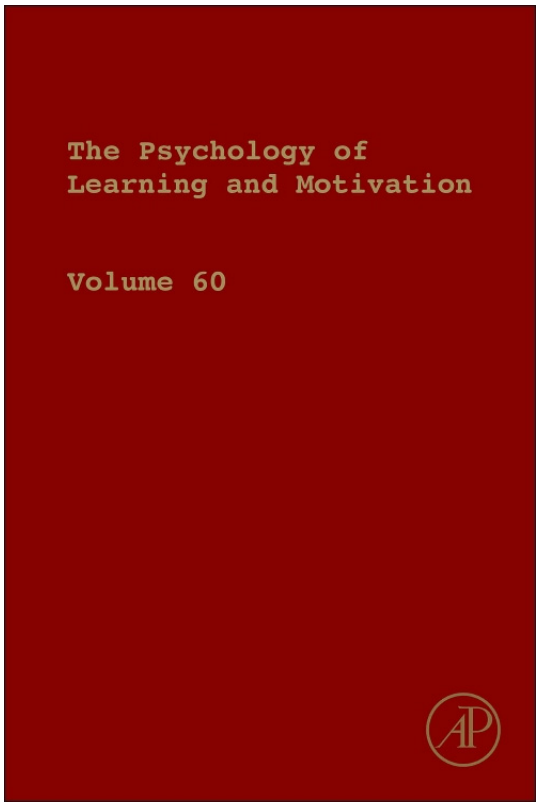

From: Jonathan W. Schooler, Michael D. Mrazek, Michael S. Franklin, Benjamin Baird, Benjamin W. Mooneyham, Claire Zedelius, James M. Broadway, The Middle Way: Finding the Balance between Mindfulness and Mind-Wandering.
In Brian H. Ross editor: *The Psychology of Learning and Motivation,* Vol. 60, Burlington: Academic Press, 2014, pp. 1-33.
ISBN: 978-0-12-800090-8

CHAPTER ONE

The Middle Way: Finding the Balance between Mindfulness and Mind-Wandering

Jonathan W. Schooler[1], Michael D. Mrazek, Michael S. Franklin, Benjamin Baird, Benjamin W. Mooneyham, Claire Zedelius, James M. Broadway

Department of Psychological and Brain Sciences, University of California, Santa Barbara, California, USA
[1]Corresponding author: e-mail address: schooler@psych.ucsb.edu

Contents

Abstract

Mind-wandering is a common everyday experience in which attention becomes disengaged from the immediate external environment and focused on internal trains of thought. This chapter reviews progress in the study of mind-wandering and its manifold effects on cognition and affect. After summarizing key recent advances in the study of mind-wandering, we focus on three fundamentally practical questions: (1) What are the costs of mind-wandering for cognition and affect? (2) Is it possible to reduce

Psychology of Learning and Motivation, Volume 60
ISSN 0079-7421
http://dx.doi.org/10.1016/B978-0-12-800090-8.00001-9

mind-wandering with practices aimed at enhancing mindfulness? (3) What are some possible benefits of mind-wandering that may help to mitigate its costs? This chapter leads to the endorsement of a "middle way" approach to mind-wandering: though it may be useful to cultivate practices for overcoming some of mind-wandering's more disruptive consequences, we should not seek to eliminate it entirely, as it can offer some unique benefits when carried out at the appropriate times.

1. INTRODUCTION

Consciousness not only flows like a stream (James, 1890/1950), continuously moving with ever-changing content, but also ebbs like a breaking wave, outwardly expanding and then inwardly retreating. This perennial rhythm of the mind—extracting information from the external world, withdrawing to inner musings, and then returning to the outer realm—defines mental life. But how optimal is this continuous oscillation between outward attention and inward reflection? After all, it can be most inconvenient when the current of internal distraction redirects the flow of consciousness away from the demands of the moment.

"The mind seems to have a mind of its own" observed Associate Professor of Religious Studies Mark Meusse (2011) during a recent lecture on mindfulness. Indeed, even those who have not attempted the challenge of staying present-focused during meditation are likely familiar with the related experience of trying to maintain undivided attention on a book or a lecture. Despite our best efforts to maintain focus, all too often, the mind meanders off to topics of its own choosing. The mind's incessant propensity to wander is an age-old lamentation. As the Buddha observed several millennia ago, "Let the wise guard their thoughts, which are difficult to perceive, extremely subtle, and wander at will" (as quoted in Easwaran, 2008, p. 459). More recently, though still over a century ago, William James similarly acknowledged the challenge of keeping the mind from straying, observing that "the essential achievement of the will… is to attend to a difficult object and hold it fast before the mind" (James, 1890/1950, p. 266).

Although the challenge of mind-wandering has been recognized for millennia, it has only recently become subject to concerted scientific scrutiny. Indeed, a search of the scholarly literature reveals that in the years 2000 to the present (2013) there have been 355 peer-reviewed articles that include the term "mind-wandering" in either the title or abstract, compared to 25 in all the years 1920 - 1999. For sure, there were a handful of forward-thinking

researchers such as Giambra (1995), Singer and Antrobus (1972), Klinger (1999), and Teasdale and colleagues (1995), who conducted pioneering research on the topic of mind-wandering. However, mind-wandering has only recently become a mainstream topic of investigation, a trend fostered by a growing appreciation of the ubiquity of the phenomenon and acceptance of the validity of self-report methods for sampling the stream of consciousness.

So what have we learned about mind-wandering in the past decade? In fact, quite a bit, much of it is recently reviewed elsewhere (e.g., Mooneyham & Schooler, 2013; Schooler et al., 2011; Smallwood, 2013). Briefly, key advances in knowledge include the following. Although mind-wandering may have been historically overlooked by many mainstream researchers out of concern that it would be too difficult to study, numerous investigations have validated self-reports of mind-wandering, demonstrating that they reliably predict a host of changes in (a) *behavioral markers* such as gaze duration (Reichle, Reineberg, & Schooler, 2010), reaction time (Cheyne, Solman, Carriere, & Smilek, 2009), and performance errors (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013; Smallwood et al., 2004); (b) *physiological measures* such as pupil dilation (Smallwood et al., 2011) and heart rate (Smallwood et al., 2004); and (c) *brain activity* as measured by functional magnetic resonance imaging (fMRI; Christoff, Gordon, Smallwood, Smith, & Schooler, 2009; Gilbert et al., 2006; Mason et al., 2007), electroencephalogram (EEG; Braboszcz & Delorme, 2011), and event-related potential (ERP; Kam et al., 2011; Smallwood, Beach, Schooler, & Handy, 2008) techniques.

Mind-wandering has proven to be a remarkably ubiquitous phenomenon, with experience-sampling studies suggesting that our minds are disengaged from the goings-on around us between 25% (Kane, Brown, et al., 2007) and 50% (Killingsworth & Gilbert, 2010) of our waking hours. When individuals mind-wander, they become "perceptually decoupled," showing reduced responsiveness to external stimuli (Smallwood, 2013; Smallwood, Beach, Schooler, et al., 2008; Smallwood, McSpadden, Luus, & Schooler, 2008; Smallwood, et al., 2008). Although external processing is curtailed, mind-wandering is associated with rich internal activity that often entails contemplating future goals (Smallwood & Schooler, 2006) and/or thinking about the self (Schooler, Reichle, & Halpern, 2004). Not surprisingly, neurocognitive activity associated with mind-wandering closely maps onto these behavioral findings, with evidence of depressed sensory processing (Kam et al., 2011; Smallwood, Beach, Schooler, et al., 2008; Smallwood,

McSpadden, Luus, et al., 2008; Smallwood et al., 2008) and increased activation of regions associated with both internal self-reflection and prospective planning (Christoff et al., 2009).

At present, the scientific study of mind-wandering is enlivened by various theoretical debates regarding the specific cognitive processes involved (e.g., Franklin, Mrazek, Broadway, & Schooler, 2013; McVay & Kane, 2010a, 2010b; Smallwood, 2010, 2013) and how various neurocognitive activities interact when individuals are mind-wandering versus on-task (Christoff et al., 2009; Gilbert et al., 2006; Mason et al., 2007; Smallwood, 2013). However, in this chapter, we will instead focus on three fundamentally pragmatic questions about mind-wandering, which have important implications for a person's quality of life, namely: 1) What are the costs to human performance of the fact that our minds routinely drift away from the tasks they are supposed to be attending to? (2) How might we remedy these costs, for example, through mindfulness training? (3) Are there any potential benefits of mind-wandering that may compensate for some of its costs? Collectively, we hope that consideration of these questions will help to elucidate the more general problem of finding a balance between the seemingly contradictory goals of being attentive to what we are doing in the here and now while also allowing our minds the freedom to wander where they like. By acknowledging the possibility that there are some benefits associated with mind-wandering, as well as considering its costs, we hope to articulate our lab's relatively unique "middle way" perspective on mind-wandering.

2. WHAT ARE THE COSTS OF MIND-WANDERING?

During mind-wandering, cognitive resources become occupied by internal activity unrelated to the external environment. Given this mental state, it is little surprise that mind-wandering can significantly interfere with the individuals' primary task performance. What is perhaps more surprising is the magnitude of the disruption that mind-wandering can produce, and the ubiquity of its impact. In this section, we consider several domains in which disruptive effects of mind-wandering have been extensively studied, including reading, vigilance, and mood. We then explore the more general thesis that the capacity to control mind-wandering may represent a core cognitive skill that contributes to one's general intellectual aptitude.

2.1. Costs for Reading

The disruptive effects of mind-wandering on reading have been thoroughly explored in recent years (Franklin, Smallwood, & Schooler, 2011; Reichle et al., 2010; Schooler et al., 2004; Smallwood, 2011; Smallwood et al., 2008). In typical examinations of the effect of mind-wandering on reading, participants are given text to read while they are periodically asked to report whether they are mind-wandering or reading attentively. Mind-wandering is routinely found to be associated with poor comprehension (Schooler et al., 2004; Smallwood, McSpadden, Luus, et al., 2008; Smallwood et al., 2008).

