academy of Sciences, USA, 106,* 8719–8724. doi:10.1073/pnas.0900234106

Davidson, R. (2010). Empirical explorations of mindfulness: Conceptual and methodological conundrums. *Emotion, 10,* 8–11. doi:10.1037/a0018480

Dreyfus, G. (2011). Is mindfulness present-centred and non-judgmental? A discussion of the cognitive dimensions of mindfulness. *Contemporary Buddhism, 12,* 41–54. doi:10.1080/14639947.2011.564815

Erisman, S., & Roemer, L. (2010). A preliminary investigation of the effects of experimentally induced mindfulness on emotional responding to film clips. *Emotion, 10,* 72–82. doi:10.1037/a0017162

Grossman, P., & Van Dam, N. T. (2011). Mindfulness, by any other name . . . : Trials and tribulations of *sati* in western psychology and science. *Contemporary Buddhism, 12,* 219–239. doi:10.1080/14639947.2011.564841

Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L. M., & Gelfand, L. (2009, October). Mindfulness training counteracts heightened distractibility in a military cohort. Poster session presented at the meeting of the Society for Neuroscience, Chicago, IL.

Kam, J. W. Y., Dao, E., Farley, J., Fitzpatrick, K., Smallwood, J., Schooler, J. W., & Handy, T. C. (2011). Slow fluctuations in attentional control of sensory cortex. *Journal of Cognitive Neuroscience, 23,* 460–470. doi:10.1162/jocn.2010.21443

MacLean, K. A., Ferrer, E., Aichele, S. R., Bridwell, D. A., Zanesco, A. P., Jacobs, T. L., . . . Saron, C. D. (2010). Intensive meditation training improves perceptual discrimination and sustained attention. *Psychological Science, 21,* 829–839.

Mason, M. F., Norton, M. I., Van Horn, J. D., Wegner, D. M., Grafton, S. T., & Macrae, C. N. (2007). Wandering minds: The default network and stimulus-independent thought. *Science (New York, N. Y.), 315,* 393–395. doi:10.1126/science.1131295

McVay, J. C., & Kane, M. J. (2009). Conducting the train of thought: Working memory capacity, goal neglect, and mind-wandering in an executive-control task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35,* 196–204. doi:10.1037/a0014104

Reichle, E. D., Reineberg, A. E., & Schooler, J. W. (2010). Eye movements during mindless reading. *Psychological Science, 21,* 1300–1310. doi:10.1177/0956797610378686

Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004). Zoning out while reading: Evidence for dissociations between experience and metaconsciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 203–226). Cambridge, MA: MIT Press.

Schooler, J. W., Smallwood, J., Christoff, K., Handy, T. C., Reichle, E. D., & Sayette, M. A. (2011). Meta-awareness, perceptual decoupling and the wandering mind. *Trends in Cognitive Sciences, 15,* 319–326.

Seibert, P. S., & Ellis, H. C. (1991). Irrelevant emotional mood states and cognitive performance. *Memory & Cognition, 5,* 507–513. doi:10.3758/BF03199574

Smallwood, J., Baracaia, S. F., Lowe, M., & Obonsawin, M. (2003). Task unrelated though whilst encoding information. *Consciousness and Cognition, 12,* 452–484. doi:10.1016/S1053-8100(03)00018-7

Smallwood, J., Beach, E., Schooler, J. W., & Handy, T. C. (2008). Going

AWOL in the brain: Mind wandering reduces cortical analysis of external events. *Journal of Cognitive Neuroscience, 20,* 458–469. doi: 10.1162/jocn.2008.20037

Smallwood, J., Davies, J. B., Heim, D., Finnigan, F., Sudberry, M., O'Connor, R., & Obonsawin, M. (2004). Subjective experience and the attentional lapse: Task engagement and disengagement during sustained attention. *Consciousness and Cognition, 13,* 657–690. doi:10.1016/j.concog.2004.06.003

Smallwood, J., Fishman, D. J., & Schooler, J. W. (2007). Counting the cost of an absent mind: Mind wandering as an underrecognized influence on educational performance. *Psychonomic Bulletin & Review, 14,* 230–236. doi:10.3758/BF03194057

Smallwood, J., Fitzgerald, A., Miles, L. K., & Phillips, L. H. (2009). Shifting moods, wandering minds: Negative moods lead the mind to wander. *Emotion, 9,* 271–276. doi:10.1037/a0014855

Smallwood, J., McSpadden, M., Luus, B., & Schooler, J. (2008). Segmenting the stream of consciousness: The psychological correlates of temporal structures in the time series data of a continuous performance task. *Brain and Cognition, 66,* 50–56. doi:10.1016/j.bandc.2007.05.004

Smallwood, J., O'Connor, R. C., & Heim, D. (2005). Rumination, dysphoria, and subjective experience. *Imagination, Cognition and Personality, 24,* 355–367.

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin. 132,* 946–958. doi:10.1037/0033-2909.132.6.946

Smallwood, J. (2010). Why the global availability of mind wandering necessitates resource competition: Reply to McVay and Kane (2010). *Psychological Bulletin, 136,* 2, 202.

Tang, Y. Y., Fan, Y., Feng, H., Wang, J., Feng, S., Lu, Q., . . . Fan, M. (2009). Central and autonomic system interaction is altered by short term meditation. *Proceedings of the National Academy of Sciences, USA, 106,* 8865–8870. doi:10.1073/pnas.0904031106

Tang, Y. Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., . . . Posner, M. I. (2007). Short-term meditation training improves attention and self-regulation. *Proceedings of the National Academy of Sciences, USA, 104,* 17152. doi:10.1073/pnas.0707678104

Wallace, B. A., & Shapiro, S. (2006). Mental balance and well being: Building bridges between Buddhism and western psychology, *American Psychologist, 61,* 690–701. doi:10.1037/0003-066X.61.7.690

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54,* 1063–1070. doi:10.1037/0022-3514.54.6.1063

Way, B. M., Creswell, J. D., Eisenberger, N. I., & Lieberman, M. D. (2010). Dispositional mindfulness and depressive symptomatology: Correlations with limbic and self-referential neural activity during rest. *Emotion, 10,* 12–24. doi:10.1037/a0018312

Wong, L. M., Vugt, M. K., Smallwood, J. S., Carpenter-Cohn, J., Baime, M., & Jha, A. P. (2008, April). Mindfulness training reduces mind wandering during a sustained attention task. Poster session presented at the meeting of the Cognitive Neuroscience Society, San Francisco, CA.

Zeidan, F., Johnson, S. K., Diamond, B. J., David, Z., & Goolkasian, P. (2010). Mindfulnes training improves cognition: Evidence of brief mental training. *Consciousness and Cognition, 19,* 597–605.

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