

Opening minds by supporting needs: do autonomy and competence support facilitate mindfulness and academic performance?

Robert J. Goodman¹ · Stephen K. Trapp² · Ernest S. Park³ · Jody L. Davis⁴

Received: 23 March 2019 / Accepted: 12 July 2020 / Published online: 5 January 2021 © Springer Nature B.V. 2021

Abstract

In a pair of studies, the present research examined mindfulness as a mediator through which perceived support for the basic psychological needs of autonomy and competence facilitate adaptive outcomes in a university classroom setting. In Study 1 (N=199), dispositional mindfulness mediated the relation between perceived support for autonomy and competence in daily life and generalized test anxiety in college students. In Study 2 (N=328), perceived support for autonomy and competence in the classroom predicted higher test performance and instructor evaluations among college students. Notably, perceived support for autonomy and competence in the classroom predicted increased state mindfulness minutes before a final exam, which in turn was associated with less test anxiety and better test performance, even after controlling for past academic achievement. In summary, instructor support of students' basic needs for autonomy and competence in the classroom context predicted heightened states of mindful awareness prior to a final exam, which explained improvements in academic performance among students. This research represents a first step toward identifying situational factors that facilitate mindful awareness in academic contexts.

Keywords Mindfulness · Basic psychological needs · Test anxiety · Selfdetermination · Academic performance

Robert J. Goodman robert.goodman@nau.edu

¹ Department of Psychological Sciences, Northern Arizona University, 5 E. McConnell Dr, PO Box 15106, Flagstaff, AZ 86011, USA

² Department of Physical Medicine and Rehabilitation, University of Utah, 30 N. 1900 E, Salt Lake City, UT 84132, USA

³ Department of Psychology, Grand Valley State University, 2224 Au Sable Hall, Allendale, MI 49401-9403, USA

⁴ Department of Psychology, Virginia Commonwealth University, P.O. Box 842018, Richmond, VA 23284-2018, USA

1 Introduction

1.1 Mindfulness and Intrinsic Motivation

Mindfulness represents a human capacity for bringing an equanimous, receptive attention and awareness to immediate experiences (Anālayo 2003; Brown and Ryan 2003). Throughout its 2500-year history of practice, mindfulness has been deliberately exercised to increase and refine the clarity of awareness toward internal states, such as interoception, feelings, thoughts, and external stimuli, such as the immediate environment and other people (Anālayo 2003; Bodhi 2011). Early Buddhist scholarship and emerging scientific evidence highlight the salutary effects of mindfulness on a variety of cognitive processes central to learning, such as improvements in attention (Analayo2013; Jha et al. 2007; Tang and Posner 2015; Lutz et al. 2008), memory (see SN 48.10 in Bodhi 2000; Brown et al. 2016; Jha et al. 2010) and prosociality (Berry et al. 2018). For this reason, it is important to identify factors that promote the development of mindful awareness, particularly among students.

In recent years burgeoning research has demonstrated that systematic mindfulness training conduces to higher levels of mindfulness. However, scholars disagree whether mindfulness requires systematic training to cultivate (Grossman 2011) or is an innate human capacity with meaningful variability experienced by all people without training (Baer 2011; Brown and Ryan 2003; Kabat-Zinn 2003). As suggested by Dunne (2011), perspectives on the nature of mindfulness fall on a spectrum from constructivist to innatist. Constructivist perspectives suggest mindfulness emerges through the systematic training of qualities that promote mindfulness. Innatist perspectives, on the other hand, conceptualize mindfulness as an inherent human capacity, and improvements in mindfulness result from reducing biopsychosocial factors that hinder it. Thus, from an innatist point of view, the acuity of mindfulness may be influenced by a variety of developmental (Shaver et al. 2007), psychological (Harvey et al. 2004), genetic (Murakami et al. 2009), and social (Ryan et al. 2007) factors outside the purview of formal mindfulness training. The present research seeks to identify environments supportive of intrinsic motivation as one factor that facilitates the development of mindful awareness among college students in classroom contexts.

Intrinsic motivation, defined as engagement in an activity for the sole enjoyment of the task, has been linked to beneficial outcomes across a variety of settings (e.g., Ryan and Stiller, 1991; Vallerand et al. 2008). The important and positive effects of intrinsic motivation on performance have generated interest in the topic amongst theorists and practitioners, and advances in understanding the conditions that precede intrinsic motivation have been made. For example, self-determination theory (SDT; Deci and Ryan, 1985) has argued that the fulfillment of the basic psychological needs for autonomy, competence, and relatedness increase intrinsic motivation, and subsequent research has shown that when environments are structured to fulfill these needs, intrinsic motivation is in fact enhanced and desirable outcomes do increase (Reeve and Jang, 2006; Reeve et al. 2004). It is well-established that mindfulness serves a foundational role in the development of autonomous motivation (Brown and Ryan, 2003). In the present paper, we suggest that classroom environments that facilitate autonomy and competence among students—antecedents of intrinsic motivation—will also increase their state mindfulness among students. In the following sections, theoretically-grounded links between the fulfillment of basic psychological needs and intrinsic motivation, intrinsic motivation and mindfulness, and then mindfulness and academic outcomes will be discussed. Through the integration of independent but related literatures, we seek to explain how need fulfillment can confer a range of benefits in academic settings (e.g., academic performance and positive perceptions of experiences), particularly when stakes may be high, through its association with mindfulness. Through this novel line of reasoning that is offered, we hope to contribute to the growing literature on the benefits of mindfulness and highlight the fulfillment of basic psychological needs as a factor that facilitates mindfulness and increases positive student experiences.

1.2 Self-determination theory

Over the course of its 40-year development, self-determination theory (SDT) has become a leading source of guidance regarding self-governed behaviors (Deci 1975; Deci and Ryan 1985, 2000a; Vallerand et al. 2008). SDT is a macro-theory of human motivation that assumes an organismic-dialectic meta-theory that explains psychological growth, personality, and motivation in terms of human beings' propensity towards development and the fulfillment of associated psychological needs (Ryan and Deci 2000; Ryan et al. 1997). According to SDT, two primary motivational approaches -autonomous and controlled - are facilitated or diminished by the degree to which three innate psychological needs are fulfilled: autonomy, competence, and relatedness. Autonomy refers to the degree to which behaviors are self-directed and volitional (as opposed to heteronomy, the degree to which behaviors are controlled by external forces; Brown and Ryan 2004; Ryan 1993). Competence refers to perceptions that one's actions are effective and have an impact on their immediate environment (Deci 1975). Relatedness consists of feeling close to others and sustaining meaningful interpersonal relationships (Baumeister and Leary 1995). SDT proposes that unmet psychological needs will be associated with extrinsic motivation, but as needs are satisfied (e.g., as learning and development promote competence), intrinsic motivation is more likely to emerge and frame ongoing experiences.

The predictive value of self-determination theory has been demonstrated consistently across a range of domains. For example, in one study need fulfillment was found to predict increases in both intrinsic motivation and ratings on employee performance evaluations (Baard et al. 2004), while others have reported that increased needs associate with extrinsic motivation and lower levels of job satisfaction, job dedication, and job vitality (Vansteenkiste et al. 2007). In the health domain, needs satisfaction has similarly been linked to intrinsic motivation, which was also positively associated with smoking abstinence (Williams et al. 2006) and greater adherence to medication schedules in diabetic populations (Williams et al. 2009). Likewise, in academic settings, perceived need support in the classroom and intrinsic motivation were found to predict positive academic outcomes (Fortier et al. 1995; Miserandino 1996; Niemiec and Ryan 2009). While concurrent fulfillment of all three needs leads to the most robust increases in intrinsic motivation, interestingly, in academic settings the fulfillment of the needs for autonomy and competence are key in the promotion of many beneficial outcomes that lead to increased motivational engagement (Levesque et al. 2004; Sheldon and Niemiec 2006).