One reason that mind-wandering harms reading comprehension is that mind-wandering is associated with superficial perceptual encoding (Franklin et al., 2011; Franklin et al., 2013; Franklin, Mooneyham, Baird, & Schooler, 2013; Reichle et al., 2010; Smilek et al., 2010). For example, Reichle and colleagues (2010) found that the typically strong relationship between the lexical properties of words (such as length or frequency) and the amount of time that participants take to process them visually is attenuated during periods of mind-wandering. In their experiment, participants read *Sense and Sensibility* by Jane Austen, presented page by page on a computer screen while eye movements were measured. When participants were on-task, gaze durations were sensitive to the lexical properties of the text in typical ways (e.g., gaze durations were longer for less frequent words; Rayner, 1998). However, this sensitivity was significantly diminished when participants were mind-wandering. A similar effect has been found for reaction times in word-by-word reading paradigms, in which participants must press a key to advance the text (providing a surrogate measure of viewing times). Moreover, Franklin and colleagues (2011) used such reduced coupling between reaction times/viewing times and the lexical properties of words to accurately predict whether participants would subsequently report to be mind-wandering while reading. Furthermore, mind-wandering episodes inferred from reaction times in this manner were strongly associated with diminished comprehension of the textual material, providing further support for the relationship between mind-wandering and superficial encoding of written material.

Interestingly, in addition to its effects on semantic processing in the visual modality, mind-wandering can also influence how individuals speak while reading out loud. Recently, Franklin, Mooneyham, et al. (2013) recorded

vocal output while participants read a text passage aloud. Participants were periodically asked to report whether they were mind-wandering. The results showed that participants spoke with higher volume overall and with less variable intonation when they were mind-wandering compared to when they were reading attentively. This reduced variability in speech prosody parallels the reduced sensitivity to written material during mind-wandering.

Mind-wandering has been shown not only to produce deficits in immediate comprehension (e.g., causing an individual to incorrectly answer a fact-based question about information presented just prior) but—perhaps more significantly—also to produce deficits at more complex levels of reading comprehension, such as recognizing meaning and creating models of situations and narratives. For example, one study examined participants' ability to detect whenever the text (a narrative about two boys attending a circus) periodically turned to gibberish (experimentally manipulated by reordering nouns within sentences so that the story no longer made sense). Failures to detect instances of gibberish were associated with mind-wandering, implying participants' ability to recognize meaning was impaired at higher levels (such as the sentence-level) of comprehension (Schooler, Zedelius, Franklin, McSpadden, Reichle, & Smallwood (in preparation)).

Another investigation demonstrates the effects of mind-wandering on situational model building over the course of comprehending a prolonged narrative, in which some critical information is merely suggested, as in a detective story. Smallwood, McSpadden, Luus, et al. (2008; also Smallwood et al., 2008) had participants read a Sherlock Holmes story (*The Red-Headed League* by Sir Arthur Conan Doyle). Mind-wandering was associated with an inability to correctly identify the villain in the story over and above its negative impact on subsequent memory for text-based facts. This implies that mind-wandering interfered with constructing the correct situational model of the narrative. Thus, mind-wandering appears to be associated with costs for reading comprehension at multiple levels of the processing hierarchy, from the most basic to the most complex.

In sum, it is clear that mind-wandering while reading comes at a cost. As our chapter has shown, mind-wandering while reading leads to item-specific comprehension deficits and model-building deficits and is associated with a reduced coupling between ocular, manual, and vocal responses and their lexical-semantic determinants. Unfortunately, such disengagement from the external environment as is observed in reading tasks also occurs in many other performance settings, with costs for a range of important

functions including sustaining attention and inhibiting inappropriate responses, regulating mood and affect, and using working memory and other general aptitudes. We address these costs next in turn.

2.2. Costs for Sustained Attention

The sustained attention to response task (SART; Manly, Robertson, Galloway, & Hawkins, 1999) is a go/no-go vigilance task that is commonly used to behaviorally index mind-wandering. In this task, visual stimuli (e.g., digits) are presented sequentially on a computer monitor and participants are required to withhold responses to a rare target stimulus (e.g., the digit "3") while responding as quickly as possible to all nontarget stimuli (e.g., all other digits). Mind-wandering effects on SART performance are routinely observed in distinct behavioral measures such as errors of commission (failures to withhold a response to the target), errors of omission (failures to respond to a nontarget), reaction times (RTs) and their variability (usually the coefficient of variation (CV), which is the standard deviation of RTs divided by their mean), and anticipations (in which RTs are too fast to plausibly reflect complete sensory analysis of the nontarget stimulus, sometimes occurring even before the nontarget stimulus has appeared). These performance measures derived from the SART are so robustly correlated with self-reported measures of mind-wandering that they are frequently used as indirect markers of mind-wandering, as an equivalent substitute for self-report experience-sampling procedures. Importantly, these distinct SART measures have been used to support theoretical differentiation of the potentially monolithic construct of mind-wandering: For example, it has been proposed that commission errors reflect a pronounced state of task disengagement while increased RT variability reflects a lesser degree of disengagement (Cheyne et al., 2009; Mrazek, Smallwood & Schooler, 2012; Smallwood et al., 2004). Thus, there is much evidence that mind-wandering brings costs for the ability to sustain attention, in ways that range from subtle to gross.

2.3. Costs for Mood and Affect

The effects of mind-wandering not only are limited to cognitive performance but also are associated with negative changes in mood and affect. Recent evidence suggests that individuals are generally less happy when they are mind-wandering than when they are not. Inducing negative mood increases mind-wandering (Smallwood, Nind, & O'Connor, 2009). Moreover, a large online experience-sampling study by Killingsworth and Gilbert

(2010) has verified the generality of the relationship between negative mood and mind-wandering. Using a web-based cell phone application, Killingsworth and Gilbert administered probes to individuals at random times as they went about their daily lives. An important finding was that people reported being less happy when mind-wandering. Strikingly, mind-wandering accounted for more than twice as much variance in happiness ratings as did the actual nature of people's activities at the time of questioning. Moreover, time lag analyses suggested that mind-wandering preceded negative mood and not the other way around. Altogether, Killingworth and Gilbert's findings show that mind-wandering imposes significant costs for individuals as it is often accompanied by negative mood and affect. However, this relationship can be perhaps qualified when the content of mind-wandering is also considered: notably, Killingworth and Gilbert reported no difference in happiness ratings associated with on-task thoughts versus mind-wandering about pleasant topics (a point that we will pursue in a later section when we consider potential benefits of mind-wandering).

2.4. Costs for Working Memory and General Aptitude

The fact that mind-wandering is associated with a host of cognitive and affective detriments suggests that it may represent a pervasive cognitive liability associated with general intellectual aptitude. Consistent with this hypothesis, recent work from our lab (Mrazek et al., 2012) shows that mind-wandering contributes to the strong relationship between working memory capacity (WMC) and general fluid intelligence (gF) (Conway, Cowan, Bunting, Therriault, & Minkoff, 2002; Engle, Tuholski, Laughlin, & Conway, 1999). We conducted four studies to determine whether mind-wandering is associated with worse performance on measures of general aptitude, such as standard measures of WMC and gF (Mrazek et al., 2012).

In the first study, we measured mind-wandering during three widely used WMC tasks, the operation span (OSPAN), reading span (RSPAN), and symmetry span (SSPAN; for details on all three tasks, see Redick et al., 2012; Unsworth, Redick, Heitz, Broadway, & Engle, 2009). These so-called "complex span" tasks require individuals to remember lists of items in order, which are each presented in between trials of an irrelevant but demanding mental task (e.g., verifying simple arithmetic equations). As such, complex span tasks can be characterized as measuring the ability to maintain information in the face of interference (Engle et al., 1999).

Thought sampling probes were presented during each span task to assess mind-wandering. As hypothesized, mind-wandering during testing was associated with lower WMC span scores.

A second study examined the trial-by-trial co-occurrence of mind-wandering and impaired WMC performance, establishing the relationship between mind-wandering and WMC within a given individual's performance. Participants completed an extended version of the OSPAN with thought-sampling probes. Trial-by-trial analyses showed that mind-wandering on a given trial was indeed associated with worse performance on that trial. This relationship held regardless of the difficulty (list-length) of a given trial, reducing the force of one potential explanation, which suggested that mind-wandering and WMC correlate negatively because participants who have more difficulty with the span task fail to remain engaged. But counter to this argument, we found that performing poorly on a given trial of the span task was associated with *less* mind-wandering on the subsequent trial, not more. Our third study showed that the effect of financial incentives on complex span performance (Heitz, Schrock, Payne, & Engle, 2008) could be mediated by a reduction in mind-wandering. Together, these results provide converging support that mind-wandering disrupts WMC test performance.

Finally, in a fourth study, we broadened the scope of our investigation to include additional measures of general aptitude: SAT scores and a latent variable capturing the shared variance between multiple measures of general aptitude. We embedded thought sampling into both the OSPAN and Raven's Progressive Matrices (RPM), a culture-fair measure of abstract reasoning (Raven, 1938). Following these tasks, participants logged into the website of the university registrar's office to report the SAT scores they had submitted when applying for admission. As expected, WMC and gF were positively correlated with each other and negatively correlated with mind-wandering. Furthermore, more mind-wandering during the cognitive tests was associated with lower SAT scores. Structural equation modeling was used to examine relationships between mind-wandering and general aptitude at the level of latent variables. As illustrated in Fig. 1.1, we built a model with two latent variables. The *mind-wandering* latent variable consisted of the mind-wandering scores during the OSPAN and RPM. The *general aptitude* latent variable consisted of WMC, gF, and SAT scores. Each of the indicators loaded significantly on their respective constructs. At the latent-variable level, *mind-wandering* predicted 49% of the variance in *general aptitude*.

