10

MINDFULNESS IN EDUCATION

Enhancing academic achievement and student well-being by reducing mind-wandering

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Over the last decade, the field of social psychology has become increasingly interested in investigating the effects of mindfulness. Dozens of laboratory studies have rigorously examined the short-term outcomes of mindfulness in controlled settings, yet the lack of ecological validity in these studies means that the claims of applied value and generalizability are limited. Meanwhile, mindfulness training has been introduced into classrooms worldwide in hopes of improving academic achievement and student well-being. While evidence of the efficacy of mindfulness-based intervention programs in schools is promising, their evaluation often still lacks the methodological rigor and strong theoretical foundation of most laboratory studies on mindfulness (Weare, 2013). That is a gap that we are hoping to help close. Here, we aim to integrate the extant literature on mindfulness and educational outcomes from both controlled experiments as well as research in more naturalistic settings. By synthesizing this diverse work and reconciling strengths and weaknesses from the various approaches, we present a theoretical model of the benefits of mindfulness-based interventions in primary and secondary education for student well-being and academic achievement.

Student attentiveness is an essential basis of learning, yet high levels of distraction are widely prevalent in schools (Lindquist & McLean, 2011; Rosengrant, 2011). A primary source of distraction is mind-wandering, which is commonly defined as engaging in spontaneous task-unrelated thought (Smallwood & Schooler, 2006). Mind-wandering is rampant during lectures, class activities, and even exams, and this frequency of mind-wandering has a myriad of destructive outcomes. For example, mind-wandering during (live or recorded) lectures has been shown to be detrimental to the retention of newly learned information as well as performance on exams (Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012; Schacter & Szpunar, 2015; Wammes, Seli, Allan, Boucher, & Smilek, 2016). Additionally, across

middle and high school populations, mind-wandering while taking a reading test predicts worse reading comprehension (Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013). In addition to the consequences on academic achievement and learning, students also mind-wander during class and daily life in ways that are associated with greater stress and worse mood (Mrazek, Phillips et al., 2013).

The problem of mind-wandering in the classroom is unmistakable, but solutions are less clear. Students are often asked to pay attention, but are rarely taught or trained in how to do so. As described in this chapter, our research suggests that a compounding source of frustration for students is that many of them also believe that their tendency for mind-wandering and their capacity to focus attention are immutable. To offset this, teachers attempt to retain their students' attention by strategically altering educational tools and the learning environment (Jensen, 1998; Sammons, 1995). For instance, teachers often provide activities that are sensitive to limited attention spans in order to stimulate student interest (Sylwester & Cho, 1993). Although altering educational tools and the learning environment is helpful, careful observation of almost any school classroom reveals the ongoing challenge of gaining and sustaining students' undivided attention.

As a result, mindfulness training programs have been introduced into schools, often with the hope and intention of helping students to better focus their attention over extended durations. Although promising, these training programs lack sufficient evaluation (Weare, 2013). Indeed, almost none of these programs have been specifically assessed with respect to their impact on reducing student mind-wandering, which may be one of the core mechanisms through which these interventions enhance learning (Cheyne, Solman, Carriere, & Smilek, 2009; Risko et al., 2012; Schacter & Szpunar, 2015; Schooler, Reichle, & Halpern, 2004; Wammes et al., 2016). Here we review the relevant literature and present a theoretical model that could be used to assess extant training programs as well as guide the design of potentially even more effective mindfulness curricula. In the present model, mindfulness training is proposed to reduce student mind-wandering – in part by reducing negative affect and changing students' mindsets about their mental capacities – which in turn may improve academic achievement.

Mindfulness training for wandering minds

Despite considerable disagreement regarding what the word *mindfulness* should convey, there is near consensus that sustained attentiveness, or the capacity to avoid distraction, represents an essential and valuable element. Thus, we suggest that augmenting mindfulness is a strategic route to decreasing mind-wandering. Strategies for reducing mind-wandering have immense practical significance given the robust relationship between mind-wandering and impaired task performance. Mind-wandering is a ubiquitous phenomenon that occupies approximately 30–50% of waking life (Kane et al., 2007; Killingsworth & Gilbert, 2010). This frequency is alarming, since mind-wandering is associated with impaired task vigilance (Cheyne et al., 2009), reading comprehension, and information retention

(Cheyne et al., 2009; Risko et al., 2012; Schacter & Szpunar, 2015; Schooler, Reichle, & Halpern, 2004; Smallwood, McSpadden, & Schooler, 2008; Wammes et al., 2016).