While the described research provides empirical support for the SDT-based prediction that need fulfillment generates intrinsic motivation, more recently, it has been suggested that the subsequent link between intrinsic motivation and positive performance outcomes deserves more thorough investigation and theoretical development (e.g., Cerasoli and Ford 2014). In this regard, one aim of the present paper is to introduce the potential role of mindfulness, by first describing reasons for why intrinsic motivation is likely to facilitate mindful states of awareness, followed by reasons for why mindfulness is likely to precede a variety of desirable academic outcomes.

1.3 Mindfulness, autonomy, and competence

In the framework of Self-Determination Theory, mindfulness is often considered a support for autonomous behavior (for a review, see Deci et al. 2015). Studies have shown that mindfulness increases the tendency to hold autonomous relative to extrinsically controlled values (Brown and Ryan 2004), and that mindful people are "in better position to make meaningful choices and act autonomously" (Ryan et al. 2008, p. 158). Studies have demonstrated people higher in mindfulness show greater basic psychological need fulfillment, whether operationalized as dispositional traits or psychological states captured in daily living using ecological momentary assessment (Brown and Ryan 2003). Experimental manipulations of mindfulness have demonstrated greater attention to ongoing experiences and higher states of intrinsic enjoyment during a variety of tasks, such as eating (Arch et al. 2016) and reading (Brown et al. 2016). Other studies indicate heightened state mindfulness reduces impulsive reactions to impulse-eliciting stimuli, such as unhealthy food (Papies et al. 2012). Taken together, the evidence from these studies demonstrate the strong causal influence mindfulness can have on fulfilling basic psychological needs. From this perspective, mindfulness acts as a foundation for autonomous action by increasing awareness that in every moment one can choose to respond to situations autonomously, rather than heteronomously, in which actions are controlled by extrinsic forces. Likewise, it is heightened, equanimous perspective of one's thoughts feelings and behaviors that allows one to clearly discern their degree of competence.

While mindfulness is useful to fulfill needs for autonomy and competence, we propose that need fulfillment and mindfulness live in a reciprocal, mutually reinforcing relationship. On one hand, the breadth of mindful awareness allows one to discern when they have choices that can be made autonomously (as opposed to reacting to situations and being controlled by extrinsic and introjected motivations) and to more clearly examine their sense of competence as it arises in present experience. On the other hand, when needs for autonomy and competence are met in a given context, people will likely become more motivated to actively engage in presentmoment activities. That is, when a person feels competent and is autonomously motivated, they are also more likely to engage their attention and awareness to present-moment experiences and enter into states of mindfulness. From this perspective, many the adaptive outcomes associated with meeting autonomy and competence needs, such as intrinsic motivation and improved academic performance, could stem directly from meeting needs themselves, but also from the indirect effect that meeting basic psychological needs has on the establishment of mindful awareness.

Interestingly, recent research on the link between intrinsic motivation and performance is suggestive of a possible connection between intrinsic motivation and mindfulness that may help explain why intrinsic motivation results in enhanced performance. For example, Cerasoli and Ford (2014) note that since intrinsic motivation represents interest and enjoyment of an activity for its own sake, this construct alone cannot provide sufficient explanations for performance increases. Enjoyment of a task may facilitate persistence, however, persistence does not necessitate improved performance since it is feasible one could simply continue to perform poorly for extended periods of time while remaining unaware of their incompetence (Kruger and Dunning 1999). This line of reasoning therefore presumes that some intervening mechanism must exist, a process that serves to transform intrinsic motivation into tangible performance increases. Thus, Cerasoli and Ford (2014) propose that when mastery goals are present, intrinsic motivation enhances performance because a mastery orientation offers a sense of purpose and focus to the intrinsically motivated person. More specifically, a dynamical relationship is described, whereby intrinsic motivation induces mastery goals that encourage task involvement and an attentional focus on competence-relevant activities, all of which in turn further boosts intrinsic enjoyment. A longitudinal design and analyses were used to test their predictions, and provided support for the notion that mastery goals mediate the relationship between intrinsic motivation and performance.

Similarly, other recent research has demonstrated a bidirectional relationship between intrinsic motivation and deliberate practice among Estonian athletes who participate in team sports (Vink, Raudsepp, and Kais, 2014). In the domain of competitive sports, high levels of intrinsic motivation are valued due to the need for athletes to chronically demonstrate persistence and determination, particularly since external rewards are often absent. In this study, individual deliberate practice activities were based on the input of two subject-matter experts who were coaches of National Teams (volleyball and basketball), where activities encouraged athletes to have deliberate intention after setting a clear goal of improving a specific skill. Results from linear growth modeling provide evidence of a dynamical relationship such that initial levels of intrinsic motivation predicted subsequent levels of deliberate practice and initial levels of deliberate practice predicted subsequent levels of intrinsic motivation.

Findings from these past works suggest that intrinsic motivation, particularly when followed by the adoption of mastery goals, increases deliberate attentional involvement with a specific focus being drawn towards those activities and experiences that are relevant to the gradual development of deep learning. Others have argued that as competence is pursued, attention is (ironically) directed away from self-related thoughts and concerns and is instead directed towards to moment-to-moment activity (Abuhamdeh and Csikszentmihalyi, 2012). Thus, one narrative that emerges from the integration of these literatures is that intrinsic motivation heightens attentional involvement and focus, and this attention on moment-to-moment experiences that serves to ultimately facilitate learning and performance, ends up directing attention away from self-concerns (Abuhamdeh and Csikszentmihalyi, 2012; Cerasoli and Ford, 2014; Vink et al. 2015).

With attention focused on the present and directed away from self-concerns, activities are more fully experienced, task aspects and details are more readily recognized, and enjoyment levels are sustained or increased. And importantly, as tasks are pursued and navigated for the sake of enjoyment, personal performance goals and various aspects of the self should inherently be made less accessible and central to ongoing experiences. These reductions in distraction, increases in task enjoyment, and reduced ego involvement have each been causally linked to heightened states of mindfulness in previous research (Arch et al. 2016; Heppner et al. 2008; Mrazek et al. 2012). On the basis of this reasoning and evidence, we hypothesize meeting basic needs for autonomy and competence in a particular context will lead to increased state mindfulness in that context. Furthermore, due to the heightened awareness and reductions in ego-involvement that are inherent to mindfulness, we also predict that mindfulness that stems from meeting autonomy and competence needs will be associated with positive performance outcomes on tasks that typically invoke self-evaluative performance anxiety. The reasoning for this claim will be presented next.

1.4 Mindfulness and academic performance

Several lines of research suggest mindfulness is likely to precede a variety of desirable academic outcomes. Mindfulness has been linked to improvements on a variety of indices that are central to learning and the acquisition of knowledge, such as higher scores on the GRE reading-comprehension test (Mrazek et al. 2013), and on tests of working memory (Jha et al. 2010), episodic memory, and the free recall of reading material (Brown et al. 2016). One reason mindfulness is conducive to learning and academic performance is that it may confer important regulatory advantages, particularly in evaluative contexts.

A hallmark of mindfulness is the experience of internal and external states as impermanent, changing processes to be observed, rather than identified with as concrete aspects of an unchanging self (Anālayo 2003; Gombrich, 2009). This characteristic of mindfulness, commonly known as *decentering* (Bishop et al. 2004), is theorized to promote a variety of adaptive outcomes that mitigate self-concerns and evaluative anxiety, such as reductions in ego-involvement (Heppner et al. 2008), lower defensive responding in the face of self-relevant threat and enhancements in self-regulation (Lakey et al. 2008), emotion regulation (Brown et al. 2013; Uusberg et al. 2016), and downstream performance improvements, particularly in evaluative

situations (Beddoe and Murphy 2004; Brown et al. 2012; Schoenert-Reichl and Lawlor 2010; Shapiro et al. 1998). On the basis of this reasoning and evidence, we suggest that mindfulness may improve academic performance outcomes by blunting states of test anxiety.