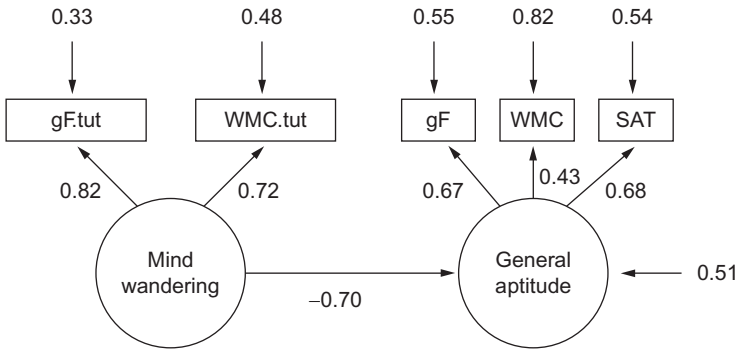

Figure 1.1 Structural equation modeling for general aptitude and mind-wandering during testing. $N = 120$. The path connecting the two latent variables (circles) reflects the association between the constructs. The numbers from the latent variables to the manifest variables (rectangles) indicate the loadings of each measure onto the latent variable. All error terms represent unexplained variance ($1 - R^2$). gF.tut, task-unrelated thought during Raven's Progressive Matrices; WMC.tut, task-unrelated thought during OSPAN; gF, fluid intelligence assessed by Raven's Progressive Matrices; WMC, working memory capacity assessed by OSPAN; SAT, Scholastic Aptitude Test scores. *Reprinted with permission from the American Psychological Association. Mrazek et al. (2012).*

To summarize, the research described here demonstrates covariation between mind-wandering and cognitive test performance, both between and within individuals, shows that mind-wandering precedes poor performance rather than vice versa, ruling out one alternative explanation proposing that mind-wandering is a consequence rather than a cause of poor performance. These studies converge to support the proposal that mind-wandering is a general feature of human cognitive architecture and thus a core dimension of general intellectual aptitude. It may be also the case that a substantial proportion of what makes tests of general aptitude sufficiently general is that they create a demanding task context in which mind-wandering is highly disruptive.

General aptitude has traditionally been regarded as unchangeable. However, recent evidence indicates that intensive training on working memory tasks can enhance information-processing capacity in a way that generalizes to improved performance on tests of gF (Jaeggi, Buschkuehl, Jonides, & Perrig, 2008). Similarly, the implications of our investigations of mind-wandering in relation to general aptitude suggest that performance on tests of general aptitude might be improved by mental training aimed at reducing mind-wandering during cognitive testing. Remarkably, until recently, relatively little progress has been made in establishing empirically validated

strategies to reduce the costs of mind-wandering. One approach that is currently showing great promise is an age-old meditative tradition known as practicing *mindfulness*. We turn to this important topic next.

3. MINDFULNESS: AN ANTIDOTE FOR MIND-WANDERING?

Although there is ongoing disagreement as to the most privileged and useful definition of mindfulness (Grossman & Van Dam, 2011), there is nevertheless consensus from meditative traditions that sustained attentiveness represents a fundamental element. Accordingly, we anticipated that mindfulness training might hold potential for reducing mind-wandering given the apparent opposition between the two constructs. The ability to remain mindfully focused on a task appears to be in direct opposition to the tendency for attention to wander to task-unrelated thoughts. Moreover, there is substantial empirical support for this intuitive notion. Existing work linking mindfulness and mind-wandering has relied heavily on the mindful awareness attention scale (MAAS; Brown & Ryan, 2003), a measure of dispositional mindfulness. The MAAS addresses the extent to which an individual attends to present experience without distraction (e.g., I find myself listening to someone with one ear, doing something else at the same time; reverse-scored). Notably, low trait mindfulness as measured by the MAAS is associated with fast and error-prone responding in the SART (Cheyne, Carriere, & Smilek, 2006; Cheyne et al., 2009).

We recently conducted a comprehensive investigation into the relationship between the MAAS and several different measures of mind-wandering (Mrazek et al., 2012). All participants completed the MAAS, a mindful-breathing task with thought-sampling probes, the SART, and a self-report measure of trait daydreaming that has been widely used to study mind-wandering (Mason et al., 2007). We found that individuals who reported high levels of mindfulness during daily life also reported less daydreaming. Furthermore, high levels of trait mindfulness were also associated with less mind-wandering assessed by the number of task-unrelated thoughts (TUTs) during the mindful-breathing task and fewer errors of commission and lower RT variability during the SART. These results provide converging evidence suggesting that mindfulness and mind-wandering are indeed opposing constructs.

If mindfulness and mind-wandering are inversely related, it follows that mind-wandering and its disruptive effects on task performance should be

reduced by interventions that increase mindfulness. While mindfulness training has been demonstrated to improve executive attention, perceptual sensitivity, and sustained attention (MacLean et al., 2010; Tang et al., 2007), the direct impact of mindfulness training on mind-wandering has been less well examined. The benefits of mindfulness training are well documented (for a review, see Brown, Ryan, & Creswell, 2007). Many prior studies have used intensive meditation training, lasting months or years. However, such long-term interventions requiring special retreat facilities are of limited practicality for many social and educational contexts where mindfulness could be of great benefit (Brefczynski-Lewis, Lutz, Schaefer, Levinson, & Davidson, 2007; MacLean et al., 2010). Therefore, we recently examined whether a *brief* mindfulness exercise can reduce mind-wandering (Mrazek, Smallwood, & Schooler, 2012).

Participants were assigned to conditions in which they completed either 8 min of mindful-breathing or one of two control conditions: 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 effects of relaxation on attention. In the mindful-breathing condition, participants were instructed to sit in an upright position while focusing their attention on the sensations of their breath without trying to control the rate of respiration. Participants were asked to return their attention to the breath anytime they became distracted. Participants in the reading condition were asked to browse a popular local newspaper, while those in the passive rest condition were asked to relax without falling asleep. Subsequently, all participants performed the SART. Relative to the two control conditions, those who did mindful-breathing exhibited enhanced performance as measured by behavioral markers of inattention commonly associated with mind-wandering (fewer errors of commission and lower RT variability). The effectiveness of this simple and brief intervention suggests that mind-wandering can be reduced by basic mindfulness training, even without a long-term commitment.

We next examined whether the reduction in mind-wandering due to mindfulness training would generalize to improvements in core processes like WMC and reading comprehension. In a randomized controlled investigation with undergraduate students, we examined whether a 2-week mindfulness training course would be more effective than a comparably demanding nutrition program in decreasing mind-wandering and improving cognitive performance (Mrazek et al., 2013). The mindfulness program emphasized the physical posture and mental strategies of focused-attention

meditation (Lutz, Slagter, Dunne, & Davidson, 2008). Furthermore, the course required participants to integrate mindfulness into their daily activities by completing 10 min of daily meditation outside of class. Each class included 10–20 min of mindfulness exercises requiring focused attention to some aspect of sensory experience (e.g., sensations of breathing, tastes of a piece of fruit, or sounds of an audio recording). Class content was designed to provide a clear set of strategies and a conceptual understanding of how to practice mindfulness. As illustrated in Fig. 1.2, we found that mindfulness training improved performance on both the measure of WMC and the test of reading comprehension (adapted from the Graduate Record Examination). Mindfulness training also reduced mind-wandering during these tasks as assessed by concurrent and retrospective measures. Critically, improvements in WMC and GRE scores following mindfulness training were statistically mediated by reduced mind-wandering and were so specifically for those individuals who were most prone to distraction at pretesting. This suggests that mindfulness-based interventions do not only benefit individuals who are already proficient at attentional control.

More generally, however, these results speak to the malleability of general aptitude. The goal of training studies is often to demonstrate a transfer of improvement beyond the trained task to an unpracticed task measuring the same ability, thereby ruling out explanations based on task-specific learning or strategies (Klingberg, 2010). Likewise, our results show the desired "far transfer" effects: cognitive enhancements associated with mindfulness training not attributable to overlap between training and testing contexts. In sum, our results suggest that training to enhance attentional focus may be a key to enhancing cognitive skills that were until recently viewed as immutable. Thus, there are good reasons to be optimistic about mind-wandering: it indeed appears that many of its documented costs for perception, cognition, and action can be remedied by applying an age-old antidote known as mindfulness.

3.1. Clinical Applications: Mind-Wandering, Meta-Awareness, and ADHD

We have shown in this chapter that mind-wandering is a major cognitive challenge that can disrupt performance across a broad range of activities and that mindfulness may help to serve as a partial antidote for it. Our observations imply, first, that individuals who are particularly troubled by mind-wandering may experience the impact of this deficit throughout their daily lives and, second, that some of these individuals might spontaneously learn to engage in mindfulness-like strategies in order to gain better cognitive control. We