Although most of this research has been conducted with young adult samples, mind-wandering among students in grades 6–12 is also associated with impaired reading comprehension (Mrazek, Phillips et al., 2013). Mind-wandering additionally impairs performance on measures of mental aptitude – such as working memory capacity and fluid intelligence – that are predictive of academic achievement, job performance, and other practical indicators (Conway et al., 2005). In fact, nearly 50% of the shared variance among working memory capacity, fluid intelligence, and performance on the SAT is explained by the mind-wandering that occurs during these assessments (Mrazek, Smallwood, Franklin et al., 2012). The capacity to avoid mind-wandering during demanding tasks is clearly an important ability with implications for learning and academic achievement.

Mind-wandering and its disruptive effects on task performance could be reduced by interventions that increase mindfulness. After all, individuals with high trait-levels of mindfulness mind-wander less in daily life and during laboratory tasks requiring focused attention (Mrazek, Smallwood, & Schooler, 2012). Furthermore, mindfulness training improves aspects of attention closely linked to mind-wandering, including executive attention, perceptual sensitivity, and task vigilance (MacLean et al., 2010; Tang et al., 2007).

Several converging studies with adult samples suggest that mindfulness training can directly influence rates of mind-wandering. In one study, the brief practice of mindful breathing in the laboratory resulted in reduced mind-wandering during an immediately subsequent task (Mrazek, Smallwood, & Schooler, 2012). In another investigation, 2 weeks of mindfulness training decreased mind-wandering and improved working memory capacity and reading comprehension among undergraduates (Mrazek, Franklin, Phillips, Baird, & Schooler, 2013). This same pattern of reduced mind-wandering and improved performance was also found using a 6-week mindfulness-based lifestyle change program (Mrazek, Mooneyham, Mrazek, & Schooler, 2016). Similarly, 4 weeks of breath counting training has also been shown to decrease mind-wandering relative to working memory training and no training controls (Levinson, Stoll, Kindy, Merry, & Davidson, 2014). Furthermore, the impact of meditation training is not limited to self-reported mind-wandering. Zanesco et al. examined the effect of meditation training on people's capacity to notice when text intermittently became meaningless (Zanesco et al., 2016) (a measure found to closely index mind-wandering during reading [Zedelius, Protzko, & Schooler, 2016]). In two separate studies, they found that meditation training not only reduced self-reported mind-wandering but enhanced performance on this objective "gibberish detection" index of mind-wandering.

Several lines of research also suggest that mindfulness training can directly affect attention and mind-wandering among youth. Students with Attentional Deficit Hyperactivity Disorder showed reduced symptomatology after receiving mindfulness training (van de Weijer-Bergsma et al., 2011). Among incarcerated youth, a

mindfulness training program buffered these adolescents from the attentional deterioration that often accompanies the high-stress interval of incarceration (Leonard et al., 2013). Ongoing research in our lab – described in greater detail later – also indicates that mindfulness training can be effective for high school students. In a recent pilot study, high school freshmen demonstrated reduced levels of mind-wandering during both a reading test as well as during daily life after receiving 4 weeks of mindfulness training and practicing on a daily basis with their teacher in the classroom (Mrazek, Phillips, & Schooler, 2015).

These results cumulatively suggest that mindfulness training holds substantial promise for alleviating the disruptive impact of mind-wandering in learning environments. The practice of mindfulness often promotes a persistent effort to regain and maintain focus on a single aspect of experience despite frequent interruptions of unrelated thoughts, perceptions, or personal concerns (Bishop et al., 2004). When this ability to concentrate is redirected to a challenging task, it can prevent the displacement of crucial task-relevant information by distractions. At least some of the performance enhancements derived from mindfulness training therefore appear to result from directly training the capacity for focused attention. However, mindfulness training may also influence mind-wandering and academic achievement indirectly by reducing levels of negative affect or by changing students' mindsets about their ability to control their attention.