Contemporary theories about test anxiety focus on the motive to avoid failure (Hagtvet and Benson 1997) and suggest that anticipated negative evaluations from others and self-critical thoughts are central aspects of the construct (Sarason 1984). From this perspective, test anxiety has distinct facets including cognitive, physiological, and behavioral components (Zeidner and Mathews 2005). The cognitive component consists of worry, self-threatening negative thoughts, and other forms of intrusive cognition that serve as distractions from the testing situation. The physiological component refers to the experience of physiological arousal related to an evaluative context. The behavioral aspect involves engaging in various self-handicapping strategies and poor study habits that tend to undermine academic achievement.

From this description it is clear that evaluative anxiety inherently involves an orientation towards the future, with cognitions and behaviors centered on the task of assessing and avoiding potential threats to the self. While it can be adaptive for self-related concerns to generate facilitative arousal in anticipation of the need to act (Alpert and Haber 1960), high arousal states such as anxiety and worry can tax attentional resources that may be required to engage more task-relevant processes. Furthermore, because the hyper-egoic drive to avoid failure makes self-protective desires particularly salient, distractions are likely to decrease attentional involvement and task focus, resulting in performance declines (Abuhamdeh and Csikszentmihalyi 2012). Therefore, it stands to reason that if one's attention can be focused on the present task at hand instead of on self-concerns that involve projections of future outcomes, then the ability to perform effectively should increase, as should enjoyment and general satisfaction (Cerasoli and Ford 2014). If heightened awareness of moment-to-moment experiences engender task aspects and activities to be more fully encountered, and the negative constellation of feelings, cognitions, and responses that accompany anxiety all decline, then mindfulness should be positively related to performance in contexts that invoke anxiety.

Complementing the existing work summarized above, the current paper aims to contribute to literature on mindfulness, motivation and performance by describing how the interrelations between mindfulness and intrinsic motivation promote salutary academic performance outcomes. The specific predictions that follow from the application of theories are provided in the subsequent section, as the methodological strategies for testing these hypotheses are outlined.

1.5 The present research

The present studies examined the possibility that mindfulness plays a role in the link between support for autonomy and competence needs in classroom contexts and improvement in academic performance outcomes. Study 1 was designed to explore the potential relationship between basic psychological need satisfaction and

mindfulness, and to examine the relationship between mindfulness and test anxiety. Students reported their general level of perceived support for autonomy and competence in daily living, generalized test anxiety, and dispositional mindfulness, as well as instructor evaluation and grade point average (GPA). We hypothesized that perceived support for the fulfillment of basic psychological needs of autonomy and competence would be associated with a tendency toward mindful awareness, which in turn would be associated with less generalized test anxiety and favorable academic outcomes.

Mindfulness and test anxiety both can be conceptualized as stable individual differences as well as psychological states; Study 2 examined the state variants of these constructs to provide convergent evidence with the measures used in Study 1. In Study 2, students who were about to take a final exam reported their perceived support for autonomy and competence in that specific class as well as their current state of mindfulness, state test anxiety, instructor evaluation, and GPA. Final exam scores also were recorded. We hypothesized that the fulfillment of basic psychological needs of autonomy and competence in the classroom would have a direct effect on instructor evaluation and test performance, after controlling for past academic achievement, and that the fulfillment of basic psychological needs in the classroom would have an direct effect on test performance, as well as a significant indirect effect on test performance through state mindfulness and state test anxiety.

2 Study 1

Study 1 had two primary aims. The first aim was to explore the possibility that relation between satisfaction of basic psychological needs and both test anxiety and academic performance would be mediated by dispositional mindfulness. Since the conditions for mediation cannot be met with the current research design (e.g., temporal precedence could not be established), a second aim of Study 1 was address this by develop short measures of support for basic needs and test anxiety that could be quickly administered to students prior to a final exam (Study 2). To this end, we performed factor analyses for the purpose of item reduction.

2.1 Method

2.1.1 Participants and procedure

Participants were 199 students attending a large Southeastern university enrolled in undergraduate psychology courses who participated voluntarily to partially fulfill a course requirement. Each student completed an online survey containing a battery of individual difference measures. The sample was 66.30% female, with a median age of 19 years (range = 18–50; SD = 4.38). Students consisted of 54.30% freshman (n=108), 24.60% sophomores (n=49), 14.10% juniors (n=28), and 7.00% seniors (n=14). Informed consent was obtained from all individual participants included in

the study. All study procedures and materials were approved by the Virginia Commonwealth University Institutional Review Board.

2.1.2 Materials

Autonomy and competence support. The autonomy and competence subscales from the General Need Satisfaction Scale (GNS; Gagné 2003; α =0.89) were used to measure perceived support for intrinsic motivation in daily living. The GNS is an adaptation of the family of Basic Need Satisfaction scales, which tap into need satisfaction in a variety of specific contexts such as work (Ilardi et al. 1993), relationships (La Guardia et al. 2000), and physical education classes (Ntoumanis 2005). Participants responded to 21 items on a 1 (*Not true at all*) to 7 (*Very true*) Likerttype scale. Table 1 depicts example items for each subscale of the GNS.

Test anxiety. The Revised Test Anxiety scale (RTA; Benson and El-Zahhar 1994; $\alpha = 0.92$) was used to measure individual differences in test anxiety. The RTA is a composite of two popular scales used to measure test anxiety: the Test Anxiety Inventory (TAI; Spielberger 1980) and the Reactions to Testing scale (RTT; Sarason 1984). The 20-item RTA measures individual differences in cognitive, behavioral, and bodily reactions to test anxiety. The scale contains four factors: worry (6 items; $\alpha = 0.81$), tension (5 items; $\alpha = 0.89$), test-irrelevant thinking (4 items; $\alpha = 0.85$), and bodily symptoms (5 items; $\alpha = 0.81$). Participants responded to each item on a 1 (*Not at all accurate*) to 4 (*Very accurate*) Likert-type scale. Table 1 depicts example items for each subscale of the RTA. Analyses were conducted on overall test anxiety score.

Dispositional mindfulness. The Mindful Attention Awareness Scale (MAAS; Brown and Ryan 2003; α =0.86) was used to capture the frequency with which people enter into states of open and receptive awareness over time. Participants responded to each of the 15 items using a 7-point Likert-type scale from 0 (*Not at all*) to 6 (*Very Much*). The MAAS is widely used and several independent analyses attest to its validity and unidimensional factor structure (Baer et al. 2006; Carlson and Brown 2005; Cordon and Finney 2008; MacKillop and Anderson 2007). Table 2 depicts example items for the MAAS.

Academic performance and instructor evaluations. As a measure of academic performance, students reported their cumulative grade point average (GPA). Participants also responded to one question on a 1 (*Poor*) to 5 (*Outstanding*) scale to evaluate their instructor, derived from the institution's course evaluation form.

2.2 Results and discussion

2.2.1 Preliminary analyses

As expected, basic psychological needs accounted for a significant proportion of the variance in test anxiety ($r_{197} = -0.28$, p < 0.0001), self-reported GPA ($r_{197} = 0.14$, p < 0.05), and instructor ratings ($r_{197} = 0.14$, p < 0.05). Those higher in dispositional mindfulness reported significantly lower levels of test anxiety ($r_{197} = -0.42$,

Measure	Scales/Sample Items	Factor Loading
Autonomy & Competence Support	General Need Satisfaction scale (GNS)	
Autonomy 01	"I generally feel free to express my ideas and opinions."	.78
Autonomy 02	"I feel like I can pretty much be myself in my daily situations."	.73
Competence 01 (R)	"I often do not feel very capable."	.80
Competence 02	"Most days I feel a sense of accomplishment from what I do."	.71
TA: Cognitive Symptoms	Revised Test Anxiety scale (RTA)	
Test Irrelevant Thinking 01	"While taking tests sometimes I think about being somewhere else."	.83
Test Irrelevant Thinking 02	"During tests I find myself thinking of things unrelated to the test material."	.81
Worry 01	"I worry a great deal before taking an important exam."	.78
Worry 02	"T am anxious about tests."	.78
TA: Physiological Symptoms		
Body Symptoms 01	"I have difficulty breathing while taking a test."	.85
Body Symptoms 02	"My mouth feels dry during a test."	.78
Tension 01	"T seem to defeat myself while taking important tests."	.82
Tension 02	"Thinking about my grade in a course interferes with my work on tests."	.76

 $\underline{\textcircled{O}}$ Springer

Opening minds by supporting needs: do autonomy and competence...