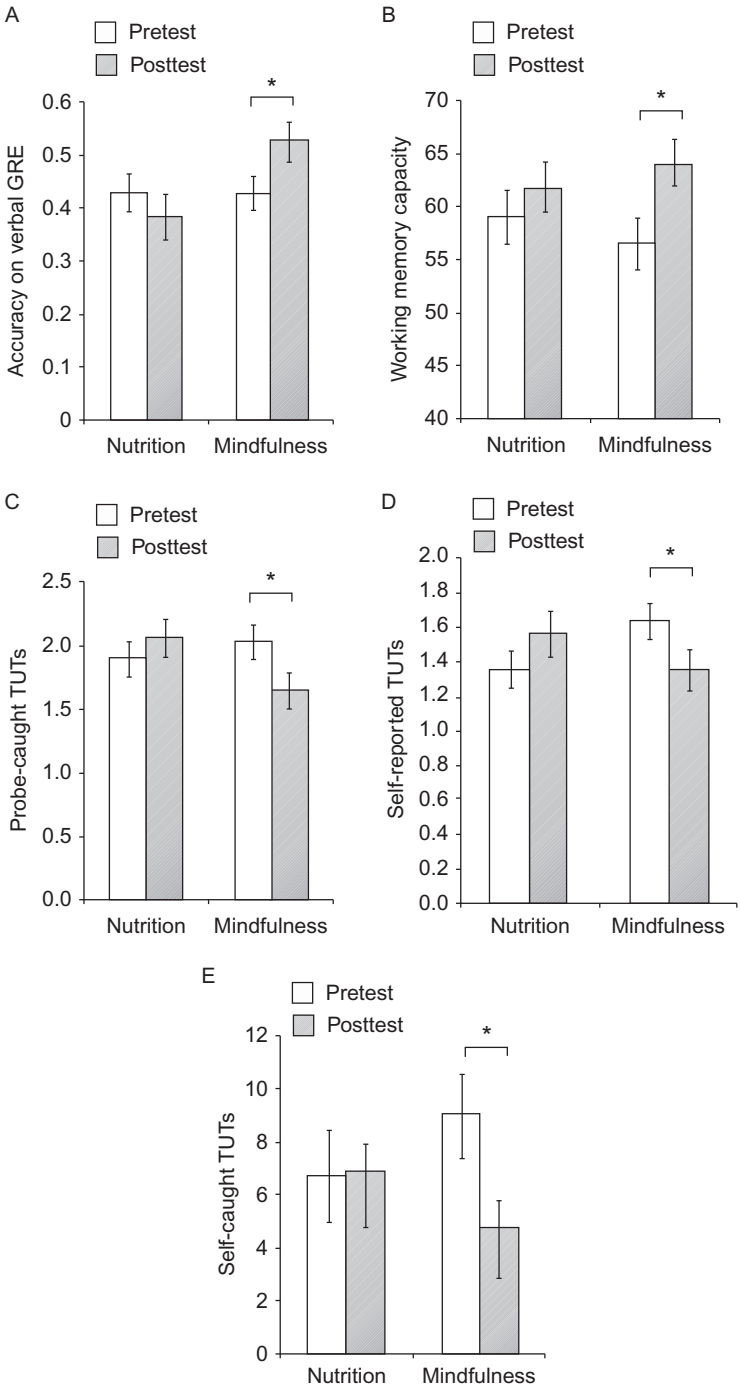

Figure 1.2 Results of mindfulness training intervention. The graphs show results for each of the following study variables as a function of condition and testing session: accuracy (proportion of correct responses) on the GRE (A), working memory capacity (WMC; B), probe-caught task-unrelated thoughts (TUTs; C), retrospectively self-reported TUTs during performance of the WMC measure (D), and self-caught TUTs during performance of the GRE (E). Error bars represent standard errors of the mean.$^{*}p < .05$. *Reprinted with permission from SAGE Publications. Mrazek et al. (2013).*

(Franklin et al., in preparation) explored these issues within a population that is especially prone to mind-wandering: individuals who suffer symptoms associated with attention-deficit/hyperactivity disorder (ADHD).

ADHD is characterized by inattention, hyperactivity, and impulsivity and has been shown to be associated with increased incidence of mind-wandering. Shaw and Giambra (1993) compared the number of off-task thoughts for college students with a prior diagnosis of ADHD to those without a prior diagnosis of ADHD but who scored high on self-report measures suggesting ADHD symptoms and to those without a diagnosis of ADHD but who scored low on such measures. While engaging in a simple sustained attention task, participants were occasionally asked whether they were mind-wandering and whether such episodes of mind-wandering were deliberate or unintended. It was found that those students with a history of ADHD had more reports of mind-wandering than students in either of the control conditions, and critically, these differences were predominantly due to unintended TUTs.

Given the previously reviewed evidence for deficits in task performance following mind-wandering and the apparent susceptibility of adults with ADHD to mind-wandering, it seems plausible that mind-wandering is an important yet underrecognized source of difficulty in the everyday lives of individuals with ADHD symptoms (Johnston & Johnston, 2002). Furthermore, given the beneficial effects that mindfulness training has shown in ameliorating the disruptive effects of mind-wandering, we speculated that those individuals with ADHD symptoms who have developed strategies for mentally noting their mind-wandering episodes (known as "meta-awareness," Schooler, 2002; Smallwood & Schooler, 2006) might show reduced negative effects. In other words, it may be that individuals who have learned through experience that their minds regularly wander could acquire a strategy of "checking in" to make sure that their minds remain on task. Such compensatory strategies could in principle help to ameliorate the negative effects of attentional deficits that might otherwise be detrimental. The existence of such strategies may also help to explain reductions in adult ADHD symptoms that result from cognitive behavioral therapy (Murphy, 2005; Safren et al., 2005), which encourages patients to focus on the contents of their thought.

In order to explore these issues, we (Franklin et al., in preparation) examined the relationship between mind-wandering, meta-awareness, and ADHD symptomatology in college students both in the laboratory and in the field. In the laboratory phase, we investigated the relationship between

mind-wandering and ADHD with a variety of tasks and scales, in order to measure (1) mind-wandering, (2) ADHD symptoms, (3) executive functioning, (4) creativity, and (5) mood. In the field phase, we employed experience-sampling methodology that required individuals to carry a personal data assistant (PDA) for a week that periodically prompted them with questions about their current experience, whether they were mind-wandering, and if they were, the degree to which the mind-wandering was disrupting their ongoing activities. In both the laboratory and field aspects of this investigation, after individuals were probed regarding whether or not they were mind-wandering, they were further asked to indicate whether they had explicitly noticed that they were mind-wandering prior to the probe. This assessment provided us with a measure of participants' meta-awareness of their mind-wandering (for similar applications of retrospective assessments of meta-awareness of mind-wandering, see Christoff et al., 2009; Smallwood, Beach, Schooler, et al., 2008; Smallwood, McSpadden, Luus, et al., 2008; Smallwood et al., 2008).

Overall, the results revealed a significant positive correlation between the ADHD scale measures and reports of mind-wandering during laboratory tasks and in daily life. The ADHD scales also correlated positively with the mind-wandering scales, SART commission errors, reports of detrimental mind-wandering during daily life, the proportion of missed PDA probes (i.e., those not responded to), and the PANAS negative score. Awareness of mind-wandering was negatively correlated with the ADHD scale measures. These findings reinforce the notion that ADHD symptoms are related to mind-wandering both during laboratory tasks and in daily life.

To follow up on the finding that participants that scored higher on the ADHD scales reported more detrimental effects of mind-wandering in daily life, we used a mediational analysis to investigate the possible role of awareness of mind-wandering in overcoming negative consequences of ADHD symptoms. The results revealed that meta-awareness partially mediated the relationship between ADHD symptoms and detrimental effects of mind-wandering. This suggests that the detrimental effects of ADHD can be attributed to the lack of awareness of distraction in addition to the simple presence of distraction. Meta-awareness of mind-wandering may enable self-regulatory processes to repair negative outcomes. If future research confirms this discovery, it may even be possible to alleviate some of the negative consequences of ADHD by encouraging people to become more meta-aware of their mind-wandering, perhaps through mindfulness training. Again, there are reasons to be optimistic about the consequences of

mind-wandering, to the extent that our research suggests that its detrimental effects may be remediated through meta-awareness and mindfulness.

4. BENEFITS OF MIND-WANDERING

As portrayed in our chapter so far, research into mind-wandering has tended to emphasize its costs. Mind-wandering is associated with a host of negative consequences including disruptions of performance across a broad range of domains, reduced mood, impaired general intellectual functioning, and disruptions in everyday life experiences. So the question naturally arises: If mind-wandering is such a disruptive activity, why do we do it so often? Might there be beneficial aspects of mind-wandering that may help to compensate for some of its disruptive consequences? We turn to this question next, considering several domains in which mind-wandering may be functional including planning for the future, creativity, and positive stimulation by interesting thoughts.

4.1. Mind-Wandering Promotes Planning for the Future

A large proportion of the thoughts that occur during mind-wandering episodes are prospective in nature (Baird, Smallwood, & Schooler, 2011; D'Argembeau, Renaud, & Van der Linden, 2011; Smallwood et al., 2009), especially in cases where task demands are sufficiently lax to permit substantial attentional resources to be directed toward an irrelevant train of thought (Baird et al., 2011; Smallwood et al., 2009). The future-directed orientation of mind-wandering, combined with the fact that spontaneous thoughts are often closely coupled with individuals' current concerns (Klinger, 1999; McVay & Kane, 2010a,2010b; Smallwood et al., 2004), suggests that one possible function of mind-wandering lies in the anticipation and planning of personally relevant future goals, otherwise known as autobiographical planning.

Mind-wandering concurrently with a task clearly produces deficits in performance, but this cost could be partly offset by the benefits gained through prospective planning and mental simulation of future events. For while mind-wandering occurs in a damaging fashion for many types of tasks, it occurs most during tasks that impose lesser attentional and working memory demands (McVay & Kane, 2010a, 2010b; Teasdale, Lloyd, Proctor, & Baddeley, 1993). This fact suggests that while we may not be entirely able to choose when and where to let our minds wander, we may be most prone to mind-wander in situations in which the nominal task is easy enough to allow

cognitive resources to be diverted toward a potentially beneficial mind-wandering state.

In a recent study (Baird et al., 2011), we took advantage of the prevalence of mind-wandering episodes during a task that places relatively few demands on cognitive resources (a choice reaction time (CRT) task; Smallwood et al., 2009) and examined the temporal focus (i.e., past-, present-, or future-oriented) and cognitive orientation (i.e., self-related or goal-directed) of participants' thoughts during the task. Several findings from this study suggest that mind-wandering may function to help individuals plan for the future. First, participants' thoughts while mind-wandering were predominately future-oriented, confirming again that people tend to think prospectively while mind-wandering. Second, when mind-wandering thoughts were self-related, they were most frequently future-oriented, cementing the link between mind-wandering, personal goals, and anticipating the future. Thirdly, thoughts that involved a combination of both self-related and goal-directed content were more frequently future-focused than present- or past-focused. Together, these results imply that mind-wandering indeed has a function: it enables goal-directed planning in relation to personal concerns.