Mindfulness, negative affect, and mind-wandering

Considerable research indicates that attention is influenced by negative affect. Self-reported measures of negative affect reliably predict both increased mind-wandering and reduced performance during laboratory tasks of vigilance and learning (Mrazek, Smallwood, & Schooler, 2012; Smallwood, Fishman, & Schooler, 2007). Similarly, naturally occurring episodes of mind-wandering during daily life tend to be associated with lower mood (Killingsworth & Gilbert, 2010). Furthermore, experimentally inducing negative affect increases mind-wandering, suggesting negative affect plays a causal role in the emergence of mind-wandering (Smallwood, Fitzgerald, Miles, & Phillips, 2009). This relationship between negative affect and mind-wandering extends to youth as well. Levels of negative affect as measured by the Positive and Negative Affect Schedule are associated with students' trait-levels of mind-wandering during daily life as well as their rates of mind-wandering during reading (Mrazek, Phillips et al., 2013). Specifically, adolescents who experience less positive and more negative affect on a regular basis tend to mind-wander more.

Meanwhile, one of the most reliable effects of mindfulness training for youth is reduced negative affect. Multiple studies using different samples of middle and high school students have found that mindfulness reduces negative affect, stress, and anxiety (Broderick & Metz, 2009; Elder et al., 2011; Kuyken et al., 2013). These results reinforce the numerous studies with adult samples indicating that mindfulness practice can improve mood (Hofmann, Sawyer, Witt, & Oh, 2010). In fact, studies with adult samples suggest that mindfulness training may reduce negative

affect in a manner that enhances attention and working memory. Military person-nel receiving mindfulness training during a highly stressful pre-deployment interval experienced less negative affect and less deterioration of working memory capacity (Jha, Stanley, Kiyonaga, Wong, & Gelfand, 2010). Similarly, teachers who received mindfulness training showed reduced depression and anxiety, as well as enhanced attention and working memory capacity (Roeser et al., 2013). This research sug-gests that reducing negative affect may be a key mechanism through which mind-fulness affects mind-wandering and academic achievement.

Growth mindsets, mind-wandering, and academic achievement

Considerable research has demonstrated that factors relevant to academic achieve-ment are influenced not only by a person's cognitive capacities, but also by their personal *beliefs* about their own capacities, often referred to as implicit theories, lay theories, or mindsets (e.g. Chiu, Hong, & Dweck, 1997; Dweck, Chiu, & Hong, 1995). Mindsets function as a "lens" through which people interpret information about themselves and the world around them. Even though mindsets are often implicit – that is, they are rarely explicitly articulated (Ross, 1989) – they can have powerful effects on learning and behaviour. Mindsets can influence whether people seek out or eschew challenges, what kinds of goals they set, and how they respond to setbacks or feedback (Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Molden & Dweck, 2006; Robins & Pals, 2002).

A mindset that has been shown to be particularly beneficial in academic con-texts is the belief that one's intelligence is malleable and can be improved with practice, rather than being genetically or otherwise determined, a system of beliefs that has been termed a *growth mindset* (Aronson, Fried, & Good, 2002; Dweck, 2006; Dweck et al., 1995). Numerous studies have shown that students with a growth mindset, compared to those who view their abilities as fixed, reach higher academic achievements (Dweck, 2006). Moreover, interventions that encouraged students to view intelligence as a skill that can be developed rather than a fixed ability led to marked improvements in students' grades and state-wide test scores (Aronson et al., 2002; Blackwell, Trzesniewski, & Dweck, 2007; Good, Aronson, & Inzlicht, 2003; Yaeger & Dweck, 2012; Yaeger & Walton, 2011).

Recent research from our laboratory has extended this research by investigating whether students hold different beliefs related to attentional control and mind-wandering, and whether these beliefs influence their ability to focus during vari-ous tasks. When noticing their mind-wandering, some people may view this as an uncontrollable event – a spontaneous attentional fluctuation inherent in the func-tioning of their brain. Others may view it as a failure on their part to regulate their attention. These different beliefs seem to be reflected in the way people talk about mind-wandering. A person may choose to say, "I wasn't paying attention," imply-ing a certain level of personal control and responsibility, or phrase it more passively: "My mind was wandering."