Table 2 Scale items and relial	bilities for items used in Study 1 analysis	
Measure	Adjusted Item	α
Perceived Support for Autono	my & Competence	
Autonomy 01	"I generally felt free to express my ideas and opinions in this class."	.61
Autonomy 02	"I felt like I could pretty much be myself in this class."	
Competence 01 (R)	"I often did not feel very capable in this class."	.79
Competence 02	"Most days I felt a sense of accomplishment from what I did in this class."	
TA: Cognitive Symptoms		
Test Irrelevant Thinking 01	"I will think about being somewhere else while taking this test."	.73
Test Irrelevant Thinking 02	"I may find myself thinking of things unrelated to the material on the test."	
Worry 01	"I am worrying a great deal before taking this important exam."	.81
Worry 02	"I am anxious about this test."	
TA: Physiological Symptoms		
Body Symptoms 01	"I am experiencing some difficulty breathing before taking this test."	.70
Body Symptoms 02	"My mouth will feel dry during this test."	
Tension 01	"I believe that I may set myself up for failure on this test."	.68
Tension 02	"Thinking about my grade in this course will interfere with my work on this test."	
State Mindfulness		
State Mindfulness 01	"I am rushing through the activity without being really attentive to it."	.80
State Mindfulness 02	"I am doing this task automatically, without being aware of what I am doing."	
State Mindfulness 03	"I am preoccupied with the future or the past."	
State Mindfulness 04	"I am doing things without paying attention."	
Instructor Evaluation	"Overall, how would you rate this instructor?"	_

a Cronbach's Alpha, R Reverse-scored item, TA Test Anxiety

p < 0.0001), but mindfulness was not related to self-reported GPA ($r_{197} = 0.04$, p > 0.05).

To determine whether dispositional mindfulness would explain the effect of basic psychological need satisfaction on individual differences in test anxiety, we examined whether mediation was present using bootstrapping analyses via PROCESS (Hayes-Skelton and Graham 2013). Predictor and mediator variables were centered against their own means to reduce multicollinearity. This model, conducted with 10,000 bootstrap samples yielded a mean bootstrap estimate of the indirect effect of the basic psychological needs satisfaction through dispositional mindfulness of -0.11. Because the 95% confidence interval did not include 0 (0.19–0.06), it was confidently concluded that dispositional mindfulness partially mediated the effect of basic psychological need satisfaction on test anxiety. That is, a significant portion of the effect of basic psychological need satisfaction on test anxiety was explained through dispositional mindfulness (see Fig. 1).



Fig. 1 Dispositional mindfulness as a partial mediator of the effect of need satisfaction and test anxiety

In short, the results from Study 1 provided preliminary evidence for the theoretical model to be tested in Study 2 (see Fig. 2). Fulfillment of basic psychological needs was associated with better academic performance, more favorable instructor evaluations, and lower levels of test anxiety. Dispositional mindfulness also was associated with lower levels of test anxiety, and partially mediated the link between basic psychological need satisfaction and test anxiety, suggesting that mindfulness is one mechanism by which need satisfaction may ameliorate test anxiety.

2.2.2 Item reduction and adjustment

Scales were submitted to an exploratory factor analysis with principal components factoring, orthogonal rotation, and an extraction cutoff of eigenvalue = 1.0 (i.e., latent root criterion). The measures of sampling adequacy for the RTA and GNS



Fig. 2 Hypothesized Conceptual Model

🖄 Springer

were 0.90 and 0.84, respectively, and Bartlett's test of sphericity resulted in significant chi-square values (RTA: $\chi^2 = 2058.39$, p < 0.001; GNS: $\chi^2 = 1158.02$, p < 0.001), indicating the appropriateness of each set of scale items for factor analysis. To be most parsimonious and reduce the amount of time students would need to complete the study before their final exam, two items from each measure were selected with the highest loadings on each subscale for use in Study 2. See the Measures section under Study 2 for information on each scale. Table 1 depicts each of the items chosen for Study 2 and their respective factor loading.

3 Study 2

Study 2 sought to extend the results from Study 1 by exploring how student perceptions of support for autonomy and competence within the classroom environment would be associated with states of mindfulness and test anxiety immediately prior to a final course examination. Final exam grade was used as a measure of academic performance, which is not susceptible to social desirability effects. Measures of test anxiety and basic psychological needs from Study 1 were shortened due to the time constraints involved in administering these measures at the start of the final exam class period. It was expected that need fulfillment would be positively related to mindfulness, and increased levels of state mindfulness before a final exam would then predict increased academic performance indirectly through the blunting effect of mindfulness on both cognitive and physiological manifestations of test anxiety. In order to examine the state experience of mindfulness before test taking, a validated state version of the MAAS was used in Study 2 (Brown and Ryan 2003). Extending the findings of Study 1, students' perceptions of support for autonomy and competence in the classroom context were expected to directly facilitate academic performance and instructor evaluations.

3.1 Method

3.1.1 Participants

Participants were 328 students attending a large Southeastern university who were enrolled in undergraduate psychology courses: two Introduction to Psychology courses (n=103; n=134) and one Interpersonal Relationships psychology course (n=91). Cumulative grade point averages for the two Introduction to Psychology courses (M=2.85; M=2.98) and the Interpersonal Relationships course (M=2.99) were not significantly different, $F_{(2,325)}$ =2.28, p>0.05, η^2 =0.01. Each course was taught by a different instructor, and analyses were conducted across all three classes while controlling for classroom/instructor to account for the nested structure of the data using the CLUSTER function in MPlus (Muthén and Muthén 2015). The overall sample was 59% female, with a median age of 20 years (range = 16–61; SD=3.23). Students consisted of 36.80% freshman (n=149), 27.20% sophomores (n=110), 22.50% juniors (n=91), and 13.50% seniors (n=55). All study procedures and materials were approved by the Virginia Commonwealth University Institutional Review Board.

3.1.2 Measures

Classroom-specific autonomy and competence support. Items adapted from the autonomy and competence subscales of the General Need Satisfaction Scale (GNS; Gagne 2003; $\alpha = 0.89$) derived in Study 1 were used to measure classroom-specific support for autonomy and competence. Revised GNS items were used to capture the degree of perceived support for autonomy and competence in a classroom context. For example, an item originally written as "I feel like I can pretty much be myself in my daily situations " was modified to read "I felt like I can pretty much be myself in this class." Participants responded to two items sensitive to autonomy support in the classroom and two items sensitive to competence support in the classroom. Responses were indicated to each of the four items on a 1 (*Not true at all*) to 7 (*Very true*) Likert-type scale. Table 2 depicts examples items for the modified scale.

State mindfulness. The state variant of the Mindful Attention Awareness Scale (s-MAAS; Brown and Ryan 2003; Study 5; $\alpha = 0.80$) was used to capture the degree to which a person is mindful at a specific point in time. Similar to the dispositional version of the MAAS used in Study 1, this state version of the MAAS also had a unidimensional factor structure. An example item is "I was preoccupied with the future or the past." Participants responded to each of the 5 items using a 7-point Likert-type scale from 0 (*Not at all*) to 6 (*Very Much*).

State test anxiety. The adapted items from Study 1 were used to measure cognitive and physiological reactions to states of test anxiety (see Table 2 for example items). Each of the RTA items was slightly modified to capture the state of students' test anxiety immediately prior to taking the exam. For example, an item originally written as "I worry a great deal before taking an important exam" was modified to read "I am worrying a great deal before taking this important exam" to better read as a state-related question. A total of 8 items were administered to assess state test anxiety. Cognitive reactions to test anxiety were measured using four items, two items were derived from the Worry subscale and two were derived from the Test Irrelevant Thinking subscale. Physiological reactions to test anxiety were measured using four items, with two items derived from the Tension subscale and two items derived from the Bodily Symptoms subscale. Participants responded to each item using a 1 (*Almost never*) to 4 (*Almost always*) scale.