4.2. Mind-Wandering Promotes Creativity

Anecdotes of creative insights occurring during periods of listless thought pervade the annals of the sciences. For example, Poincaré (1908) described the insight that occurred to him as he mind-wandered while getting on a bus, observing the following:

> *At the moment when I put my foot on the step the idea came to me, without anything in my former thoughts seeming to have paved the way for it, that the transformation that I had used to define the Fuchsian functions were identical with those of non-Euclidean geometry.*
>
> **Poincaré (1908, p. 53)**

Several lines of empirical research also suggest that mind-wandering could be linked to enhanced creativity. First, individuals with ADHD tend to score higher on laboratory measures of creativity (White & Shah, 2006) and on questionnaire-based assessments of achievement in the creative arts (White & Shah, 2011) than individuals without ADHD. Second, focused deliberation on problems can block creativity, whereas distraction can enhance it (Dijksterhuis & Meurs, 2006). Finally, a recent meta-analysis of the conditions that maximize incubation effects (enhanced creative problem solving following a break from the problem) found that the benefits of

incubation intervals are greater when individuals are occupied by an undemanding task compared to when they engage in either a demanding task or no task at all (Sio & Ormerod, 2009). Given that mind-wandering is more frequent in undemanding tasks than in demanding tasks (e.g., Mason et al., 2007; Smallwood et al., 2009), this finding suggests that one feature that may characterize successful incubation intervals could be the opportunity for creative mind-wandering.

In a recent experiment (Baird et al., 2012), we explicitly tested the hypothesis that mind-wandering is associated with enhanced creativity. We used an incubation paradigm to compare the effects of incubation tasks that systematically varied in their levels of attentional demand and thus in their conduciveness to mind-wandering. These filler tasks were performed during incubation periods in the unusual uses task (UUT), a classic measure of creativity (Guilford, 1967), typically yielding robust incubation effects (Ellwood, Pallier, Snyder, & Gallate, 2009; Sio & Ormerod, 2009). The UUT requires participants to generate as many unusual uses as possible for a common object, such as a brick, within a time limit. The originality and diversity of responses are said to index "divergent" thinking (e.g., Milgram & Milgram, 1976; Wallach & Kogan, 1965).

Our results confirmed that performing an undemanding task during the incubation period improved creative performance on the UUT to a greater extent than performing a demanding task, resting, or taking no break (Fig. 1.3). Importantly, the undemanding task condition was likewise the condition with the highest incidence of mind-wandering, but was not associated with more thoughts about the creativity problems (ruling out an alternative explanation that individuals simply were able to devote more resources to

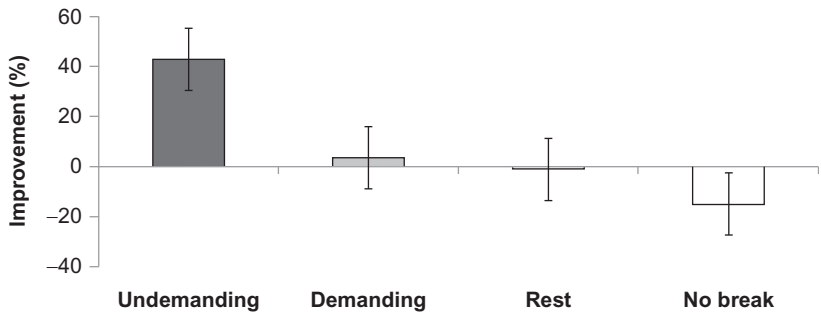

Figure 1.3 Improvement in unusual uses task (UUT) uniqueness scores (postincubation performance relative to baseline performance) for repeated exposure problems as a function of incubation condition. Error bars indicate standard errors of the mean. *Reprinted with permission from SAGE Publications. Baird et al. (2012).*

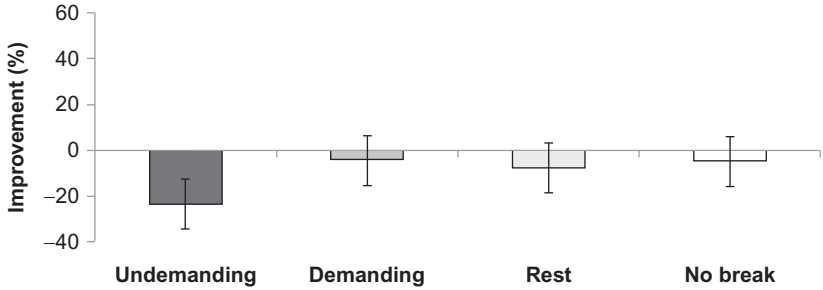

Figure 1.4 Improvement in unusual uses task (UUT) uniqueness scores (postincubation performance relative to baseline performance) for new exposure problems as a function of incubation condition. Error bars indicate standard errors of the mean. *Reprinted with permission from SAGE Publications. Baird et al. (2012).*

explicitly thinking about the prior problems). Furthermore, the improvement on the UUT was observed only for problems that participants had been exposed to before, but not new problems (Fig. 1.4), suggesting that the improvement in creativity resulted from an incubation process rather than a general increase in creative problem solving. Furthermore, we also found that scores on the daydreaming frequency subscale of the Imaginal Processes Inventory (a questionnaire measure that assesses individual's tendency for mind-wandering in everyday life; Gold & Gold, 1982) were positively correlated with UUT scores for both repeated exposure and new exposure problems. This last result suggests that those individuals who mind-wander more frequently in their daily lives may also be more creative in general.

Together, these findings provide convincing evidence that conditions that favor mind-wandering may also enhance creativity. This research helps to establish potential benefits of mind-wandering, providing at least part of an answer to the question of why we so frequently engage in this otherwise seemingly dysfunctional mental state. Although mind-wandering may be linked to compromised performance on a variety of experimenter-defined tasks (Barron, Riby, Greer, & Smallwood, 2011; McVay & Kane, 2009) and may be associated with depressed mood (Killingsworth & Gilbert, 2010), it may also serve as a wellspring of creative ideas.

4.3. If Mind-Wandering Facilitates Creativity, Could There Be a Downside to Mindfulness?

Noting that mindfulness and mind-wandering appear to be opposite tendencies and that benefit of mind-wandering is its capacity to enhance creativity, there may be paradoxical costs associated with too much mindfulness,

namely, that it might suppress certain types of creative processes. Recently, we completed a preliminary investigation to explore this issue. Specifically, we wondered whether people who are chronically less mindful and hence more prone to mind-wandering might perform better on tests of creativity. At first glance, this proposal seems counterintuitive. After all (as reviewed in this chapter), mindfulness is generally beneficial for cognitive abilities. Yet, creative problem solving is special in that it does not necessarily require the kind of controlled, analytic thought involved in many cognitive tasks (Bowers, Regehr, Balthazard, & Parker, 1990; Kounios & Beeman, 2009; Simonton, 1975). This proposal is also consistent with the link between ADHD and creative achievement (White & Shah, 2006, 2011). Thus, it is possible that being chronically less mindful may help creative performance.

To investigate individual differences in relation to creative performance, a number of studies have focused on structural differences in the brain. Interestingly, these studies have found that differences in creative performance correlate positively with activation in areas associated with the default mode network (Jung et al., 2010), which is associated positively with mind-wandering (Christoff et al., 2009; Mason et al., 2007; Schooler et al., 2011) and negatively with mindfulness (Brewer et al., 2011). Thus, recent neuroanatomical evidence supports the hypothesis that individual differences in mind-wandering and mindfulness are differentially related to creativity. In a recent study (Zedelius & Schooler, in preparation), we tested the relationship between creativity and mindfulness more directly. We assessed individual differences in mindfulness using the MAAS and measured creative problem-solving performance on the Remote Associates Test (RAT; Mednick, 1962). The RAT is a frequently used creativity task in which participants are shown three target words (e.g., "board," "magic," and "death") and are asked to find a shared but usually rather uncommon associate ("black"). Our first aim for this study was to look at the relationship between mindfulness and overall creative problem-solving performance. Consistent with our hypothesis, results showed a negative correlation between mindfulness scores and RAT performance.

Thus, this finding provides the first direct evidence that being less mindful helps to be more creative. The nature of this relationship may be further clarified by examining it in terms of different strategies that can be used to solve the RAT problems. If mindfulness is harmful for creative tasks because creativity does not necessarily rely on analytic thought, then lacking

mindfulness should be beneficial when dealing with problems that are less amenable to solution by analysis versus "insight."

Creativity researchers have long been intrigued by the fact that the same creative problems can often be solved through analytic thought, much like a noncreative cognitive task, or through spontaneous insight, typically referred to as an "Aha" experience (Aziz-Zadeh, Kaplan, & Iacoboni, 2009; Bowden, Jung-Beeman, Fleck, & Kounios, 2005; Kaplan & Simon, 1990; Metcalfe & Wiebe, 1987; Schooler & Melcher, 1995). For example, RAT problems can be solved analytically by searching associative networks in long-term memory, thus approaching a solution incrementally. Alternatively, however, a solution may also come to mind spontaneously and with sudden awareness (i.e., through insight). Interestingly, previous research has shown that analytic and insightful problem-solving methods within the RAT are associated with markedly different patterns of brain activity and that default mode network activity is related specifically to solving the problems with insight (Kounios et al., 2008). Based on this research, we expected that mindfulness should be related specifically to analytic problem solving. To test this, in addition to assessing RAT accuracy, we also asked participants after each RAT problem whether they had solved the problem mostly analytically or mostly with insight (Kounios & Beeman, 2009). Notably, we found that trait mindfulness correlated negatively with solving RAT problems through insight but not through analysis. Thus, these findings further imply that being less mindful and more prone to mind-wandering is not always a curse but can have specific benefits for creative problem solving and in particular for using creative insight.

4.4. Is a Wandering Mind Always an Unhappy Mind?

The fact that both anecdotal and experimental evidence suggest a link between mind-wandering and creativity also implies a potentially a more nuanced relationship between mind-wandering and mood than has previously been suggested. As noted earlier, a number of studies have demonstrated a negative relationship between mind-wandering and mood (Smallwood et al., 2009; Smallwood & O'Connor, 2011; Smallwood, O'Connor, Sudbery, & Obonsawin, 2007), the most notable of which was the large-scale experience-sampling study of Killingsworth and Gilbert (2010). To review, Killingsworth and Gilbert found that individuals reported worse mood when they were mind-wandering relative to when

they were on-task. Strikingly, even when individuals reported mind-wandering about pleasant topics, their mood rating was never better than when they were on-task. Killingsworth and Gilbert's findings converge nicely with other studies that have demonstrated a negative impact of mind-wandering on mood; nevertheless, there is an aspect of their results that merits further exploration. Although mind-wandering may normally be a downer, if someone is mind-wandering about a topic that he or she finds especially interesting, might such stimulating musings be one case where mind-wandering is actually uplifting?

