

Mindfulness and Its Association with Varied Types of Motivation:

A Systematic Review and Meta-analysis using Self-Determination Theory

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Abstract

Mindfulness has been shown to have varied associations with different forms of motivation, leading to a lack of clarity as to how and when it may foster healthy motivational states. Grounded in self-determination theory, the present study proposes a theoretical model for how mindfulness supports different forms of human motivation, and then tests this via meta-analysis. A systematic review identified 89 relevant studies ($N = 25,176$), comprised of 104 independent datasets and 200 effect sizes. We used a three-level modelling approach to meta-analyze these data. Across both correlational and intervention studies, we found consistent support for mindfulness predicting more autonomous forms of motivation; and among correlational studies, less controlled motivation and amotivation. We conducted moderation analyses to probe heterogeneity in the effects, including bias within studies. We conclude by highlighting substantive and methodological issues that need to be addressed in future research in this area.

Key Words: Mindfulness; Motivation; Self-Determination Theory; Meta-Analysis

Introduction

Within self-determination theory (SDT), autonomous motivation is characterized by engagement in activities out of a sense of interest, valuing, and volition (Ryan & Deci, 2017). When autonomous, individuals endorse their actions and engage in them willingly. Autonomous motivation has been associated with wellness, vitality and flourishing across contexts (e.g., Slemp, Kern, Patrick, & Ryan, 2018), cultures (e.g., Yu, Chen, Levesque-Bristol, & Vansteenkiste, 2018), and age groups (e.g., Duineveld, Parker, Ryan, Ciarrochi, & Salmela-Aro, 2017). SDT also posits that motivational states characterized by controlled motivations—those driven by internal pressure or external contingencies—are associated with diminished wellness and functioning, including greater stress, anxiety, depression, anger and hostility (Legate, Ryan, & Weinstein, 2012; Ryan & Deci, 2017), energy depletion (Kazén, Kuhl, & Leicht, 2015), less self-control (Muraven, Gagné, & Rosman, 2008), and worse cognitive performance (Kazén et al., 2015).

Considerable research on SDT has examined contextual factors that support or thwart autonomy. Hundreds of studies in homes, schools, and workplaces have thus examined how autonomy supportive or controlling elements in interpersonal environments affect autonomy (Ryan & Deci, 2017). Yet, far fewer studies have explored *intraindividual* factors that support autonomous functioning, especially in situations where contextual autonomy supports may not be present (e.g., Niemiec et al., 2010; Schultz, Ryan, Niemiec, Legate, & Williams, 2015).

Within SDT, *mindfulness* is postulated as a particularly important intraindividual resource that supports autonomy. Ryan and Deci (2017) proposed that “mindfulness, defined as the open and receptive awareness of what is occurring both within people and within their context, facilitates greater autonomy and integrated self-regulation” (p. 268). With greater mindfulness, individuals become more aware of internal phenomena such as emotions, impulses, and needs, as well as external conditions such as seductions and pressures, and are

thus in a better position to engage in reflective choices and self-congruent actions (Ryan & Deci, 2017).

Evidence suggests that mindful individuals may indeed be more autonomously motivated. For example, mindfulness has been associated with the pursuit of more self-concordant values (Levesque & Brown, 2007; Vago & Silbersweig, 2012), and increased intrinsic motivation on some tasks (e.g., Brown, Goodman, Ryan, & Anālayo, 2016). Both trait and state mindfulness predict daily autonomy in experience sampling studies (Brown & Ryan, 2003). Mindfulness has also been linked with SDT's basic psychological need satisfactions, including autonomy (e.g., Chang, Huang, & Lin, 2015).

However, mindfulness does not enhance all forms of motivation, and may even reduce certain types of motivation (e.g., Hafenbrack & Vohs, 2018), particularly those not characterized by autonomy (Weinstein, Brown, & Ryan, 2009). For example, mindfulness inhibits the pursuit of extrinsic rewards and goals across a range of settings (e.g., Leigh & Anderson, 2013; Martin, Plumb-Villardaga, & Timko, 2014; Roche & Haar, 2013). Individuals trained in mindfulness have also shown lower neural susceptibility to monetary rewards (Kirk, Brown, & Downar, 2014).

To date, no meta-analysis has tested the relations between mindfulness and motives that differ in their relative autonomy, as detailed in SDT's taxonomy of motives. SDT specifies varied motivational subtypes, ranging from those focused on external controls and rewards to those stemming from more internal interests or values, which are argued to fall in an order way along a continuum of autonomy (Ryan & Connell, 1989). Of interest is how mindfulness relates to each of the forms of motivation. A meta-analysis in this domain is timely and has substantial theoretical and empirical value both within SDT and beyond, as it would advance our understanding of the links between mindfulness and motivation and the processes connecting them. The present review has two primary aims: 1) to develop a testable theoretical model of

the links between mindfulness and varieties of motivation comprising SDT's taxonomy; and 2) to test this model via a systematic review and meta-analysis of the empirical literature. Figure 1 illustrates the theoretical model. In what follows, we elaborate on the different components of the model, and explain how being mindful is expected to relate differently to the different motivational orientations.