Academic performance and instructor evaluations. Each questionnaire packet contained an ID number that students recorded on the Scantron® form supplied for their final exam. The course instructor provided exam grades using the packet ID number such that anonymity could be maintained. Instructor evaluation was assessed with the same item as in Study 1.

3.1.3 Procedure

In each of three classes, students had the opportunity to voluntarily participate in a study exploring test anxiety during their final exam period. Participation rates were

over 80% within each of the three classrooms. Following consent, the experimenter handed out questionnaire packets to each student before exams were distributed. Students had 15-min to complete the questionnaire packet before starting their final examination. There were two forms of the packet with counterbalanced scale orders to examine and control for any potential order effects.

3.2 Results and Discussion

The hypothesized Structural Equation Model (SEM) was tested using the Mplus statistical package (Muthén and Muthén 2015). Prior to analyses, data were excluded from several cases due to excessive missingness (n=46), failure to follow instructions (n=9), or failure to provide the requisite information to link their data to their final exam grade (n=19). Mean imputation was used to correct for the 15 missing scale responses that remained. Independent samples *t*-tests revealed no significant effects due to packet order (all ps > 0.10).

The final hypothesized SEM model is described graphically in Fig. 2. Circles represent latent variables and rectangles represent observed variables. A correlation table using standardized variables (with means set to 0 and standard deviations set to 1) is shown in Table 3. SPSS was used to evaluate assumptions of univariate normality, multivariate normality, and linearity, and three multivariate outliers were removed from subsequent analyses, leaving a final sample of 328 students. Given the nested structure of the data, maximum likelihood with robust standard errors for parameter estimation was chosen to adjust the standard errors for clustered sampling, such that analyses could be conducted across the three classrooms without violating assumptions of independence. A range of fit indices suggested that the hypothesized model fit the data reasonably well (CFI=0.90; TLI=0.87; RMSEA=0.06), and although the chi-square test of model fit was significant (χ^2_{138} =313.86, *p*<0.0001), it was retained as our final model.

Structural and measurement coefficients from the completely standardized solution are displayed in Fig. 3. All coefficients emerged as significant besides the direct effect of physiological symptoms of test anxiety on final exam grade and the correlation between final exam grade and instructor evaluation. Students who perceived a greater level of support for autonomy and competence in the classroom evaluated their instructor more positively ($\beta = 0.53$), were more mindful immediately prior to the final exam ($\beta = 0.33$) and performed better on the final exam ($\beta = 0.23$) after taking past achievement (GPA) into account. Furthermore, students who were more mindful immediately prior to the final exam reported fewer cognitive ($\beta = -0.43$) and physiological symptoms ($\beta = -0.31$) of test anxiety. Moreover, students with fewer cognitive symptoms of test anxiety performed better on the final exam $(\beta = -0.28)$ after taking into account past achievement (GPA). As expected, students with higher self-reported GPA's also performed better on the final exam ($\beta = 0.38$). Indirect and total effects are depicted in Table 4. As is evident, perceived support for autonomy and competence in the classroom had a significant total effect that explained final exam score ($\beta = 0.28$, p < 0.001). State mindfulness also had a significant total effect on final exam score ($\beta = 0.15$). Overall, the effect of perceived

Table 3 Correlations for SE	M Anal	yses in	Study 2																
Observed variable	1	2	3	4	5	6	7	8	6	10	11	12	13	14	15	16	17	18	6
01. Autonomy 1	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I	1		Ι.
02. Autonomy 2	.47	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	I		
03. Competence 1	.31	.38	1	I	I	I	I	I	I	I	I	I	I	I	I	I	I	'	
04. Competence 2	.33	4.	.29	1	I	I		I	I	I	I	I	I	I	I	I	I	' 1	
05. State mindfulness 1	.15	.15	.13	.18	1	I	I	I		I	I		I	I	I	I	I		
06. State mindfulness 2	.15	.17	.12	.12	.61	1	I	I	I	I	I	I	I	I	I	I	I		
07. State mindfulness 3	.06	.16	.13	.05	.29	.32	1	I	I	I	I	I	I	I	I	I	I	'	
8. State mindfulness 4	.12	.20	.16	.17	.57	.66	.51	1	I	I	I	I	I	I	I	I	·		
09. TA: worry 1	04	11	28	.03	05	07	32	10	1	I	I	I	I	I	I	I	·		
10. TA: Worry 2	90.	12	19	<u>.</u>	10	15	33	17	.71	1	I	I	I	I	I	I	I		
11. TA: body symptoms 1	07	18	21	- 03	05	12	20	15	.36	.39	1	I	I	I	I	I			
12. TA: body symptoms 2	17	15	19	03	- 00	12	13	15	.31	.34	.48	1	I	I	I	I	·		
13. TA: irr. thinking 1	12	21	18	14	26	23	30	30	60.	.18	.14	.14	1	I	I	I	I	1	
14. TA: irr. thinking 2	07	22	18	17	24	24	34	34	.22	.32	.27	.22	.57	-	I	I		1	
15. TA: tension 1	14	34	35	19	21	25	24	30	.31	.33	4.	.36	.42	.48	1	I			
16. TA: tension 2	13	22	33	10	- 00	24	36	23	.51	44	.43	.40	.26	.40	.51	1		1	
17. Self-reported GPA	.10	.12	.13	01	01	.0	90.	.03	09	10	13	33	 -	18	23	19	-	1	
18. Instructor Evaluation	.33	.30	.25	.41	60.	.10	.04	.18	00.	.01	05	16	17	14	21	17	.07	-	
19. Final exam grade	.21	.23	.31	.15	00.	.10	.03	.11	15	09	17	13	15	19	36	27	4.	20 1	
All variables were standardi	zed to h	ave a m	lean of () and a st	tandard o	leviation	n of 1. A	<i>I</i> =328;	M = 0; S	D=1									I

🙆 Springer



Fig. 3 Results for the structural equation model. $\chi^2(138) = 313.86$, p < .0001; Comparative Fit Index = .90; Tucker-Lewis Index = .87; root mean square error of approximation = .06; Parameter estimation conducted using maximum likelihood with robust standard errors. N=328; degrees of freedom = 138. Note. Coefficients indicated within disturbance variables represent the proportion of variance explained (R^2) for the variable

Table 4Indirect and totaleffects for SEM model	Indirect Effects	β	р
	Need support on final exam	.04	.001
	Need support on TA-cognitive	14	.001
	Need support on TA-physio	10	.001
	Total effects		
	Need support on final exam	.28	.001
	State mindfulness on final exam	.15	.001

support for autonomy and competence in the classroom on final exam score was partially mediated by state mindfulness and state test anxiety.

4 General discussion

The present research tested a model that integrated existing theories from SDT and mindfulness as determinants of academic performance outcomes. Consistent with our hypotheses, the perceived support for basic psychological needs in the classroom predicted higher levels of academic achievement, mindfulness, instructor evaluations, and lower levels of test anxiety. Moreover, the effect of basic psychological need satisfaction on students' generalized test anxiety was partially explained by dispositional mindfulness (Study 1). Study 2 extended the findings of Study 1 by administering a measure of classroom-specific basic psychological need satisfaction and state measures of mindfulness and test anxiety prior to a final exam. Structural

equation modeling revealed students who perceived greater support for basic psychological need satisfaction also demonstrated more favorable test performance and instructor evaluations. Importantly, the effect of classroom-specific basic psychological need satisfaction on test performance was partially mediated by state mindfulness and test anxiety, even after controlling for past academic achievement. In sum, the model suggests support for the roles of basic psychological need satisfaction and states of mindfulness prior to a final exam, which is inversely related with cognitive and physiological manifestations of test anxiety and directly related to improvements in test performance.