To assess such differences in people's mindsets and examine their relation to actual mind-wandering, we developed a novel scale (building on the existing *theories of intelligence* scale by Hong, Chiu, & Dweck, 1995) that assesses the extent to which individuals believe that they have control over their tendency to mind-wander (Zedelius et al., 2016). In several studies, we found that scores on the scale varied among individuals, and predicted their self-reported ability to focus in everyday life as well as their mind-wandering frequencies during reading tasks in the laboratory. We also found that undergraduate students who tended to believe more strongly that mind-wandering is controllable showed greater reading comprehension performance, providing further evidence that mindsets related to attentional control can have important implications for academic success. Moreover, in a pilot study with 58 high school freshmen, we found that mindsets related to attentional control significantly predicted not only rates of mind-wandering during testing and levels of reading comprehension, but also trait-levels of mindfulness.

Having established the importance of theories of mind-wandering in correlational studies, we next conducted two experimental studies indicating that these mindsets can be influenced by providing explicit information suggesting that people have (or lack) reasonable control over their tendency to mind-wander (Zedelius et al., 2016). However, challenging people's mindsets about attentional control through explicit information alone may not necessarily elicit long-lasting changes. After all, the belief that one has control over one's wandering mind is easily challenged by frequent and sometimes frustrating experiences of mind-wandering in everyday life. Achieving stable improvements in mind-wandering may therefore require both an adaptive mindset as well as practices that enhance attentional control.

Many published mindfulness interventions do already include extensive didactic instruction of various mindsets related to mindfulness. An important distinction regarding control over mind-wandering that is often made in mindfulness training programs is attempting to suppress thoughts versus allowing thoughts to pass away without elaborating, judging, or analyzing them. Many mindfulness programs emphasize the importance of recognizing that thoughts arise spontaneously, and that the control one has is in choosing not to elaborate these thoughts. This suggests that mindfulness training may have nuanced effects on participants' theories of mind-wandering, though this remains a largely unexplored research question. Future work could track changes in mindsets about various dimensions of attentional control and observe how these changes relate to objective outcomes of mindfulness training. For instance, many people report being surprised at the sheer number of thoughts that rush through their mind when they first practice mindfulness, and without effective guidance this experience could lead to disempowering theory of mind-wandering as completely uncontrollable. However, with instruction and practice people may find that they can control such mental turbulence by deliberately adopting an attitude towards spontaneous thoughts that dampens their capacity to draw the mind away from the present.

A mechanistic theory of change

Although teachers and policymakers work hard to maximize student learning, students' ability to pay attention and integrate information is compromised by the pervasive tendency to mind-wander. The reviewed research suggests a theory of change regarding how mindfulness interventions – ideally complemented by additional mindset instructions – could lead to improved academic achievement. The theory begins with the premise, strongly supported by various lines of research, that mind-wandering is a crucial constraint to effective learning. When students' minds are not present in the learning environment, students are unable to extract the relevant material and learning is compromised. This initial detriment in information extraction and integration leads to a cascading process of learning difficulties, where it becomes increasingly challenging to understand and relate to new material (Smallwood et al., 2007). Students can find themselves falling further and further behind. We propose that mindfulness interventions can target the compounding disruptive effects of mind-wandering on learning in at least three ways. First, mindfulness directly strengthens the capacity to remain focused. Second, mindfulness reduces negative emotional states. Since negative affect is itself a major source of distraction, the attenuation of this aversive state enhances mental focus and helps to further minimize mind-wandering. Third, we think that mindfulness training may enhance people's general dispositions towards both a general growth mindset regarding their overall intelligence and a specific growth mindset regarding their capacity to control their wandering minds. Such changes may be the result of personal observation stemming from mindfulness practice and may be further enhanced by the supplementation of mindfulness training with additional instruction that particularly targets those mindsets. Given that our research has found that students who believe their attention is not under their control tend to mind-wander more frequently, helping students gain new perspectives on their ability to control their attention may provide an important route for minimizing mind-wandering and enhancing learning. In short, this mechanistic theory of change (see Figure 10.1) posits that mindfulness instruction increases attentional focus, reduces negative affect, and encourages adaptive mindsets, which in turn lead to reduced mind-wandering, and thereby enhance students' ability to attend to the material that they encounter in the classroom and in other learning contexts.