[INSERT FIGURE 1 ABOUT HERE]

Mindfulness

Mindfulness concerns open and receptive attention to the present moment (Brown & Ryan, 2003). Mindfulness has been associated with a variety of positive outcomes, from greater self-regulation to higher well-being (Creswell, 2017). Although seemingly a simple idea, the phenomenon is quite complex, as reflected in controversies concerning **how to conceptually define and operationalize mindfulness** (Chiesa, 2012; Monteiro, Musten, & Compson, 2014; Van Dam et al., 2018). Some definitions focus on mindfulness simply as present oriented attention (e.g., Brown & Ryan, 2003), whereas others seek to more explicitly emphasize separate attentional and attitudinal components, such as openness, non-judgment, and acceptance (e.g., Bishop et al., 2004; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). Still others emphasize the multi-dimensional nature of mindfulness, including, observing, acting with awareness, describing present experience, non-judging, and non-reactivity (Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). These differences in definition are reflected in different mindfulness measures, which tap unitary (e.g., Brown & Ryan, 2003), bi-factor (e.g., Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Feldman, Hayes, Kumar, & Greeson, 2004), and multi-factor dimensions (e.g., Baer et al., 2006; see Siegling & Petrides, 2014, for a review). Adding to the complexity, research shows different latent profiles of mindfulness, suggesting that people can exhibit varied levels of different components of mindfulness, leading to mixed associations with positive and negative outcomes (Sahdra, Ciarrochi, Parker,

Basarkod, Bradshaw, et al., 2017). Yet despite the different approaches to defining and measuring mindfulness, there is evidence that they converge upon a common underlying construct, reflecting the broad definition provided by Ryan and Deci (2017) above (see Siegling & Petrides, 2014). In the present review, we therefore took a maximally inclusive approach, and included all well-validated measures of mindfulness. **We also examined whether the different aspects of mindfulness measures are differentially related to the relevant motivational types (see p. 12, *Measuring mindfulness*, below, for more detail on this).**

SDT's Taxonomy of Motivation

A central tenet of SDT is that human motivation varies not only in amount but also in quality (Deci & Ryan, 1985; Ryan & Deci, 2017). Specifically, the theory suggests that people vary in their level of autonomy, or the extent to which they value, willingly engage in, and wholeheartedly endorse their actions. SDT provides a taxonomy of different motives, each of which has its own specific character, but which also vary systematically in their relative autonomy. We next review each, from most to least autonomous.

Intrinsic motivation. Intrinsic motivation is the most autonomous form of motivation, and is the driving force behind engagement in activities out of genuine interest and enjoyment (Ryan & Deci, 2000). Humans have an innate tendency to interact with and explore their environments. Children's play is a prototype of intrinsically motivated activity. Other examples include solving puzzles, observing art, and playing music or sport for fun.

The pleasure and satisfaction of an intrinsically motivated activity is sourced in the moment the behavior occurs. Given that mindfulness also involves awareness of and curiosity about present experiences, we expect mindful individuals to be more sensitive to activities that spark interest and enjoyment, making engagement in activities out of intrinsic motivation more likely (Schultz & Ryan, 2015). Mindfulness has been linked with expressions of intrinsic motivation such as flow experiences (Aherne, Moran, & Lonsdale, 2011; Scott-Hamilton,

Schutte, & Brown, 2016), task engagement (Klatt, Norre, Reader, Yodice, & White, 2017; Shiba, Nishimoto, Sugimoto, & Ishikawa, 2015), and task enjoyment (Brown et al., 2016). Mindfulness is also associated with greater interest-taking in everyday activities, for example, in social interactions with romantic partners (Barnes, Brown, Krusemark, Campbell, & Rogge, 2007; Karremans & Papiés, 2017), engaging in every-day work tasks (Shiba et al., 2015), and connecting with natural environments (Wolsko & Lindberg, 2013).

Identified motivation. Although a form of instrumental or extrinsic motivation, identified motivation is an autonomous form of motivation—though relatively less so than intrinsic motivation (Ryan & Brown, 2017). Identified motivation describes a willing engagement in an activity because it is accepted as valuable and worthwhile, even if it is not inherently enjoyable (as is the case for an intrinsically motivated act). Identified motivation is considered relatively autonomous because activities are self-endorsed and consciously valued (Ryan & Deci, 2017). We expect that mindfulness will relate positively to identified forms of motivation, via greater awareness of personal values. In support of this hypothesis, evidence suggests that mindful individuals are more aware of personal values and engage with values-consistent activities (Brown, Kasser, Ryan, Linley, & Orzech, 2009; Christie, Atkins, & Donald, 2017; Donald, Atkins, Parker, Christie, & Ryan, 2016; Warren & Wray-Lake, 2017). Further, evidence suggests that mindful individuals can sustain effort toward valued activities (i.e., identified motivation), even when such pursuits are challenging or aversive. Examples include smoking cessation (Bowen & Marlatt, 2009), substance use reduction (Lee, An, Levin, & Twohig, 2015), reducing binge drinking (Chatzisarantis & Hagger, 2007), weight loss (Tapper et al., 2009), and increasing exercise (Chatzisarantis & Hagger, 2007). Feasibly, this occurs via the acceptance of and non-reactivity to negative emotions and thoughts associated with mindfulness, enabling such pursuits.

Despite its utility in driving personally valued actions, identified motivation is still extrinsic insofar as it involves engagement in activities for a separable outcome rather than for the enjoyment of the activity itself. Additionally, although they are personally valued, identifications can vary in how well integrated they are with other identifications (Ryan & Deci, 2017). Therefore, we anticipate that mindfulness will be positively related to identified motivation, although somewhat less strongly than to intrinsic motivation, in accord with its lower relative autonomy (Litalien et al., 2017; Howard, Gagne & Bureau, 2017).