Notably, perceptions of autonomy and competence need satisfaction in the classroom explained twice the variability in academic performance as domain-general need satisfaction. This difference highlights the influence that situational factors may have on psychological need fulfillment and downstream states of mindfulness, and suggests additional questions of rich theoretical and practical importance. Is the intrinsic motivation that results from satisfying basic psychological needs in general life domains blunted by controlling or unsupportive contexts? Conversely, is context-specific support for basic psychological need satisfaction as beneficial for students coming from backgrounds unsupportive of their psychological needs? Future research should explore the potential interactions between domain general and domain specific support for basic psychological needs on performance outcomes in education.

Mindfulness was a significant mediator of the effect of basic psychological need fulfillment on test anxiety and subsequent academic performance outcomes. Mindfulness is widely considered a foundational support for autonomous behavior (Brown and Ryan 2003; Levesque and Brown 2007), and students with greater dispositional mindfulness tended to have higher levels of basic psychological need satisfaction in daily life (Study 1). Study 2 extended these findings by demonstrating that student perceptions of instructor support for autonomy and competence had a direct effect on states of mindfulness among students prior to taking a final exam. This finding suggests that student perceptions of support for their needs for autonomy and competence in the classroom may be a situational antecedent that facilitates mindful awareness in the classroom, and particularly when self-evaluative threat is likely. From this perspective, the results of the second study provide support for an innatist view of mindfulness by identifying perceived support for intrinsic motivation as one situational factor that encourages heightened states of mindfulness other than structured mindfulness training.

We suggest perceived support for intrinsic motivation could facilitate mindfulness for several reasons. First, when the classroom environment provides students with opportunities to behave autonomously and demonstrate competence, they will seek to express these qualities. One effective way to do this is to increase mindful awareness of their present moment internal experience and external circumstances. This is consistent with past research linking higher levels of intrinsic motivation with greater attentional involvement and sustained task focus and enjoyment, as well as decreased attention allocated to future-focused self-evaluative concerns (Abuhamdeh and Csikszentmihalyi 2012; Brown et al. 2016; Cerasoli and Ford 2014; Vink et al. 2015).

🖉 Springer

Second, support for basic psychological need fulfillment would increase mindfulness by mediating the deleterious consequences of low intrinsic motivation. For example, a student with low intrinsic motivation to attend a class may have greater desire to engage in activities not related to the class. The desire to engage in activities unrelated to learning have a strong pull in the absence of intrinsic motivation, and self-control is necessary to regulate such temptations and direct behavior in classroom appropriate ways (Baumeister et al. 1998; Hoffmann and Van Dillen 2012). The struggle to overcome internal resistance to present circumstances could increase mind wandering and ego-depletion among students who are not intrinsically motivated, and potentially lower qualities of mindfulness (Mrazek et al. 2012). In contrast, students who are intrinsically motivated to be in the classroom would not need to overcome such internal resistance, and would be more likely to mindfully engage with present moment activities (Csikszentmihaly, 1990).

Both studies demonstrated an effect of basic psychological need satisfaction on test anxiety and academic performance. Domain-general and classroom-specific measures of autonomy and competence support predicted higher academic achievement. Moreover, students with greater satisfaction of basic psychological needs tended to have lower levels of generalized test anxiety, and this relationship was partially mediated by dispositional mindfulness. However, dispositional mindfulness did not predict students' self-reported GPA in Study 1. Study 2 demonstrated that perceptions of support for autonomy and competence in the classroom led to greater mindfulness immediately prior to a final exam, which ameliorated cognitive and physiological manifestations of state test anxiety and, in turn, led to better test performance.

To our knowledge, this is the first study to demonstrate effects of basic psychological need satisfaction on test anxiety and mindfulness in an educational context. Past research has identified effects of intrinsic motivation support on qualities that closely covary with test anxiety, such as concentration, time management, attitudes toward studying (Vansteenkiste et al. 2005; Zeidner and Mathews 2005), and subjective well-being (Levesque et al. 2004). Additional research has demonstrated that controlling academic environments increase negative experiences among students, such as anger and anxiety (Assor et al. 2005). Likewise, greater mindfulness has been associated with greater subjective well-being and lower anxiety (Brown and Ryan 2003) as well as more self-directed, autonomous behavior (Levesque and Brown 2007; Brown and Ryan 2004). In sum, the results of the present studies are consonant with the pattern of relationships found in previous work, and extend the literature on self-determination by providing evidence that classroom-specific support for autonomy and competence is associated with less test anxiety and improved academic performance via increased states of mindfulness among students.

Interestingly, students were not the only people to benefit from a classroom environment supportive of autonomy and competence. Consistent with past research (Filak and Sheldon 2003), Study 1 found that students who satisfy their basic psychological needs in daily life also tend to rate instructors more favorably. Study 2 revealed a significant effect of perceptions of support for autonomy and competence in the classroom on instructor evaluations, and the magnitude of this effect was substantially larger than with student grades. Thus, instructors may likely reap professional benefits for their efforts in establishing a classroom context supportive of autonomy and competence by receiving more favorable evaluations from their students. Research has shown that instructors can be supportive of their students' basic psychological need satisfaction by probing for the needs of the students, allowing time for students to work problems through their own methods, offer praise as informational feedback, and providing hints (Reeve and Jang 2006).

4.1 Limitations and future research

These studies were designed in part to examine how preexisting differences in perceptions of support for basic psychological need satisfaction would translate into states of mindfulness, test anxiety, and test performance. Although the proposed structural equation model from Study 2 fits well with theoretical causal assumptions, such assumptions must be taken as provisional support for causality. Collecting data at time points appropriate for the establishment of temporal precedence or conducting experiments that manipulate support for autonomy and competence would increase confidence in the validity of conclusions made in the present study.

Another limitation of the present study involved time-constraints imposed on the administration of measures prior to final exams. Measures of support for basic psychological need satisfaction and state test anxiety each were reduced to four items (Study 1). Even though care was taken to select items that accounted for the most unique variance in each construct, Study 2 would have benefited from the administration of measures with a greater number of items.

4.2 Conclusion

Perceived support for autonomy and competence need satisfaction in the classroom had a direct effect on states of mindfulness prior to a final examination, which was associated with fewer physiological and cognitive manifestations of test anxiety and, in turn, better test performance. In addition, students who perceived their classroom context as supportive of autonomy and competence need satisfaction rated their instructors more favorably. These results contribute to a growing body of literature on self-determination in educational contexts by suggesting that instructor support for the satisfaction of students' innate psychological needs in the classroom has both direct and indirect benefits on academic outcomes. This knowledge may inform course instructors of the manifold beneficial outcomes that result from structuring the classroom context to support student autonomy and competence, and represents a first step toward identifying factors besides systematic training that facilitate states of mindfulness.

Funding This study was did not receive funding from any intramural or extramural source.