In order to explore this question, we took advantage of the fine-grained questions included in the mind-wandering experience-sampling study that we discussed in the previous section (Franklin, Mrazek, et al., 2013). In this study, individuals first responded to a probe asking whether they were mind-wandering. If they responded affirmatively, they were asked several additional questions about the quality of their mind-wandering, which included rating their off-task thoughts on how interesting and useful they were. Additionally, participants (regardless of whether they were mind-wandering) were asked to rate their mood. This aspect of the study enabled us to examine (1) the general claim made by Killingsworth and Gilbert (2010) that all mind-wandering episodes have equal or lower happiness ratings than on-task episodes and (2) whether mind-wandering episodes that rate highly on interest and usefulness can lead to enhanced positive mood, relative to on-task episodes.

Consistent with Killingsworth and Gilbert's findings, we found that overall on-task reports had a higher positive mood rating than off-task reports. However, the effect of a mind-wandering episode on mood was varied based on how interesting and useful it was. Positive mood ratings were significantly correlated with both interest and usefulness assessments of the mind-wandering episode. Additional analyses revealed that high-interest episodes were associated with a more positive mood than on-task episodes, whereas highly useful episodes did not differ significantly from on-task episodes. These results suggest that the content of mind-wandering episodes can make a big difference for its effects on mood and affect. Specifically, mind-wandering episodes of high interest may lead to increased positive mood relative to being on-task. These results suggest another potential benefit of mind-wandering: enhancing positive mood through engaging in off-task thoughts that are personally interesting.

Having now provided multiple lines of evidence that suggests an inherent functionality in mind-wandering, we will briefly speculate about two

additional possible adaptive functions of mind-wandering: relieving boredom and promoting dishabituation.

4.5. Relieving Boredom

We have reported in this chapter the novel finding that positive mood can be enhanced by mind-wandering when people mind-wander about topics they find personally interesting. This suggests more generally that a potential benefit of mind-wandering may be to relieve boredom. When faced with a tedious task or situation, our minds tend to wander, sometimes intentionally as a form of escape. This may be adaptive: the ability of our minds to disengage from the current external environment and to engage in an alternative train of thought may have evolved in part to allow us to overcome tedium and disinterest without overtly abandoning a necessary task (perhaps one necessary for survival or procreation). Preliminary evidence in support of this relationship comes from a recent study (Baird, Smallwood, & Schooler, 2010), in which we gave participants a very tedious task to work on for a relatively long time (45 min). Comparison of the difference between pre- and posttask assessments of mood revealed that people were less happy overall following participation in the task. However, the magnitude of this drop in mood was reduced the more people mind-wandered. In short, mind-wandering appeared to partially insulate people against the mood-related costs of engaging in a particularly tedious task.

Mind-wandering may also relieve boredom by shortening perceived temporal duration. While boring tasks are typically estimated to last longer than they actually do, mind-wandering is accompanied by temporal estimations that are shorter than the objective durations and more so than when people are on-task (Mooneyham & Schooler, in preparation-b). Thus, mind-wandering may help to speed up the perceived flow of time during tedious or boring activities.

4.6. Promoting Dishabituation

Paradoxically, mind-wandering may promote long-term learning and memory by promoting dishabituation, which is the rerepresentation of an "old" stimulus as "new." Long-term learning is enhanced by "distributed" versus "massed" practice (Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006). Distributed practice is when learning episodes are more widely spaced in time, and massed practice is when they are more closely spaced in time (Cepeda et al., 2006). The advantage of distributed practice may stem from processing

benefits afforded by dishabituation (Schooler et al., 2011).Therefore, it is possible that mind-wandering during learning tasks may allow for periods of dishabituation from the task, thus providing the mind with an opportunity to return to the task with a refreshed capacity for attentive processing. We conjecture that this mechanism might be similar to those that promote creative mind-wandering during the incubation paradigm discussed earlier in this chapter.

One way in which we (Mooneyham & Schooler, in preparation-a) are currently testing this idea is to compare recall performance for word lists presented in massed versus distributed schedules, while measuring mind-wandering during word list presentation. In this experiment (currently in data collection), participants take two word recall tests, in counterbalanced order. In one test (the massed practice condition), each of the 30 words is presented once for 30 s, while in the other test (the distributed practice condition), each of the 30 (different) words is presented 30 times for only 1 s at a time. Probe-caught mind-wandering is also assessed during both rehearsal periods, and participants are asked to recall back as many of the words as possible after each of the approximately 15 min presentation periods. If mind-wandering serves to promote dishabituation, then mind-wandering during massed practice, by averting attention away and then allowing it to return to the display of a single word, may result in the attenuation of the usual learning advantage for distributed practice. Mind-wandering during the massed practice condition may serve to improve recall performance by causing a word that is only presented once to "seem" to be presented more than once (by averting attention away and then returning during the display of a single word). Furthermore, this line of reasoning predicts that for massed practice schedules, those participants who mind-wander the most may actually show better recall success than those who mind-wander less often. The collection of data bearing on this hypothesis is not yet completed; however, the thought experiment may serve to illustrate the extent to which determining the possible beneficial aspects of mind-wandering can lead to exciting new avenues of research. This experiment can potentially provide evidence that mind-wandering can improve performance beyond the level that occurs when individuals are fully on-task.

5. CONCLUSIONS: FINDING THE RIGHT BALANCE

Our chapter suggests that mind-wandering can be a major detriment to cognitive performance and well-being, yet it may also enable future planning, facilitate creativity, and at least on occasion provide uplifting

stimulation. The cultivation of mindfulness may help to reduce mind-wandering and thereby provide an important antidote to some of its negative consequences. At the same time, those who are routinely mindful may sacrifice some of the creativity of their more free-wheeling peers. So how then do we find the right balance between the focus of mindfulness and the freedom of a mind untethered to the present?

A full answer to the question of how to optimally balance mind-wandering and mindfulness must await further research. Such research will need to take into account not only the range of activities that may be most amenable to the two modes of thought but also the individual differences. For many people, a simple move toward greater mindfulness is likely to afford significant benefits, reducing the many negative consequences of mind-wandering and enhancing well-being in some of the other ways attributed to mindfulness, such as reduced stress (Tang et al., 2007) and improved health (Grossman, Niemann, Schmidt, & Walach, 2004). For others, an easing up on the rigorous requirement of always being attentive to the goings-on of the present moment might enable a freedom of thought that enables enhanced creativity.

Ideally, techniques might be developed that could enable people to optimize their mental mode for each situation. When the situation demands attention, one may be able to learn to spontaneously maintain focus on the task at hand; however, when task demands are more lax, mind-wandering can be indulged without fear. Indeed, there are already several lines of evidence suggesting that some people are particularly talented at limiting their mind-wandering episodes to appropriate times. For example, Kane, Brown and colleagues (2007) and Kane, Conway, Hambrick, and Engle (2007) found that individuals with high WMC were more skillful than individuals with low WMC at mind-wandering at times when such activity was not disruptive for their primary task performance. Similarly, in their ADHD experience-sampling study, Franklin et al. (in preparation) found that low-ADHD participants tended to have detrimental mind-wandering episodes that were also rated as useful (i.e., they appeared to be willing to incur a cost to the current task in order to engage in useful mind-wandering). In contrast, high-ADHD participants showed no relationship between how detrimental a mind-wandering episode was and its rated usefulness. Casner and Schooler (2013) found more examples of "strategic" mind-wandering, in that professional pilots tended to mind-wander when their flight demands were minimal but returned their attention to the task at hand when conditions were more difficult. Perhaps, mindfulness training could be expanded

to relax the demand of always being present in the moment and instead encourage individuals to take stock of their experience and recognize times when flights of fancy might be valuable.

In addition to helping people to learn to be more skillful in mind-wandering at the right times, people might also be encouraged to engage in topics of mind-wandering that are maximally stimulating. When people catch their minds escaping the present, they may not necessarily need to return the mind to the present, but if they are engaging in a nonproductive or uninteresting topic, they might want to think about something else that they find more engaging. Given that especially interesting mind-wandering topics may enhance mood, people might seek to identify topics that they find especially attractive to think about. When opportunities arise for mind-wandering or when one catches oneself perseverating on a nonproductive topic, they might simply shift to one of their preferred topics, perhaps to return to their original problem with a fresh outlook.

Finally, future research should take advantage of advances in technology to help people to better recognize their mental states and adjust them accordingly to the situation. As noted, a host of indirect measures have been found to correlate with whether or not people are mind-wandering, including behavioral markers such as gaze duration (Reichle et al., 2010), RT (Cheyne et al., 2009), and performance errors (Mrazek et al., 2012; Smallwood et al., 2004); physiological measures such as pupil dilation (Smallwood et al., 2011, 2012) and heart rate (Smallwood et al., 2004); and brain activity as measured by fMRI (Christoff et al., 2009), ERPs (Smallwood, Beach, Schooler, et al., 2008; Smallwood, McSpadden, Luus, et al., 2008; Smallwood, et al., 2008), and EEGs (Braboszcz & Delorme, 2011). In principle, such measures could be used individually or in combination, for example, in neurofeedback training and monitoring protocols, in order to help people learn to notice their mind-wandering episodes and adjust them accordingly. Experience-sampling methods could also be used, alone or in concert with such indirect measures, to help people learn which activities are disrupted by mind-wandering and which are facilitated.

Given the ubiquity and impact of mind-wandering, it is encouraging that research on this topic is becoming more commensurate with the significance of the phenomenon. While there is much more to learn about mind-wandering, the current state of research is sufficient to offer some practical advice. Each of us would be advised to take heed of the fact that mind-wandering can markedly impede our ability to perform to the best of our

abilities. Developing the habit of mindfulness, through regularly taking note of our thoughts and possibly initiating a meditation practice, would be helpful for many of us. While the cultivation of mindfulness is likely to be useful, we should not seek to eliminate mind-wandering entirely from our lives, as it may offer some unique benefits when carried out at the appropriate times. Ultimately, each one of us must determine for ourselves the optimum balance between mind-wandering and mindfulness. Appreciating that this "middle way" is a worthy direction may be an important first step toward finding it.