Introjected motivation. In SDT, controlled motivation is reflected in behaviors that are governed by various forms of coercion and external pressure. For example, introjected motivation describes engaging with activities because of an internalized sense of compulsion, pressure toward standards, or self-esteem contingencies (Ryan & Deci, 2017). Behaviors guided by introjected motivation often reflect the incomplete internalization of a value, which can be experienced as internal pressure, for instance, in the form of guilt.

Internal pressures such as guilt are often experienced as aversive, but the impact of such states may be attenuated by acceptance, which can be facilitated by mindfulness. Mindfulness includes an attitude of openness, non-judgement and acceptance (Shapiro et al., 2006; Bishop et al., 2006). There is evidence that mindful individuals are more accepting of their internal states, and are less prone to shame, guilt and social embarrassment (Cameron & Fredrickson, 2015), and unhealthy behaviors driven by these emotions (Heppner et al., 2008; Lakey, Kernis, Heppner, & Lance, 2008; Masuda, Hayes, Sackett, & Twohig, 2004). There is also more direct evidence that mindfulness is associated with less introjected motivation (Roche & Haar, 2013; Stewart, Ahrens, & Gunthert, 2018; Warren & Wray-Lake, 2017).

Relatedly, introjected motivation has been linked to greater ego-involvement, wherein activities are undertaken to defend or bolster one's sense of self and identity (Ntoumanis, 2001). In contrast, mindfulness has been linked to a lack of ego-involvement (Heppner et al.,

2008) or the transcendence of a narrow, rigid and conceptualized sense of self (Hayes et al., 2006; Karremans & Papies, 2017; Sahdra, Ciarrochi, & Parker, 2016; Shapiro et al., 2006). Mindfulness is related to less ego-defensiveness across a range of contexts including death salience (Niemic et al., 2010), social rejection (Heppner et al., 2008), writing about distressing experiences (Lakey et al., 2008), and performing poorly on an intelligence test (Donald & Atkins, 2016). At a neurological level, mindfulness is negatively associated with brain activity linked to self-referential processing (Farb et al., 2007; Hölzel et al., 2011; Vago & Silbersweig, 2012). Therefore, mindfulness is expected to be negatively associated with introjected forms of motivation.

Yet, the negative link between mindfulness and introjected motivation is most likely modest due to the mixed nature of introjection, particularly in the context of projects and goals that are personally-valued, for example, cultivating healthy lifestyle habits or achieving career goals. In these kinds of situations, there may be high levels of ego-involvement (negatively associated with mindfulness), but also high levels of goal-salience and persistence (positively associated with mindfulness; Evans, Baer, & Segerstrom, 2009). Therefore, we expect a range of effects ultimately resulting in a modest overall association between mindfulness and introjected motivation.

External motivation. In SDT, external motivation is the most controlled form of motivation. When externally motivated the person is driven by externally controlled contingencies such as rewards (e.g., financial incentives or social recognition) and punishments (e.g., financial penalties or social exclusion) rather than values or interests. External motivation, although not autonomous, can feel powerful insofar as extrinsic rewards and punishments tend to produce strong affective responses via the activation of the brain's reward and threat centers (Lang & Bradley, 2010). Yet mindful individuals appear to be better able to detach from these affective responses, and view them with a broader perspective (Shapiro et

al., 2006), and thus, be less likely to implicitly ‘buy in’ to extrinsic rewards and punishments. Consistent with this claim, evidence has linked mindfulness with better regulation of threat-related emotion in varied contexts, including social rejection (Heppner et al., 2008), writing about distressing experiences (Lakey et al., 2008), physical pain (Eifert & Heffner, 2003; Schultz & Ryan, 2019), viewing distressing images (Arch & Craske, 2006), and daily stressful events (Donald et al., 2016).

Mindful individuals are also less prone to endorse extrinsic values such as social status, wealth, and body-image (Brown et al., 2009; Roche & Haar, 2013; Schultz & Ryan, 2015; Wang, Liu, Tan, & Zheng, 2017). For example, Brown et al. (2009) found that dispositional mindfulness was associated with less dissatisfaction with one’s current financial situation. In another study, mindfulness was associated with less materialism (Wang et al., 2017). Taken together, mindful individuals’ enhanced ability to regulate threat-based emotions and their orientation away from materialistic rewards, suggest that external motivation will be negatively correlated with mindfulness.

Amotivation. We expect mindfulness to have its most negative relationships with amotivation, a state in which there is a lack of intention to act (Ryan & Deci, 2017). Amotivation describes the extent to which a person feels ineffective, without purpose, or internally resistant toward an action (Ryan & Deci, 2017). In contrast, mindfulness involves an attitude of open interest and curiosity in one’s moment-by-moment experience—even in activities that are not otherwise interesting or pleasant (Kabat-Zinn et al., 1992). We therefore expect that individuals who are mindful will be less likely to experience amotivation, but instead be engaged and willingly to respond to a broad range of events and situations.