Compliance with ethical standards

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

- Abuhamdeh, S., & Csikszentmihalyi, M. (2012). The importance of challenge for the enjoyment of intrinsically motivated, goal-directed activities. *Personality and Social Psychology Bulletin, 38*, 317–330.
- Anālayo, Bh. (2003). Satipatthāna: The direct path to realization. Birmingham, UK: Windhorse.
- Anālayo, Bh. (2013). Perspectives on Satipatthāna. Birmingham, UK: Windhorse.
- Arch, J. J., Brown, K. W., Goodman, R. J., Della Porta, M. D., Kiken, L. G., & Tillman, S. (2016). Enjoying food without caloric cost: The impact of brief mindfulness on laboratory eating outcomes. *Behaviour Research and Therapy*, 79, 23–34.
- Assor, A., Kaplan, H., Kanat-Maymon, Y., & Roth, G. (2005). Directly controlling teacher behaviors as predictors of poor motivation and engagement in girls and boys: The role of anger and anxiety. *Learning and Instruction*, 15, 397–413.
- Baard, P. P., Deci, E. L., & Ryan, R. M. (2004). Intrinsic need satisfaction: A motivational basis of performance and well-being in two work settings. *Journal of Applied Psychology*, 34, 2045–2068.
- Baer, R. A. (2011). Measuring mindfulness. Contemporary Buddhism, 12, 241-261.
- Baer, R. A., Smith, G. T., Hopkins, J., Krietemeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. Assessment, 13, 27–45.
- Baumeister, R. F., Bratslavsky, E., Muraven, M., & Tice, D. M. (1998). Ego-depletion: Is the active self a limited resource? *Personality Processes and Individual Differences*, 74, 1252–1265.
- Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117, 497–529.
- Beddoe, A. E., & Murphy, S. O. (2004). Does mindfulness decrease stress and foster empathy among nursing students? *The Journal of Nursing Education*, 43, 305–312.
- Benson, J., & El-Zahhar, N. (1994). Further refinement and validation of the revised test anxiety scale. Structural Equation Modeling, 1, 203–221.
- Berry, D. R., Cairo, A. H., Goodman, R. J., Quaglia, J. T., Green, J. D., & Brown, K. W. (2018). Mindfulness increases prosocial responses toward ostracized strangers through empathic concern. *Journal of Experimental Psychology: General*, 147(1), 93.
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., et al. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and practice*, 11, 230–241.
- Brown, K. W., Goodman, R. J., & Inzlicht, M. (2013). Dispositional mindfulness and the attenuation of neural responses to emotional stimuli. *Social Cognitive and Affective Neuroscience*, 8, 93–99.
- Brown, K. W., Goodman, R. J., Ryan, R. M., & Anālayo, Bh. (2016). Mindfulness enhances episodic memory performance: Evidence from a multimethod investigation. *PLoS ONE*, 11, 1–19.
- 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. (2004). Fostering healthy self-regulation from within and without: A selfdetermination theory perspective. In P. A. Linley & S. Joseph (Eds.), *Positive Psychology in Practice* (pp. 105–124). New Jersey: John Wiley & Sons Inc.
- Brown, K. W., Weinstein, N., & Creswell, J. D. (2012). Trait mindfulness modulates neuroendocrine and affective responses to social evaluative threat. *Psychoneuroendocrinology*, 37, 2037–2041.
- Bodhi, Bh. (2011). What does mindfulness really mean? a canonical perspective. *Contemporary Buddhism, 12,* 19–39.
- Bodhi, Bh. (2000). The Connected discourses of the Buddha: The Samyutta Nikāya. Boston: Wisdom Publications.

Carlson, L. E., & Brown, K. W. (2005). Validation of the Mindful Attention Awareness Scale in a cancer population. *Journal of Psychosomatic Research*, 58, 29–33.

- Cerasoli, C. P., & Ford, M. T. (2014). Intrinsic motivation, performance, and the mediating role of mastery goal orientation: A test of self-determination theory. *Journal of Psychology*, 148, 267–286.
- Cordon, S., & Finney, S. J. (2008). Measurement invariance of the Mindful Attention Awareness Scale across adult attachment style. *Measurement and Evaluation in Counseling and Development*, 40, 228–246.

Csikszentmihalyi, M. (1990). Flow: the psychology of optimal experience. New York: Harper and Row.

Deci, E. L. (1975). Intrinsic motivation. New York: Plenum.

- Deci, E. L., & Ryan, R. M. (1985). Intrinsic motivation and self-determination in human behavior. New York: Plenum.
- Deci, E. L., Ryan, R. M., Schultz, P. P., & Niemiec, C. P. (2015). Being aware and functioning fully: Mindfulness and interest taking within self-determination theory. In K. W. Brown, J. D. Creswell, & R. M. Ryan (Eds.), *Handbook of Mindfulness: Theory, Research, and Practice* (pp. 112–129). New York, NY: Guilford.
- Dunne, J. (2011). Toward an understanding of non-dual mindfulness. *Contemporary Buddhism, 12*(1), 71–88.
- Filak, V. F., & Sheldon, K. M. (2003). Student psychological need satisfaction and college teacher-course evaluations. *Educational Psychology*, 23, 235–247.
- Fortier, M. S., Vallerand, R. J., & Guay, F. (1995). Academic motivation and school performance: Toward a structural model. *Contemporary Educational Psychology*, 20, 257–274.
- Gagné, M. (2003). The role of autonomy support and autonomy orientation in prosocial behavior engagement. *Motivation and Emotion*, 27, 199–223.
- Gombrich, R. (2009). What the Buddha Thought. London: Equinox Publishing.
- Grossman, P. (2011). Defining mindfulness by how poorly I think I pay attention during everyday awareness and other intractable problems for psychology's (re)invention of mindfulness: Comment on Brown et al. (2011). *Psychological Assessment*, 23, 1034–1040.
- Hagtvet, K. A., & Benson, J. (1997). The motive to avoid failure and test anxiety responses: Empirical support for the integration of two research traditions. *Anxiety, Stress and Coping*, 10, 35–57.
- Harvey, A. G., Watkins, E., Mansell, W., & Shafran, R. (2004). Cognitive behavioral processes across psychological disorders: A transdiagnostic approach to research and treatment. Oxford: Oxford University Press.
- Hayes-Skelton, S. A., & Graham, J. R. (2013). Decentering as a common link among mindfulness, cognitive reappraisal, and social anxiety. *Behavioural and Cognitive Psychotherapy*, 41(3), 317.
- Heppner, W. L., Kernis, M. H., Lakey, C. E., Campbell, W. K., Goldman, B. M., Davis, P. J., et al. (2008). Mindfulness as a means of reducing aggressive behavior: Dispositional and situational evidence. *Aggressive behavior*, 34, 486–496.
- Hoffmann, W., & Van Dillen, L. (2012). Desire: The new hot spot in self-control research. Current Directions in Psychological Science, 21, 317–322.
- Ilardi, B. C., Leone, D., Kasser, R., & Ryan, R. M. (1993). Employee and supervisor ratings of motivation: Main effects and discrepancies associated with job satisfaction and adjustment in a factory setting. *Journal of Applied Social Psychology*, 23, 1789–1805.
- Jha, A. P., Kromginger, J., & Baime, M. J. (2007). Mindfulness training modifies subsystems of attention. Cognitive, Affective, and Behavioral Neuroscience, 7, 109–119.
- Jha, A. P., Stanley, E. A., Kiyonaga, A., Wong, L., & Gelfand, L. (2010). Examining the protective effects of mindfulness training on working memory capacity and affective experience. *Emotion*, 10, 54–64.
- Kabat-Zinn, J. (2003). Mindfulness-Based Interventions in Context: Past, Present, and Future. Clinical Psychology Science and Practice, 10, 144–156.
- Kruger, J., & Dunning, D. (1999). Unskilled and unaware of it: how difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77, 1121.
- LaGuardia, J. G., Ryan, R. M., Couchman, C. E., & Deci, E. L. (2000). Within-person variation in security of attachment: A self-determination theory perspective on attachment, need fulfillment, and well-being. *Journal of Personality and Social Psychology*, 79, 367–384.
- Lakey, C. E., Kernis, M. H., Heppner, W. L., & Lance, C. E. (2008). Individual differences in authenticity and mindfulness as predictors of verbal defensiveness. *Journal of Research in Personality*, 42, 230–238.

