

# The Role of Adherence in the Effects of a Mindfulness Intervention for Competitive Athletes: Changes in Mindfulness, Flow, Pessimism, and Anxiety

John Scott-Hamilton and Nicola S. Schutte

University of New England

This study examined the role of degree of adherence in a mindfulness-based intervention on mindfulness, flow, sport anxiety, and sport-related pessimistic attributions in athletes. Twelve athletes participated in an 8-week mindfulness intervention which incorporated a mindfulness focus on movement training component. Participants completed baseline and posttest measures of mindfulness, flow, sport anxiety, and sport-related pessimistic attributions, and they filled out daily mindfulness-training logbooks documenting their frequency and duration of mindfulness practice. Participants were identified as either high adherence or low adherence with mindfulness-training based on a composite score of logbook practice records and workshop attendance. Athletes high in adherence, operationalized as following recommended practice of mindfulness exercises, showed significantly greater increases in mindfulness and aspects of flow, and significantly greater decreases in pessimism and anxiety than low adherence athletes. Greater increases in mindfulness from baseline to posttest were associated with greater increases in flow and greater decreases in pessimism. Increases in flow were associated with decreases in somatic anxiety and pessimism.

**Keywords:** adherence, mindfulness, flow, anxiety, pessimism, athletes

Flow facilitates feelings of enjoyment and exhilaration (Csikszentmihalyi, 1990). When in flow, athletes may reach upper limits of performance (Jackson & Csikszentmihalyi, 1999). Absorption in the task and feelings of union between body and mind converge to create a present-moment conscious state that results in optimal functioning (Jackson, 2000). For example, Jackson, Thomas, Marsh, and Smethurst (2001) found associations between greater flow and better performance in athletes involved in road cycling, surf life-saving, and orienteering. Consistent with Eastern philosophies, the ability to self-regulate sustained attention on a present-moment

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John Scott-Hamilton and Nicola Schutte are with the Department of Psychology, University of New England, Armidale, Australia. Address author correspondence to Nicola Schutte at [nschutte@une.edu.au](mailto:nschutte@une.edu.au).

task creates the opportunity to experience flow (Csikszentmihalyi, 1978). Cognitive processes involving attention and awareness regulation are at the core of athletes' flow experiences (Swann, Keegan, Piggott, & Crust, 2012). Mindfulness may facilitate flow directly and also impact flow through decreasing sport anxiety and pessimistic sports-related thoughts. Mindfulness can be enhanced through training (Cayoun, 2011; Grossman, Niemann, Schmidt, & Walach, 2004; Kabat-Zinn, 2003). One might expect that the greater the adherence to and engagement with mindfulness training, the greater the increases in mindfulness and characteristics that may be influenced by mindfulness, such as increases in flow experience and decreases in anxiety and pessimism.

Flow as a holistic construct is commonly defined by nine characteristics or dimensions (Csikszentmihalyi, 1990). Three of these dimensions, challenge–skill balance, clear proximal goals, and unambiguous feedback, are considered to be flow conditions. When fulfilled, these three flow conditions facilitate the subjective experience of being in a flow state (Hunter & Csikszentmihalyi, 2000). A flow state consists of the following six characteristics: concentration on a task, action–awareness merging, loss of self-consciousness, sense of control, transformation of time, and autotelic experience (Nakamura & Csikszentmihalyi, 2005). Generally flow results in heightened feelings of well-being (Csikszentmihalyi, 1978; Haworth, 1993). As well as being associated with good performance (Jackson et al., 2001), flow enhances enjoyment of sport and feelings of well-being while engaged in sport (Csikszentmihalyi, 1990; Jackson, 2000).

Enhanced mindfulness may be a foundation for experiencing flow (Cathcart, McGregor, & Groundwater, 2014; Moore, 2013). Mindfulness involves the conscious awareness of the present and purposeful attention to present-moment experiences with a nonjudgmental attitude (Bishop et al., 2004; Brown & Ryan, 2003; Kabat-Zinn, 2003, 2009). Brown and Ryan (2003) suggest mindfulness facilitates attentional and emotional regulation, which may be associated with enhanced well-being. A mindful attitude may result in disengagement of automatic habitual thought processes and reduce automatic reactive behavioral tendencies (Cayoun, 2011). Both mindfulness and flow conceptualizations emphasize that a person's present-moment conscious experience is regulated by his or her focus of attention and awareness and the importance of nonjudgmental awareness (Cayoun, 2011; Csikszentmihalyi, 1978). Sustained concentration of attention and nonjudgmental awareness may facilitate a flow state experience. Some sport research has identified correlations between elements of flow and facets of mindfulness (e.g., Aherne, Moran, & Lonsdale, 2011; Cathcart, et al., 2014; Kee & Wang, 2008; Moore, 2013).