ACKNOWLEDGMENTS

B. B. is supported by a National Science Foundation Graduate Research Fellowship under Grant No. DGE-0707430. B. M. is supported by a National Science Foundation Graduate Research Fellowship under Grant No. DGE-1144085. C. Z. and J. W. S. are supported by a grant from the John Templeton Foundation awarded to J. W. S. M. D. M., M. S. F., J. M. B., and J. W. S. are supported through the US Department of Education grant R305A110277 awarded to J. W. S. The content of this chapter does not necessarily reflect the position or policy of the US government, and no official endorsement should be inferred.

REFERENCES

Aziz-Zadeh, L., Kaplan, J. T., & Iacoboni, M. (2009). "Aha!": The neural correlates of verbal insight solutions. *Human Brain Mapping*, *30*, 908–916.

Baird, B., Smallwood, J., Mrazek, M. D., Kam, J. W., Franklin, M. S., & Schooler, J. W. (2012). Inspired by distraction mind wandering facilitates creative incubation. *Psychological Science*, *23*(10), 1117–1122.

Baird, B., Smallwood, J., & Schooler, J. W. (2010). I can shake that feeling: Positive mind-wandering prevents the deterioration of mood. In *Poster presented at: Toward a science of consciousness, Tucson, AZ*.

Baird, B., Smallwood, S., & Schooler, J. W. (2011). Back to the future: Autobiographical planning and the functionality of mind-wandering. *Consciousness and Cognition*, *20*, 1604–1611.

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.

Bowden, E. M., Jung-Beeman, M., Fleck, J., & Kounios, J. (2005). New approaches to demystifying insight. *Trends in Cognitive Sciences*, *9*(7), 322–328.

Bowers, K. S., Regehr, G., Balthazard, C., & Parker, K. (1990). Intuition in the context of discovery. *Cognitive Psychology*, *22*, 72–110.

Braboszcz, C., & Delorme, A. (2011). Lost in thoughts: Neural markers of low alertness during mind wandering. *NeuroImage*, *54*(4), 3040–3047. http://dx.doi.org/10.1016/j.neuroimage.2010.10.008.

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*, *104*(27), 11483–11488.

Brewer, J. A., Worhunsky, P. S., Gray, J. R., Tang, Y. Y., Weber, J., & Kober, H. (2011). Meditation experience is associated with differences in default mode network activity

and connectivity. *Proceedings of the National Academy of Sciences of the United States of America*, *108*, 20254–20259.

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.

Brown, K. W., Ryan, R. M., & Creswell, D. (2007). Mindfulness: Theoretical foundations and evidence for its salutary effects. *Psychological Inquiry*, *18*(4), 211–237.

Casner, J. M., & Schooler, J.W. (2013). Thoughts in flight: The relationship between automation use and professional pilots' task related and unrelated thought. *Human Factors*. http://dx.doi.org/10.1177/0018720813501550.

Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin*, *132*, 354–380.

Cheyne, J. A., Carriere, J. S. A., & Smilek, D. (2006). Absent-mindedness: Lapses of conscious awareness and everyday cognitive failures. *Consciousness and Cognition*, *15*(3), 578–592.

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.

Christoff, K., Gordon, A. M., Smallwood, J., Smith, R., & Schooler, J. W. (2009). Experience sampling during fMRI reveals default network and executive system contributions to mind wandering. *Proceedings of the National Academy of Sciences*, *106*(21), 8719–8724.

Conway, A. R. A., Cowan, N., Bunting, M. F., Therriault, D., & Minkoff, S. (2002). A latent variable analysis of working memory capacity, short term memory capacity, processing speed, and general fluid intelligence. *Intelligence*, *30*, 163–183.

Dijksterhuis, A., & Meurs, T. (2006). Where creativity resides: The generative power of unconscious thought. *Consciousness and Cognition*, *15*, 135–146.

Easwaran, E. (2008). *Words to live by: A daily guide to living an exceptional life*. Tomales, CA: Blue Mountain Center of Meditation.

Ellwood, S., Pallier, G., Snyder, A., & Gallate, J. (2009). The incubation effect: Hatching a solution? *Creativity Research Journal*, *21*, 6–14.

Engle, R. W., Tuholski, S. W., Laughlin, J. E., & Conway, A. R. A. (1999). Working memory, short-term memory, and general fluid intelligence: A latent variable approach. *Journal of Experimental Psychology*. *General*, *125*, 309–331.

Franklin, M. S., Mooneyham, B. W., Baird, B., & Schooler, J. W. (2013). Thinking one thing, saying another: The behavioral correlates of mind-wandering while reading aloud. *Psychonomic Bulletin & Review*, *1–6*. http://dx.doi.org/10.3758/s13423-013-0468-2.

Franklin, M. S., Mrazek, M. D., Anderson, C. L., Johnston, C., Smallwood, J., Kingstone, A., et al. (in preparation). The relationship between mind-wandering, meta-awareness, and attention-deficit/hyperactivity disorder symptomatology.

Franklin, M. S., Mrazek, M. D., Anderson, C. L., Smallwood, J., Kingstone, A., & Schooler, J. (2013). The silver lining of a mind in the clouds: Interesting musings are associated with positive mood while mind-wandering. *Frontiers in Perception Science*, *4*, 583. http://dx.doi.org/10.3389/fpsyg.2013.00583.

Franklin, M. S., Mrazek, M. D., Broadway, J. M., & Schooler, J. W. (2013). Disentangling decoupling: Comment on Smallwood (2013). *Psychological Bulletin*, *139*(3), 536–541. http://dx.doi.org/10.1037/a0030515.

Franklin, M., Smallwood, J., & Schooler, J. (2011). Catching the mind in flight: Using behavioral indices to detect mindless reading in real time. *Psychonomic Bulletin & Review*, *18*(5), 992–997. http://dx.doi.org/10.3758/s13423-011-0109-6.

Giambra, L. M. (1995). A laboratory method for investigating influences on switching attention to task-unrelated imagery and thought. *Consciousness and Cognition*, *4*(1), 1–21.

Gilbert, S. J., Spengler, S. J., Simons, J. S., Steele, J. D., Lawrie, S. M., Frith, C. D., et al. (2006). Functional specialization within rostral prefrontal cortex (area 10): A meta-analysis. *Journal of Cognitive Neuroscience*, *18*, 932–948.

Gold, S. R., & Gold, R. G. (1982). Actual daydream content and the Imaginal Processes Inventory. *Journal of Mental Imagery*, *6*, 169–173.

Grossman, P., Niemann, L., Schmidt, S., & Walach, H. (2004). Mindfulness-based stress reduction and health benefits: A meta-analysis. *Journal of Psychosomatic Research*, *57*(1), 35–43.

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*(1), 219–239.

Guilford, J. P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.

Heitz, R. P., Schrock, J. C., Payne, T. W., & Engle, R. W. (2008). Effects of incentive on working memory capacity: Behavioral and pupillometric data. *Psychophysiology*, *45*, 119–129.

Jaeggi, S. M., Buschkuehl, M., Jonides, J., & Perrig, W. J. (2008). Improving fluid intelligence with training on working memory. *Proceedings of the National Academy of Sciences*, *105*(19), 6829–6833. http://dx.doi.org/10.1073/pnas.0801268105.

James, W. (1890/1950). *The principles of psychology*. Vol. I. New York, NY: Dover Publications, Inc.

Johnston, C., & Johnston, C. (2002). The impact of attention deficit hyperactivity disorder on social and vocational functioning in adults. In P. S. Jensen, & J. R. Cooper (Eds.), *Attention deficit hyperactivity disorder: State of the science-best practices* (pp. 6-1–6-21). Kingston, NJ: Civic Research Institute.

Jung, R. E., Segall, J. M., Bockholt, H. J., Chavez, R. S., Flores, R., & Haier, R. J. (2010). Neuroanatomy of creativity. *Human Brain Mapping*, *31*, 398–409.

Kam, J. W. Y., Dao, E., Farley, J., Fitzpatrick, K., Smallwood, J., Schooler, J. W., et al. (2011). Slow fluctuations in attentional control of sensory cortex. *Journal of Cognitive Neuroscience*, *23*(2), 460–470.

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychological Science*, *18*(7), 614–621. http://dx.doi.org/10.1111/j.1467-9280.2007.01948.x.

Kane, M. J., Conway, A. R. A., Hambrick, D. Z., & Engle, R. W. (2007). Variation in working memory as variation in executive attention and control. In A. R. A. Conway, C. Jarrold, M. J. Kane, A. Miyake, & J. N. Towse (Eds.), *Variation in working memory* (pp. 21–48). Oxford, England: Oxford University Press.

Kaplan, C. A., & Simon, H. A. (1990). In search of insight. *Cognitive Psychology*, *22*, 374–419.

Killingsworth, M. A., & Gilbert, D. T. (2010). A wandering mind is an unhappy mind. *Science*, *330*, 932.

Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Sciences*, *14*(7), 317–324. http://dx.doi.org/10.1016/j.tics.2010.05.002.

Klinger, E. (1999). Thought flow: Properties and mechanisms underlying shifts in content. In J. A. Singer & P. Salovey (Eds.), *At play in the fields of consciousness: Essays in honor of Jerome L. Singer*. Mahwah, NJ: Lawrence Erlbaum Associates.

Kounios, J., & Beeman, M. (2009). The aha! moment: The cognitive neuroscience of insight. *Psychological Science*, *18*, 210–216.

Kounios, J., Fleck, J. I., Green, D. L., Payne, L., Stevenson, J. L., Bowden, E. M., et al. (2008). The origins of insight in resting-state brain activity. *Neuropsychologia*, *46*, 281–291.

Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in Cognitive Sciences*, *12*(4), 163–169. http://dx.doi.org/10.1016/j.tics.2008.01.005.

MacLean, K. A., Ferrer, E., Aichele, S. R., Bridwell, D. A., Zanesco, A. P., Jacobs, T. L., et al. (2010). Intensive meditation training improves perceptual discrimination and sustained attention. *Psychological Science*, *21*(6), 829–839.