Consistent with this hypothesis, mindfulness has been linked with greater vitality, energy, and vigor (Aherne et al., 2011; Scott-Hamilton et al., 2016), suggesting it may serve as a buffer against apathy and disinterest. Meta-analytic evidence also shows that mindfulness

meditators more actively engage in prosocial behaviors (Donald et al., 2019), such as helping a stranger (Condon, Desbordes, Miller, & DeSteno, 2013; Lim, Condon, & DeSteno, 2015) or giving to charity (Galante, Bekkers, Mitchell, & Gallacher, 2016). Further, mindful individuals have been found to engage in more approach forms of coping with stressful situations (Donald & Atkins, 2016; Donald et al., 2016; Niemiec et al., 2010; Weinstein et al., 2009), and are more likely to persist on undesirable tasks (Evans et al., 2009; Gutiérrez, Luciano, Rodríguez, & Fink, 2004). We thus expect that mindfulness allows individuals to better connect with valued aspects of living, and thus be less prone to amotivation.

The present review

Based on the above theorizing, we anticipated that mindfulness would influence motivation in a graded way, as presented in Figure 1. More formally, our hypotheses were as follows:

Hypothesis 1(a). Mindfulness will be positively associated with autonomous forms of motivation, namely intrinsic and identified motivation.

Hypothesis 1(b). Mindfulness will have largest positive associations with intrinsic motivation, followed by identified motivation.

Hypothesis 2(a). Mindfulness will be unrelated or negatively associated with controlled forms of motivation, namely external and introjected motivation.

Hypothesis 2(b). Mindfulness will have largest negative associations with amotivation, relative to external and introjected motivation.

Hypothesis 3. Mindfulness-based interventions will result in increases in all forms of autonomous motivation.

Hypothesis 4. Mindfulness-based interventions will result in decreases in all forms of controlled motivation.

Method

Eligibility criteria

In conducting this systematic review, we were guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). (<http://www.prisma-statement.org/>). To be included, studies needed to meet the following criteria: 1) Include quantitative, not qualitative, measures of mindfulness and motivational orientation; 2) Include either a measure of mindfulness that is psychometrically valid (i.e., is associated with one published study supporting reliability and validity), or a mindfulness induction or intervention, where the principle focus is cultivating mindful states; 3) Include a psychometrically valid measure of motivational orientation—either a direct or an indirect measure (detailed below); 4) Assess the relations between mindfulness and motivational orientation, including either an effect-size (e.g., Cohen's *d*), sufficient information to calculate one, or have a corresponding author provide such information upon request; 5) Full-text access available in English; 6) Use an intervention (with or without a control condition), longitudinal, or cross-sectional study design. On 7 November, 2017, this protocol was registered with PROSPERO (<https://www.crd.york.ac.uk/prospero/>), an international prospective register of systematic reviews (registration number CRD42017075611). Literature searches were conducted in Scopus, PubMed, PsychINFO, and ProQuest Psychology databases. Details of the search terms used can be found in Section 1 of *Supplemental Material*. This search produced 9,795 studies.

Study selection

After removing duplicates, two authors independently screened 7,108 titles and abstracts. This process resulted in 416 full-text studies. The same two authors assessed the eligibility of these full-texts, and differences of opinion were resolved by consultation with three experienced mindfulness researchers. This resulted in the identification of 89 studies for inclusion. Out of the 327 papers that did not meet inclusion criteria, 149 did not include the variables of interest, 81 did not report original data (e.g., newspaper articles, literature reviews,

meta analyses), 44 were duplicates, 26 had the wrong study design (e.g., qualitative or case study design), 24 did not report correlations or effect sizes for the variables of interest, 2 were not in English, and 1 was inaccessible. As a second step to identify studies for inclusion, the reference lists of the articles identified from the literature search were inspected for any additional relevant articles. This did not yield any further studies for inclusion. On 30 April, 2018, we concluded the literature search, with a total of 89 included studies. See Figure 2 for a breakdown of the study selection process.

[INSERT FIGURE 2 ABOUT HERE]

Data extraction

Two researchers independently extracted data from the 89 papers included in this review. Within the 89 papers, there were a total of 104 separate studies, each with an independent sample. Data were extracted from each of the 104 studies as follows: (1) publication author(s) and year; (2) study design (cross-sectional, longitudinal or experimental); (3) number of participants; (4) cell-sizes (if experimental); (5) instrument used to measure or manipulate mindfulness; (6) instrument used to measure motivation; (7) average participant age; (8) proportion of female participants; and (9) the statistical result measuring the relationship between mindfulness and motivation. There was 95% consistency between the two raters. These data are included in Tables 4 and 5 of *Supplemental Material*.

Measuring mindfulness

In the present review, we took a maximally inclusive approach to measuring mindfulness, and included validated single, bi-factor, and multi-faceted measures of the construct. A complete list of these measures is in Table 2 of *Supplemental Material*. Further, to better understand whether different components of mindfulness might relate to SDT motivations in different ways, we coded mindfulness measures (and their subscales) for whether they tapped the “attentional” or the “attitudinal” component of mindfulness (see Table

2 of *Supplemental Material* for this coding), and conducted moderation analyses. Given that many measures of mindfulness emphasize *attentional* as distinct from *attitudinal* components of mindfulness (e.g., Baer et al, 2006; Bishop et al., 2004; Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008; Feldman, Hayes, Kumar, Greeson, & Laurenceau, 2007; Shapiro, Carlson, Astin, & Freedman, 2006), we examined whether these two aspects of mindfulness are differentially associated with motivation. Simply being attentionally present with one's experience may be enough to experience more autonomous forms of motivation; or it may instead be that an attitude of openness, nonjudgement and nonreactivity is important for facilitating more autonomous states.