Although we have chosen to focus on a small set of key mechanisms that may enhance academic achievement by reducing mind-wandering, it is important to recognize that there are a number of additional ways that mindfulness training may support academic success. For instance, socially prescribed perfectionism within schools may increase distress and anxiety, which can in turn lead to burnout and lower student success (Short and Mazmanian, 2013; Walburg, 2014). Mindfulness training may protect against these negative outcomes by decreasing the ruminative thought that leads to worry, depression, and perfectionism (Burns, Lee, and Brown, 2011; Short and Mazmanian, 2013). Furthermore, emotional regulation engendered by mindfulness training not only reduces negative affect but also positively impacts
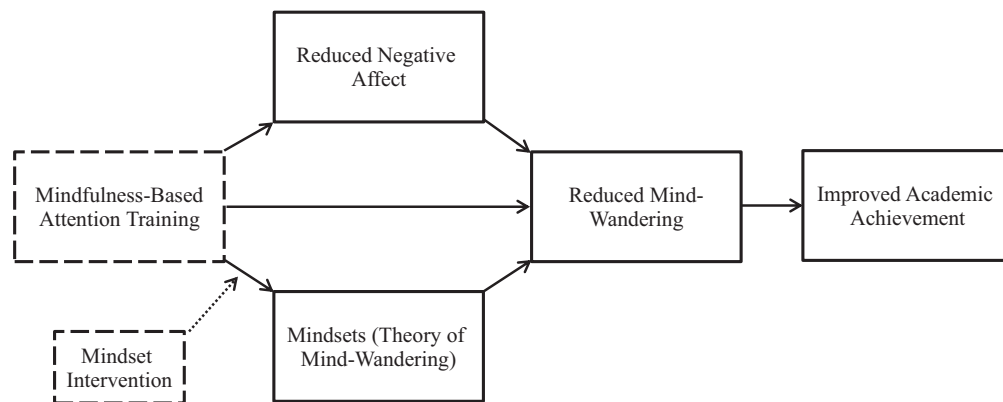
FIGURE 10.1 Theory of change

student–teacher interactions and student motivation (Graziano et al., 2007). A complete understanding of the ways that mindfulness enhances academic achievement will ultimately require a more complex model that incorporates dispositional and behavioural skills conducive to effective learning environments.

A review of the sparse literature on the benefits of mindfulness for academic achievement

Given the existing evidence that mindfulness training can improve mood, reduce mind-wandering, and change beliefs about one's control over attention, our theory of change would suggest that there should also be strong evidence that mindfulness training can enhance academic achievement. Perhaps surprisingly, relatively little research is available to speak to this question. However, the few studies that have sought such assessment have generally observed a positive impact on learning outcomes.

For instance, using standardized measures of academic performance, some research teams have observed improvements after a brief mindfulness intervention. Nidich and colleagues examined the effect of a mindfulness-based transcendental meditation (TM) program on subsequent performance on the California Standards Tests (CST), a state-wide standardized test administered to measure student progress (Nidich et al., 2011). In this study, the at-risk group of urban middle school students who completed the TM program showed a boost of at least one performance level on both math and English categories. The TM intervention has also been shown to improve graduation rates and decrease dropout rates among high school students (Colbert, 2013). Similarly, in a different mindfulness-based program, reading and science grades have likewise been found to significantly improve after participation (Bakosh, Snow, Tobias, Houlihan, & Barbosa-Leiker, 2015). Finally, after completing the mindfulness-based stress reduction (MBSR; Kabat-Zinn, 1990) program, a group of students age 16–18 performed significantly better on

the General Certificate of Education (GCE), another standardized test for grade-schoolers (Bennett & Dorjee, 2015). These researchers observed a medium-sized effect in test scores differences between those who completed MBSR compared to control students. In sum, although few studies have rigorously assessed the utility of mindfulness training programs for academic achievement, the few that have point towards promising results.