Manly, T., Robertson, I. H., Galloway, M., & Hawkins, K. (1999). The absent mind: Further investigations of sustained attention to response. *Neuropsychologia*, *37*, 661–670.

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*, *315*(5810), 393–395.

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*(1), 196–204.

McVay, J. C., & Kane, M. J. (2010a). Adrift in the stream of consciousness: The effects of mind wandering on executive control and working memory capacity. In A. Gruszka, G. Matthews, & B. Szymura (Eds.), *Handbook on individual differences in cognition* (pp. 321–334). New York, NY: Springer.

McVay, J. C., & Kane, M. J. (2010b). Does mind wandering reflect executive function or executive failure? Comment on Smallwood and Schooler (2006) and Watkins (2008). *Psychological Bulletin*, *136*, 188–197. http://dx.doi.org/10.1037/a0018298.

Mednick, S. (1962). The associative basis of the creative process. *Psychological Review*, *69*, 220–232.

Metcalfe, J., & Wiebe, D. (1987). Intuition in insight and noninsight problem solving. *Memory & Cognition*, *15*(3), 238–246.

Meusse, M. (2011). *Practicing mindfulness: An introduction to meditation*. Chantilly, VA: The Teaching Company, Lecture 9.

Milgram, R. M., & Milgram, N. A. (1976). Creative thinking and creative performance in Israeli students. *Journal of Educational Psychology*, *68*, 255–259.

Mooneyham, B. W., & Schooler, J. W. (2013). The costs and benefits of mind-wandering: A review. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale*, *67*(1), 11–18. http://dx.doi.org/10.1037/a0031569.

Mooneyham, B. W., & Schooler, J. W. (in preparation-a). Mind-wandering and massed versus distributed practice effects.

Mooneyham, B. W., & Schooler, J. W. (in preparation-b). Mind-wandering and time perception.

Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, B., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science*, *24*(5), 776–781.

Mrazek, M. D., Smallwood, J., & Schooler, J. W. (2012). Mindfulness & mind-wandering: Finding convergence through opposing constructs. *Emotion*, *12*(13), 442–448.

Mrazek, M. D., Smallwood, J., Franklin, M. S., Baird, B., Chin, J. M., & Schooler, J. W. (2012). The role of mind-wandering in measurements of general aptitude. *Journal of Experimental Psychology. General*, *141*(4), 788–798.

Murphy, K. (2005). Psychosocial treatments for ADHD in teens and adults: A practice-friendly review. *Journal of Clinical Psychology*, *61*(5), 607–619. http://dx.doi.org/10.1002/jclp.20123.

Poincaré, H. (1908). *Science and method*. New York, NY: Thomas Nelson and Sons.

Raven, J. (1938). *Raven progressive matrices*. Los Angeles, CA: Western Psychological Services.

Rayner, K. (1998). Eye movements in reading and information processing: 20 years of research. *Psychological Bulletin*, *124*, 372–422.

Redick, T. S., Broadway, J. M., Meier, M. E., Kuriakose, P. S., Unsworth, N., Kane, M. J., et al. (2012). Measuring working memory capacity with automated complex span tasks. *European Journal of Psychological Assessment*, *28*, 164–171. http://dx.doi.org/10.1027/1015-5759/a000123.

Reichle, E. D., Reineberg, A. E., & Schooler, J. W. (2010). An eye-movement study of mindless reading. *Psychological Science*, *21*, 1300–1310.

Safren, S. A., Otto, M. W., Sprich, S., Winett, C. L., Wilens, T. E., & Biederman, J. (2005). Cognitive-behavioral therapy for ADHD in medication-treated adults with continued symptoms. *Behaviour Research and Therapy*, *43*(7), 831–842. http://dx.doi.org/10.1016/j.brat.2004.07.001.

Schooler, J. W. (2002). Re-representing consciousness: Dissociations between experience and meta-consciousness. *Trends in Cognitive Sciences*, *6*(8), 339–344. http://dx.doi.org/10.1016/S1364-6613(02)01949-6.

Schooler, J. W., & Melcher, J. (1995). The ineffability of insight. In S. M. Smith, T. B. Ward, & R. A. Finke (Eds.), *The creative cognition approach* (pp. 97–133). Cambridge, MA: The MIT Press.

Schooler, J. W., Reichle, E. D., & Halpern, D. V. (2004). Zoning-out during reading: Evidence for dissociations between experience and meta-consciousness. In D. T. Levin (Ed.), *Thinking and seeing: Visual metacognition in adults and children* (pp. 204–226). 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*(7), 319–326. http://dx.doi.org/10.1016/j.tics.2011.05.006.

Schooler, J. W., Zedelius, C., Franklin, M.S., McSpadden, M., Reichle, E.D., & Smallwood, J. (in preparation). Unnoticed nonsense: Mind-wandering can prevent people from realizing that they are reading gibberish.

Shaw, G. A., & Giambra, L. (1993). Task-unrelated thoughts of college students diagnosed as hyperactive in childhood. *Developmental Neuropsychology*, *9*(1), 17–30. http://dx.doi.org/10.1080/87565649309540541.

Simonton, D. K. (1975). Creativity, task complexity, and intuitive versus analytical problem solving. *Psychological Reports*, *27*, 315–354.

Singer, J. L., & Antrobus, J. S. (1972). Daydreaming, imaginal processes, and personality: A normative study. In P. W. Sheehan (Ed.), *The function and nature of imagery* (pp. 175–202). New York, NY: Academic press.

Sio, U. N., & Ormerod, T. C. (2009). Does incubation enhance problem solving? A meta-analytic review. *Psychological Bulletin*, *135*, 94–120.

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

Smallwood, J. (2011). Mind wandering while reading: Attentional decoupling, mindless reading and the cascade model of inattention. *Language and Linguistic Compass*, *5*(2), 63–77.

Smallwood, J. (2013). Distinguishing how from why the mind wanders: A process–occurrence framework for self-generated mental activity. *Psychological Bulletin*, *139*(3), 519–535. http://dx.doi.org/10.1037/a0030010.

Smallwood, J., Beach, E., Schooler, J. W., & Handy, T. (2008). Going AWOL in the brain: Mind wandering reduces cortical analysis of external events. *Journal of Cognitive Neuroscience*, *20*(3), 458–469.

Smallwood, J., Brown, K. S., Baird, B., Mrazek, M. D., Franklin, M. S., & Schooler, J. W. (2012). Insulation for daydreams: A role for tonic norepinephrine in the facilitation of internally guided thought. *PloS One*, *7*(4), e33706.

Smallwood, J., Brown, K. S., Tipper, C., Giesbrecht, B., Franklin, M. S., Mrazek, M. D., et al. (2011). Pupillometric evidence for the decoupling of attention from perceptual input during offline thought. *PloS One*, *6*(3), e18298.

Smallwood, J., Davies, J. B., Heim, D., Finnigan, F., Sudberry, M., O'Connor, R., et al. (2004). Subjective experience and the attentional lapse: Task engagement and disengagement during sustained attention. *Consciousness and Cognition*, *13*(4), 657–690. http://dx.doi.org/10.1016/j.concog.2004.06.003.

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*(1), 50–56.

Smallwood, J., McSpadden, M., & Schooler, J. (2008). When attention matters: The curious incident of the wandering mind. *Memory & Cognition*, *36*(6), 1144–1150. http://dx.doi.org/10.3758/MC.36.6.1144.

Smallwood, J., Nind, L., & O'Connor, R. C. (2009). When is your head at? An exploration of the factors associated with the temporal focus of the wandering mind. *Consciousness and Cognition*, *18*, 118–125.

Smallwood, J., & O'Connor, R. C. (2011). Imprisoned by the past: Unhappy moods lead to a retrospective bias to mind wandering. *Cognition & Emotion*, *25*(8), 1481–1490. http://dx.doi.org/10.1080/02699931.2010.545263.

Smallwood, J., O'Connor, R. C., Sudbery, M. V., & Obonsawin, M. (2007). Mind-wandering and dysphoria. *Cognition & Emotion*, *21*(4), 816–842. http://dx.doi.org/10.1080/02699930600911531.

Smallwood, J., & Schooler, J. W. (2006). The restless mind. *Psychological Bulletin*, *132*(6), 946–958. http://dx.doi.org/10.1037/0033-2909.132.6.946.

Tang, Y. Y., Ma, Y., Wang, J., Fan, Y., Feng, S., Lu, Q., et al. (2007). Short-term meditation training improves attention and self-regulation. *Proceedings of the National Academy of Sciences*, *104*(43), 17152.

Teasdale, J. D., Dritschell, B. H., Taylor, M. J., Proctor, L., Lloyd, C. A., Nimmo-Smith, I., et al. (1995). Stimulus-independent-thought depends on central executive resources. *Memory and Cognition*, *28*, 551–559.

Teasdale, J. D., Lloyd, C. A., Proctor, L., & Baddeley, A. (1993). Working memory and stimulus-independent-thought: Effects of memory load and presentation rate. *European Journal of Psychology*, *5*, 417–433.

Unsworth, N., Redick, T. S., Heitz, R. P., Broadway, J. M., & Engle, R. W. (2009). Complex working memory span tasks and higher-order cognition: A latent variable analysis of the relationship between processing and storage. *Memory*, *17*, 635–654. http://dx.doi.org/10.1080/09658210902998047.

Wallach, M. A., & Kogan, N. (1965). *Modes of thinking in young children: A study of the creativity–intelligence distinction*. New York, NY: Holt, Rinehart, & Winston.

White, H. A., & Shah, P. (2006). Uninhibited imaginations: Creativity in adults with attention deficit/hyperactivity disorder. *Personality and Individual Differences*, *40*, 1121–1131.

White, H. A., & Shah, P. (2011). Creative style and achievement in adults with attention-deficit/hyperactivity disorder. *Personality and Individual Differences*, *50*, 673–677.

Zedelius, C., & Schooler, J.W. (in preparation). The inverse relationship between mindfulness and creative insight.