Measuring motivation

In this review, we took a maximally inclusive approach to identifying measures of SDT's continuum of motivation. We did this by including what we term *direct* and *indirect* measures of motivation. Direct measures include measures of motivation from SDT research that explicitly measure motivational states and traits along the motivational continuum. Direct measures also include indices of motivation from outside SDT research literature, for example constructs such as flow, said to be a prototype of intrinsic regulation (Csikszentmihalyi, 1975; Deci & Ryan, 2000), and authentic functioning, thought to embody autonomous motivation (Kernis & Goldman, 2006). These constructs arguably tap motivational orientations and can be relatively readily placed along the continuum.

Direct indicators of motivation can be further complemented through the inclusion of constructs that have theoretical and empirical links to, but do not directly measure, a specific motivational orientation. We term these indirect measures of motivation. For instance, autonomy satisfaction is sometimes used as an analogue for intrinsic motivation. However, this does not mean that measures of autonomy satisfaction are necessarily reflective of intrinsic motivation; rather, evidence suggests that autonomy satisfaction facilitates intrinsic motivation

(Ryan & Deci, 2017). As another example, the endorsement of intrinsic aspirations (Kasser & Ryan, 1993, 1996, 2001) has been shown to be associated with greater autonomous motivation, especially identification (Ryan & Deci, 2017). Insofar as these indirect measures have theoretical and empirical links to the SDT continuum of motivation, their inclusion may be helpful in painting the full picture of motivation and its relationship with mindfulness. Sections 2 to 4 in *Supplemental Material* include further information on each direct and indirect measure of motivation, inter-rater reliability statistics for their classification, a table summarizing these classifications into the five motivational orientations described in SDT, and a discussion of trait versus state measures of motivation within SDT.

Summary measures

For correlational studies, all summary measures were converted to Pearson's r . Following Borenstein, Hedges, Higgins, and Rothstein's (2005) recommendations, Pearson's r correlations were transformed into Fisher's z , and all analyses were performed using the transformed values. Results were then converted back to Pearson's r for reporting to facilitate interpretation of results. All summary measures from intervention studies were converted to Cohen's d , using Rosenthal's (1994; 1991) conversion formulas. Cohen's d effect sizes from intervention studies were derived from an odds-ratio, an eta-squared statistic, an adjusted mean difference (i.e., in pre-test-post-test-control group designs; Morris, 2008), or a post-test-only mean difference (i.e., where baseline scores on the outcome variable were not measured). This way, all available information for calculating effect sizes was used. Where a study did not report the information needed to convert relevant summary measures to either Pearson's r or Cohen's d , we contacted the study's lead author to obtain this information.

Risk of bias assessment

To assess the risk of bias in the experimental and correlational designs included in the review, we drew upon the methods outlined in the PRISMA statement. Details regarding risk

of bias assessment criteria, and methods used for implementing them, including interrater reliability statistics, can be found in Sections 11 to 13 of *Supplemental Material*.

Publication bias assessment

To assess publication bias, we took the following steps: the generation of contour enhanced funnel plots; Egger's test of regression intercept to quantify the degree of asymmetry reflected in the funnel plots (Egger, Smith, Schneider, & Minder, 1997); the three-parameter selection method (3PSM; Vevea & Woods, 2005); and moderation analysis to test whether effect sizes varied as a function of publication status. Further information regarding these procedures is in Section 10 of *Supplemental Material*.

Meta-analytic procedures

We used a three-level modelling approach to meta-analysis, which included a study-level clustering variable to explicitly model dependence among effect sizes within studies (Cheung, 2014). This method employs structural equation modeling in conducting multi-level analysis (for a description of this approach, see Cheung, 2014, pp. 216-218). Key advantages of this approach include that it: places flexible constraints on parameters; constructs more accurate confidence intervals using the likelihood-based method; and handles missing covariates using full information maximum likelihood (Cheung, 2009; 2014). (See Section 14 of *Supplemental Material* for additional details).

All analyses were conducted in the R environment (R Core Team, 2019) and meta-analyses were conducted using the *metaSEM* package (Cheung, 2015). To assess the degree of 'true' heterogeneity in pooled effect sizes, as opposed to variation due to sampling error, the I^2 statistic was used as the basis for conducting moderation analyses to probe unexplained variation in effects across studies (Borenstein, Hedges, Higgins, & Rothstein, 2011). (See Section 14 in *Supplemental Material* for further details).

Results

Study characteristics

Of the 104 studies included in the meta-analysis, 83 were correlational ($n = 21,194$) and 21 were intervention studies ($n = 3,982$), with a total of 25,176 participants. Of the correlational studies, 16 were unpublished dissertations, one was a book chapter and 66 were journal publications. Further information on each correlational study, including sample size, extracted effect size, and measures of mindfulness and motivation used, appears in Table 4 of *Supplemental Material*.

Among the intervention studies, two were unpublished dissertations and 19 were published papers. There was considerable variation in the design of the intervention studies. Eighteen studies compared a mindfulness intervention with a control condition, while 3 examined pre- and post-intervention effects, with no control condition. Significantly, of the studies that included a comparison condition, 14 were RCTs, whereas 5 studies did not randomly allocate subjects to condition. Further, among the RCTs, 9 used a waitlist control, whereas only 5 studies used an active control condition. Further information regarding characteristics of the intervention studies included is in Table 5 of *Supplemental Material*.