Deringer

- Levesque, C., & Brown, K. W. (2007). Mindfulness as a moderator of the effect of implicit motivational self-concept on day-to-day behavioral motivation. *Motivation and Emotion*, 31, 284–299.
- Levesque, C., Zuehlke, A. N., Stanek, L. R., & Ryan, R. M. (2004). Autonomy and competence in German and American university students: A comparative study based on Self-Determination Theory. *Journal of Educational Psychology*, 96, 68–84.
- Lutz, A., Slagter, H. A., Dunne, J. D., & Davidson, R. J. (2008). Attention regulation and monitoring in meditation. *Trends in the Cognitive Sciences*, 12, 163–169.
- MacKillop, J., & Anderson, E. J. (2007). Further psychometric validation of the Mindful Attention Awareness Scale (MAAS). Journal of Psychopathology and Behavioral Assessment, 29, 289–293.
- Miserandino, M. (1996). Children who do well in school: Individual differences in perceived competence and autonomy in above-average children. *Journal of Educational Psychology*, 88, 203–214.
- Mrazek, M. D., Franklin, M. S., Phillips, D. T., Baird, D., & Schooler, J. W. (2013). Mindfulness training improves working memory capacity and GRE performance while reducing mind wandering. *Psychological Science*, 24, 776–781.
- Mrazek, M. D., Smallwood, J., & Schooler, J. W. (2012). Mindfulness and mind-wandering: finding convergence through opposing constructs. *Emotion*. https://doi.org/10.1037/a0026678.
- Murakami, H., Matsunaga, M., & Ohira, H. (2009). Association of serotonin transporter gene polymorphism and emotion regulation. *NeuroReport*, 20, 414–418.
- Muthén, L. K., & Muthén, B. O. (2015). *Mplus User's Guide* (6th ed.). Los Angeles, CA: Muthén & Muthén.
- Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom Applying self-determination theory to educational practice. *Theory and Research in Education*, 7, 133–144.
- Ntoumanis, N. (2005). A prospective study of participation in optional school physical education using a self-determination theory framework. *Journal of Educational Psychology*, 97, 444–453.
- Papies, E. K., Barsalou, L. W., & Custers, R. (2012). Mindful attention prevents mindless impulses. Social Psychological and Personality Science, 3, 291–299.
- Reeve, J., & Jang, H. (2006). What teachers say and do to support students' autonomy during a learning activity. *Journal of Educational Psychology*, 98, 209–218.
- Reeve, J., Jang, H., Carrell, D., Jeon, S., & Barch, J. (2004). Enhancing students' engagement by increasing teachers' autonomy support. *Motivation and emotion*, 28, 147–169.
- Ryan, R. M. (1993). Agency and organization: Intrinsic motivation, autonomy and the self in psychological development. In J. Jacobs (Ed.), *Nebraska symposium on motivation: Developmental perspectives on motivation* (Vol. 40, pp. 1–56). Lincoln: University of Nebraska Press.
- Ryan, R. M., Brown, K. W., & Creswell, J. D. (2007). How integrative is attachment theory? unpacking the meaning and significance of felt security. *Psychological Inquiry*, 18, 177–182.
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55, 68–78.
- Ryan, R. M., Huta, V., & Deci, E. L. (2008). Living well: A self-determination theory perspective on eudaimonia. *Journal of Happiness Studies*, 9, 139–170.
- Ryan, R. M., Kuhl, J., & Deci, E. L. (1997). Nature and autonomy: An organizational view on the social and neurobiological aspects of self-regulation in behavior and development. *Development and Psychopathology*, 9, 701–728.
- Ryan, R. M., & Stiller, J. (1991). The social contexts of internalization: Parent and teacher influences on autonomy, motivation and learning. In P. R. Pintrich & M. L. Maehr (Eds.), Advances in motivation and achievement (Vol. 7, pp. 115–149). Greenwich, CT: JAI Press.
- Sarason, I. G. (1984). Stress, anxiety, and cognitive interference: Reactions to tests. Journal of Personality and Social Psychology, 4, 929–938.
- Schonert-Reichl, K. A., & Lawlor, M. S. (2010). The effects of a mindfulness-based education program on pre- and early adolescents' well-being and social and emotional competence. *Mindfulness*, 3, 137–151.
- Shapiro, S. L., Schwartz, G. E., & Bonner, G. (1998). Effects of Mindfulness-Based Stress Reduction on medical and premedical students. *Journal of Behavioral Medicine*, 21, 581–599.
- Shaver, P. R., Lavy, S., Saron, C. D., & Mikulincer, M. (2007). Social foundations of the capacity for mindfulness: An attachment perspective. *Psychological Inquiry*, 18, 264–271.
- Sheldon, K., & Niemiec, C. (2006). It's not just the amount that counts: Balanced need satisfaction also affects well-being. *Journal of Personality and Social Psychology*, 91, 331–341.
- Spielberger, C. D. (1980). Test anxiety inventory. Palo Alto: Consulting Psychologists Press.

- Tang, Y., & Posner, M. I. (2015). Mindfulness in the context of the attention system. In K. W. Brown, J. D. Creswell, & R. M. Ryan (Eds.), *Handbook of mindfulness: Theory, research, and practice* (pp. 81–89). New York: Guilford.
- Uusberg, H., Uusberg, A., Talpsep, T., & Paaver, M. (2016). Mechanisms of mindfulness: the dynamics of affective adaptation during open monitoring. *Biological psychology*, 118, 94–106.
- Vallerand, R., Pelletier, L., & Koestner, R. (2008). Reflections on self-determination theory. Canadian Psychology, 49, 257–262.
- Vansteenkiste, M., Neyrinck, B., Niemiec, C., Soenens, B., De Witte, H., & Van Den Broeck, A. (2007). On the relations among work value orientations, psychological need satisfaction and job outcomes: A self-determination theory approach. *Journal of Occupational & Organizational Psychology*, 80, 251–277.
- Vansteenkiste, M., Zhou, M., Lens, W., & Soenens, B. (2005). Experiences of autonomy and control among Chinese learners: Vitalizing or immobilizing? *Journal of Educational Psychology*, 97, 468–483.
- Vink, K., Raudsepp, L., & Kais, K. (2015). Intrinsic motivation and individual deliberate practice are reciprocally related: Evidence from a longitudinal study of adolescent team sport athletes. *Psychol*ogy of Sport and Exercise, 16, 1–6.
- Williams, G. C., McGregor, H. A., Sharp, D., Levesque, C., Kouides, R. W., Ryan, R. M., et al. (2006). Testing a self-determination theory intervention for motivating tobacco cessation: Supporting autonomy and competence in a clinical trial. *Health Psychology*, 25, 91–101.
- Williams, G. C., Patrick, H., Niemiec, C. P., Williams, L. K., Divine, G., Lafata, J. E., et al. (2009). Reducing the health risks of diabetes: How self-determination theory may help improve medication adherence and quality of life. *The Diabetes Educator*, 35, 484–492.
- Zeidner, M., & Matthews, G. (2005). Evaluative anxiety. In A. Elliot & C. Dweck (Eds.), Handbook of competence and motivation (pp. 141–166). New York: Guilford Press.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Dr. Robert J. Goodman Ph.D. is an Associate Professor in the Department of Psychological Sciences at Northern Arizona University in Flagstaff, Arizona. He received his Ph.D in Social Psychology from Virginia Commonwealth University in 2014. His research takes a social and affective neuroscience approach to examine the influence of mindfulness and its training on markers of attention, emotion regulation, and memory function.

Dr. Stephen K. Trapp Ph.D. is an Assistant Professor in the Department of Physical Medicine and Rehabilitation at the University of Utah in Salt Lake City, Utah. After completing his pre-doctoral internship in Clinical Psychology at the Veterans Affairs Health Care System, He received his Ph.D. in Counseling Psychology from Virginia Commonwealth University in 2015. His research explores the adaptive roles of need support and motivation play in fostering rehabilitation and psychosocial wellness.

Dr. Ernest S. Park Ph.D. is an Associate Professor in the Department of Psychology at Grand Valley State University in Allendale, Michigan. He received his Ph.D. in Social Psychology from Michigan State University in 2003. His primary research emphasis explores the intersection of motivation and group dynamics on a variety of real-world performance outcomes.

Dr. Jody L. Davis Ph.D. is an Associate Professor in the Department of Social Psychology at Virginia Commonwealth University in Richmond, Virginia. She received her Ph.D. in the field of Social Psychology from the University of North Carolina at Chapel Hill in 2000. Her research examines a scope of phenomenon in the area of close relationships, including forgiveness, attitude alignment, and the role of commitment in maintaining interpersonal relationships and promoting ecological behavior.