Providing mindfulness training for students with learning disabilities appears to further highlight the potential this type of practice may have on learning outcomes. In addition to the benefits on academic performance, mindfulness-based programs have provided some success in improving social skills and behavioural conduct, while also reducing emotional disturbances and social difficulties (Beauchemin, Hutchins, & Patterson, 2008; Haydicky, Wiener, Badali, Milligan, & Ducharme, 2012). For instance, Beauchemin and colleagues (2008) investigated the efficacy of a mindfulness meditation intervention on adolescents with mild to severe learning disabilities. After a 5-week interval, results revealed significant improvements in social anxiety as well as academic and social skills, as measured by a subscale in the Social Skills Rating System (SSRS).

Reducing social anxiety and improving attention in the classroom are goals of researchers and educators alike, partially due to the strong role they play in predicting academic success (Boyer & Sedlacek, 1988). Specifically, a longitudinal analysis demonstrated that attention was one of the top factors affecting learning outcomes (Duncan & Magnuson, 2011). Fortunately, mindfulness training programs seem to be useful from this perspective as well. A well-established intervention, mindfulness-based cognitive therapy, recently adapted for use with children, revealed improvements in attention, managing anxiety, and curbing behavioural problems (Semple, Lee, Rosa, & Miller, 2010). Emphasizing the interplay between mental health and learning capabilities, additional research has shown the detrimental effect that anxiety can have on attention, which may be especially relevant in test anxiety situations (Bellinger, DeCaro, & Ralston, 2015; Wine, 1971). Correspondingly, a randomized controlled trial, which applied a mindfulness-based program to primary school students, found significant improvements in social skills, selective attention, and managing test anxiety (Burke, 2010).

Despite the promise of these preliminary findings, more methodologically robust research is needed to substantiate the connection between academic achievement and mindfulness training. Many of the studies reviewed here lack a large and diverse sample, which limits both the statistical power and generalizability of these results (Bennett & Dorjee, 2015; Shapiro, Brown, Thoresen, & Plante, 2011). In addition, lack of randomization and the use of teacher-based measures may introduce causal ambiguity and reporting bias, respectively (Flook, Goldberg, Pinger, & Davidson, 2015; Maynard, Solis, & Miller, 2015). The methodological weaknesses of existing investigations may be due to the nascent nature of research in this area, where feasibility has been prioritized over stringent experimental designs (Burke, 2010). For example, the paucity of rigorous research may result in part from the practical challenges of implementing large-scale randomized control trials that include waitlist

or active-treatment controls in schools. Many constraints make this task difficult, including ensuring consistent delivery of the mindfulness program by teachers, gaining informed consent from guardians, and merging the programs seamlessly into the existing school curricula. Nevertheless, rigorously controlled studies are ultimately necessary for the causal inference that mindfulness training can improve academic achievement (see Alberts, Chapter 2 in this volume). Given the encouraging preliminary results and the accelerating societal interest in mindfulness, methodologically sound, large-scale investigations are a worthwhile and important future direction for the field.

Conclusion

Worldwide interest in mindfulness is growing rapidly. Mindfulness is being introduced into most every major sector of society, including education, medicine, business, government, and the military. This rapid expansion has been fuelled by the encouraging results of rigorous scientific investigation, and research into the many benefits of mindfulness continues to progress. Yet despite these encouraging trends, the role that mindfulness will play in our society's learning institutions over the long-term is at a pivotal crossroads. Despite mounting documentation of the *benefits* of mindfulness, relatively little is known about the mechanisms through which these benefits are achieved and the strategies through which mindfulness can be taught most effectively. Much more research is needed to examine the mediating (a) cognitive processes such as mind-wandering, (b) affective processes such as mood, and (c) implicit beliefs or mindsets about attentional control. To ensure that the growing demand for mindfulness can be met with high-quality evidence-based instruction, a new science of the *instruction* of mindfulness is essential. Our hope is that the theory of change presented here can provide some direction in thinking about how to optimize mindfulness training programs for youth as well as how to assess the mechanisms that might underlie potential improvements in academic achievement.

Author note

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