Risk of bias

There was near complete agreement between the two raters on risk of bias ratings, and discrepancies were resolved by discussion. Among correlational studies, there was agreement on 698 of 708 cells (98.5% consistency; Cohen's kappa = .97). Among intervention studies, there was agreement on 208 of 224 cells (, 93% consistency; Cohen's kappa = .86). A kappa coefficient of .81-1.00 is considered to reflect almost perfect rater-agreement (Landis & Koch, 1977). Three correlational studies and six intervention studies were assessed as having high risk of bias. Four correlational studies were assessed as having low risk of bias, while no intervention studies had low risk of bias. The remaining 76 studies were assessed as having

moderate risk of bias. Details of the risk of bias ratings for each study appear in *Supplemental Material* (Table 6 for correlational studies; Table 7 for intervention studies).

We tested whether having a high risk of bias accounted for variation in effect sizes. There was no evidence for this among either correlational ($\Delta\chi^2 = .30, p = .857$) or intervention studies ($\Delta\chi^2 = 0.42, p < .516$). As a supplementary step, we calculated pooled effect sizes for the moderate and high risk of bias studies separately (no intervention studies were assessed as having low risk of bias). The pooled effect size for moderate risk of bias studies was $r = .31$ (.02), 95% CI [.28, .35], while the pooled effect size for high risk of bias studies was $r = .34$ (.07), 95% CI [.19, .48]. Given that the 95% CIs around these estimates were overlapping, we included both sets of studies in subsequent analyses.

Publication bias

Contour enhanced funnel plots for correlational studies appear in Figure 3, and for intervention studies in Figure 4. Among the plots for correlational studies, there were clearly missing effect sizes in the unshaded ‘funnel’ for intrinsic motivation, and to a lesser extent in the external regulation plot, indicating the presence of publication bias, whereas for the remaining plots, missing effect sizes lay in the external shaded regions of the plots, indicating that heterogeneity was due to factors other than publication bias (e.g., variation in study design or measures used). Among the plots for intervention studies, there was evidence of missing effect sizes in the unshaded ‘funnel’ for identified motivation, suggesting publication bias may be present among these studies.

[INSERT FIGURES 3 AND 4 ABOUT HERE]

Following these visual inspections, we ran Egger’s test of asymmetry in effect sizes. For correlational studies, these tests indicated low levels of bias across all pooled effects: external ($t = .21, p = .836$); introjected ($t = -.07, p = .949$); identified ($t = 1.37, p = .176$); and intrinsic ($t = -.12, p = .902$). Among intervention studies, we similarly found low levels of bias:

identified ($t = 2.13, p = .167$); and intrinsic ($t = 1.73, p = .097$). It was not possible to run Egger's test for correlational amotivation studies as there were only two data points.

Similarly, the 3PSM test showed no publication bias for any of the motivational orientations. Among correlational studies, the results were as follows: external ($\chi^2 = 0.73, p = .392$); introjected ($\chi^2 = 0.00, p = .984$); identified ($\chi^2 = 1.13, p = .287$); and intrinsic ($\chi^2 = 1.08, p = .299$). Among intervention studies, there was similarly no evidence of publication bias: identified ($\chi^2 = 0.01, p = .936$); and intrinsic ($\chi^2 = 0.05, p = .819$). However, it should be noted that the 3PSM sensitivity test is less robust with less than 10 data points (Vevea & Woods, 2005), which was the case for correlational amotivation studies and intervention studies of identified regulation.

Finally, we ran mixed effects structural equation models for correlational and intervention studies and tested whether publication status moderated our effects. We did not find evidence for this for the correlational studies ($\chi^2 = 1.27, p = .259$). We were not able to test for moderation effects by publication status for interventions, as only two studies were unpublished.

Main analysis

We first tested whether pooled effects from a three-level model (i.e., accounting for non-independence among effect-sizes within the same study) were significantly different to those obtained using a two-level model (Cheung, 2014), and found evidence for this ($\Delta\chi^2 = 22.71, p < .001$). We therefore used three-level models (i.e., with 'study' as a clustering variable) in all subsequent analyses. Second, we tested whether study design (i.e., correlational versus intervention studies) explained heterogeneity in effects across the studies included and did not find evidence for this ($R^2_{\text{within}} = .00; R^2_{\text{between}} = .00; \Delta\chi^2 = .973$).

Correlational effects

We next tested Hypotheses 1(a) and 2(a) regarding the links between dispositional mindfulness and the motivational orientations outlined in SDT. Results are in Table 1 and Figure 5. We first conducted moderation analyses to test whether differences in the type of motivation examined across studies (i.e., intrinsic, identified, introjected, external and amotivation) explained a significant amount of variation in pooled effects, and found evidence for this ($\Delta\chi^2 = 94.26; p < .001$). We then examined the association between mindfulness and each motivational orientation separately. Consistent with our predictions, we found that trait mindfulness was positively associated with autonomous forms of motivation and negatively associated with controlled forms of motivation, with the confidence intervals around pooled effects for all motivation-types being different from zero. Further, we found support for Hypothesis 1(b), that effects would be most positive for intrinsic motivation, and less-so for identified motivation, with effects for intrinsic motivation being larger (i.e., non-overlapping CIs) than those for identified motivation. Non-overlapping 95% confidence intervals imply an 84% probability that effects would differ in future studies (Cumming & Maillardet, 2006). However, Hypothesis 2(b) was not supported; we did not find differences in effect sizes between amotivation and either external or introjected motivation, perhaps due to the smaller number of studies in these categories.

[INSERT TABLE 1 ABOUT HERE]

[INSERT FIGURE 5 ABOUT HERE]

We next tested whether these findings changed when we excluded studies with *indirect* measures of motivation. We found that mindfulness related to the five motivational orientations in a very similar way when only direct measures of motivational orientation were included in the analysis, with negative pooled effects for controlled forms of motivation and positive effects for autonomous forms of motivation (see Table 2). Again, we found support for Hypothesis 1(b), with effects for intrinsic motivation being larger than those for identified

motivation. We also found support for Hypothesis 2(b), with amotivation having a statistically significantly smaller effect size than introjection (as indicated by CIs). Together, these results indicate a graded association between mindfulness and relative autonomy.

[INSERT TABLE 2 ABOUT HERE]

Next, we collapsed all effects into the two overarching categories of autonomous and controlled motivation, in order to take a parsimonious approach to exploring our research question. This also ameliorates concerns about potential misclassifications within sub-categories of motivation that are adjacent on the continuum. The increased power that came from collapsing categories allowed us to test potential moderators of effects, and we examined three: components of mindfulness (i.e., attentional versus attitudinal components), participant age, and gender. We did not find evidence that any of these variables explained variation in the effects across studies. Notably, effect sizes for both the attentional and attitudinal components of mindfulness were of a similar magnitude for both autonomous and controlled motivations. The statistics from these moderation tests, as well as information on our methods for conducting them, are in Section 15 of *Supplemental Material*.

Intervention effects

We included studies of mindfulness interventions in this review to test whether mindfulness *leads* to greater autonomous and less controlled motivation. Intervention studies included in our review only reported effects for identified and intrinsic motivation, meaning we could test Hypothesis 3 but not Hypothesis 4. Figure 7 shows the pooled effects from studies of mindfulness interventions on motivation.

We observed a moderate effect of mindfulness interventions on motivational outcomes (i.e., combining studies of identified and intrinsic motivation; $d = 0.47$ (.10) 95% CI [.28 - .67]). To test Hypothesis 3, that mindfulness interventions will be associated with increases in all forms of autonomous motivation, we calculated pooled effect sizes for studies of identified

and intrinsic motivation separately. We obtained a medium-sized effect of mindfulness interventions on intrinsic motivation ($d = 0.54$ (.11) 95% CI [.33 - .76]), and an effect on identified motivation that was not different from zero ($d = 0.20$ (.18) 95% CI [-.15 - .55]). Notably, there were only four studies of the effect of a mindfulness intervention on identified regulation, limiting the inferences that can be drawn from the latter analysis. To formally test whether these two effects differed, we ran moderation analyses. However, type of motivation orientation did not moderate the pooled effect ($\chi^2 = 1.94, p = .16, R^2_{\text{between}} = .09$). We therefore combined effect sizes for both types of motivation in subsequent analyses.

The pooled effect for mindfulness intervention studies (across both intrinsic and identified motivation) had medium-to-large amounts of between-study heterogeneity ($I^2_{\text{between}} = .68$), suggesting that further moderation analysis was warranted, for example targeting methodological factors that might explain variation in effect sizes across studies. We examined five such factors: study design (pre-post design versus studies with a control condition); whether the study was an RCT; the lag between the intervention and the measure of motivation (post-intervention measure versus follow-up measure); the type of control condition used (active versus waitlist); and the sample used (undergraduates versus working adults). These tests of moderation indicated that a substantial proportion of between-study variance in effect sizes can be explained by the lag between the intervention and the measure of motivation (post-intervention measure versus follow-up measure) and the type of control condition used (active versus waitlist), but not the other factors. Detailed description of these analyses is in Section 15 of *Supplemental Material*.

[INSERT FIGURE 7 ABOUT HERE]

Discussion

In the present review we aimed to rigorously examine the theorized association between mindfulness and motivation, by first developing clear hypotheses regarding the links between

mindfulness and different forms of motivation specified in SDT, and then testing these hypotheses via a systematic review and meta-analysis. We found support for our predictions that mindfulness would have positive associations with autonomous forms of motivation and negative associations with controlled motivation. Further, we found support for our hypotheses of a graded association between mindfulness and different forms of motivation along SDT's relative autonomy continuum, with the largest and most positive effects on intrinsic motivation, smaller yet positive associations with identified regulation, negative links with introjected regulation, and, among studies with 'direct' measures motivation, the most negative associations with external motivation and amotivation. This review thus provides evidence of a graded set of correlations between mindfulness and the various motivational orientations proposed in SDT.

Regarding intervention studies, we found a medium-sized pooled effect from mindfulness interventions to autonomous motivation. This replicates our findings from correlational studies of a positive association between mindfulness and autonomous motivation but additionally provides evidence of directionality of the effect. To more robustly test causality, we examined the effects of mindfulness interventions on motivation from RCTs only, and again found a medium-sized pooled effect on autonomous motivation.

Theoretical contribution

First, SDT has previously argued that mindfulness is an important intraindividual factor that both supports autonomous engagement in activities, and helps people be less susceptible to controlled motives (Ryan & Deci, 2017). Yet to date, evidence for this has been scattered. The current findings provide meta-analytic support for these propositions, demonstrating that mindfulness is positively associated with autonomous forms of motivation and negatively with controlled motivations.

Second, our findings suggest that mindfulness affects motivation in different ways depending on the relative autonomy of the motivation being examined, which can at least partly explain why studies have found inconsistent effects of mindfulness on motivational outcomes (e.g., Brown et al., 2016; Leigh & Anderson, 2013). Our findings also speak to why not all studies of mindfulness show enhancements in motivation, especially when motivation is measured in a manner that does not distinguish autonomous and controlled forms (e.g. Hafenbrack & Vohs, 2018).

Third, our findings suggest that both the attentional and attitudinal components of mindfulness positively relate to autonomous forms of motivation. This is consistent with other work showing that both these mindfulness components play an important role in the health-conducive effects of mindfulness (e.g., Bishop et al., 2004; Cameron & Fredrickson, 2015). We speculate that being attentive to present-experience affords opportunities to notice and engage with activities that are interesting, and meaningful. Similarly, mindful attitudes of openness and receptivity support greater interest-taking and integration, and less likelihood of being unconsciously triggered by extrinsic rewards and punishments or threats to the self.

More generally, there has been much scholarly interest in the associations of mindfulness with positive life-outcomes. Although not directly tested in this review, the current findings suggest that autonomous motivation may be a mechanism through which mindfulness contributes to more distal life outcomes such as well-being and performance. In support of this, research has shown that relative autonomy can account for the effects of mindfulness on outcomes including well-being (Christie, Atkins & Donald, 2017), work engagement and performance (Reb, Narayan & Chaturvedi, 2012), memory function (Brown et al., 2016), and reduced substance abuse (Roos, Pearson & Brown, 2015).

Practical contribution

Interest in mindfulness interventions is growing across various occupational settings, although the evidence supporting such interventions is limited (Rupperecht et al., 2019). The present review suggests that mindfulness interventions may help individuals find more interest or value in aspects of their daily activities (i.e., autonomous forms of motivation). Our meta-analytic finding of a positive link between mindfulness and autonomous motivation also adds to related literature showing mindfulness interventions can reduce stress and anxiety, and support well-being (e.g., Lomas et al., 2017).

Conversely, our findings show that more mindful individuals are less likely to be motivated by controlled motives, such as extrinsic financial rewards, social recognition, or subtle forms of coercion such as the use of guilt, shame or social pressure. This raises the question whether, for individuals living or working in environments that are relatively controlling, mindfulness interventions might lead them to be *less* motivated, and consequently, more disengaged, following a mindfulness intervention. Therefore, the ‘motivational environment’ in which mindfulness interventions are implemented is critical and needs to be carefully considered when designing these interventions (see Rupperecht et al., 2019, for a similar discussion in relation to workplace mindfulness interventions).

Limitations and future directions

We found no intervention studies exploring the effects of a mindfulness intervention on controlled motivation, preventing us from testing Hypothesis 4. Further research is needed to explore the links between mindfulness and controlled forms of motivation. Whilst mindfulness research has focused extensively on variables linked to a lack of well-being, such as anxiety, depression and stress (Hofmann, Sawyer, Witt, & Oh, 2010; Khoury et al., 2013), future work is needed to examine the extent to which mindfulness inhibits motivations such as those based on social expectation, guilt, pressure and shame, as well as those based on extrinsic rewards and sanctions.

Among the correlational studies, there was considerable unexplained heterogeneity in pooled effects of mindfulness on some motivation types, notably introjected and intrinsic motivation (see Table 1). For introjected motivation, almost all the variation in effect sizes was explained by whether the study used ‘direct’ or ‘indirect’ measures of motivation. However, since the number of effect sizes for ‘direct’ measures was relatively small ($ES = 7$), this evidence is best treated tentatively. On the other hand, for intrinsic motivation, considerable unexplained heterogeneity remained (see Table 2). Future research is needed to identify moderators. There was also considerable heterogeneity among intervention studies. Although we were able to substantially reduce this heterogeneity by removing nonrandomized studies and focusing on post-intervention (as opposed to follow-up) effects, such findings still indicate considerable variation in the way mindfulness interventions are designed and implemented.

Relatedly, our risk of bias assessment indicated a high risk of bias for 6 of the 21 intervention studies. Common sources of bias in intervention studies were non-randomization of participants to conditions, no description or use of participant eligibility criteria, non-concealment of the allocation sequence (or no evidence that this was done), and non-blinding of participants and researchers to conditions. These potential methodological weaknesses add caution to any conclusions drawn from the intervention studies in this review.

Conclusion

We examined the SDT proposition that mindfulness facilitates autonomous self-regulation. Across 104 studies, we systematically examined the links between mindfulness and varieties of motivation, ranging from autonomous forms such as intrinsic motivation and identification to controlled forms such as introjection, external regulation and amotivation. Our findings were consistent with the proposed linkages, revealing a graded set of relations of mindfulness and motives as they differed in relative autonomy, as depicted in SDT’s continuum

model (Ryan & Deci, 2017). Despite the methodological limitations of some studies included in this review, especially among intervention studies, our findings suggest that mindfulness may play an important role in supporting identified and intrinsic motivation for activities and may be less likely to accompany motivational states associated with control.

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