In studies not specifically focusing on sport, mindfulness-based interventions are beneficial in increasing mindfulness and reducing a variety of undesired characteristics, including anxiety (Cayoun, 2011; Grossman, et al., 2004; Hofmann, Sawyer, Witt, & Oh, 2010; Hölzel, Lazar, Gard, Schuman-Olivier, Vago, & Ott, 2011; Kabat-Zinn, 2003; Khoury, Lecomte, Fortin, Masse, Therien, Bouchard, & Hofmann, 2013). Mindfulness-based interventions involving athletes can reduce sport-related worry linked to performance expectations (De Petrillo, Kaufman, Glass, & Arnkoff, 2009; Thompson, Kaufman, De Petrillo, Glass, & Arnkoff, 2011) and enhance sports performance (Bernier, Thienot, Codron, & Fournier, 2009; Gardner & Moore, 2004; Thompson et al., 2011).



Among athletes, high mindfulness is associated with a greater frequency of the key flow dimensions of challenge–skill balance, clear goals, concentration, merging of action and awareness, and loss of self-consciousness (Kee & Wang, 2008). Some initial research with athletes suggests that mindfulness interventions may increase flow experience (Aherne et al., 2011; Briegel-Jones, Knowles, Eubank, Giannoulatos, & Elliot, 2013; Kaufman, Glass, & Arnkoff, 2009). Building on this initial intervention research, the present research aimed to investigate how mindfulness may influence flow and how adherence to mindfulness practice may facilitate this process.

We suggest that from a mindfulness perspective, it can be argued that the preconditions of flow are reliant on optimal attentional and emotional self-regulation. Flow may be impeded by high levels of anxious arousal that invoke a negative self-conscious focus that disrupts concentrated attention (Csikszentmihalyi, 1990; Jackson & Csikszentmihalyi, 1999) and can potentially impede engagement with challenges (Nakamura & Csikszentmihalyi, 2005). This proposition is consistent with research findings that suggest a strong association between greater performance anxiety and a reduction in the experience of flow reported by musicians (Fullagar, Knight, & Sovern, 2013). Similarly, in a sample of athletes, Jackson, Ford, Kimiecik, and Marsh (1998) found a strong association between high performance anxiety and lower frequency of key flow dimensions: challenge–skill balance, unambiguous feedback, clear goals, concentration, and sense of control. The cognitive rather than the physiological component of anxiety may be the factor that is most responsible for the reported negative impact of anxiety on flow (Jackson & Wrigley, 2004).

The nonjudgmental attitude associated with mindfulness (Bishop et al., 2004; Brown & Ryan, 2003; Kabat-Zinn, 2009) may also facilitate flow by lessening pessimism. Judgmental thoughts about the self may be related to pessimism, and pessimism may interfere with the frequency and intensity of flow (Catley & Duda, 1997). Increased mindfulness may provide the opportunity to modify reactive judgments to events, both positive and negative. Kiken and Shook (2011) found some evidence that mindfulness may facilitate a shift toward lessening negative judgments, in that in their study a mindfulness intervention reduced negativity bias.

As proposed in the attribution reformulation of learned helplessness theory (Abramson, Seligman, & Teasdale, 1978), pessimistic and optimistic attribution styles relate to the thoughts used by a person to habitually explain the cause(s) of successful or disappointing outcomes. A pessimistic style is defined by attributions related to the permanence, universality, and internal focus on the causes of failure. For example, a pessimistic attribution process that focuses attention on thoughts of permanence related to failure may manifest as “I was hopeless at this before, I am hopeless at it now, and I will probably be hopeless at this next time if I try.” Universal pessimistic attributions may contain thoughts such as “I am hopeless at whatever I try . . . it does not matter what I compete in—the result will be a failure” and internal causes: “I am hopeless at this because I am simply not good enough, no matter how hard I try.” Moreover, individuals with a pessimistic attribution style tend to attribute success to temporary, specific, and external causes (Buchanan & Seligman, 1995). Pessimism in sport is associated with poorer performance (Gordon, 2008) as well as more disengagement-oriented coping and less life satisfaction (Gaudreau, Gunnell, Hoar, Thompson, & Lelièvre, 2015).

A pessimistic attribution style may be a basis for the experience of anxiety (Schleider, Vélez, Krause, & Gillham, 2014), including in sport (Moran, 2012), by focusing attention toward anticipated failure. Pessimism may also impede the fulfillment of flow conditions due to a focus on negative self-concepts. That is, habitual negative perceptions that focus attention on low self-competence and a lessened sense of control or autonomy over the task may cue feelings of trepidation and self-doubt that lead to a lowering in self-confidence in one's ability and skill to adequately meet the impending high challenge (Kowal & Fortier, 1999).

Dispositional, or characteristic, mindfulness is relatively enduring; however, a number of studies have shown that dispositional mindfulness can be increased through interventions. Eight-week mindfulness protocols—which train attentional and emotional regulation skill—have been found to increase dispositional mindfulness and also result in other psychological and physical benefits (Cayoun, 2011; Geschwind, Peeters, Drukker, Van Os, & Wichers, 2011; Kabat-Zinn, 1982, 2009; Segal, Williams, & Teasdale, 2002; Williams, Teasdale, Segal, & Kabat-Zinn, 2007).

Mindfulness-based interventions may be most beneficial when there is a match of specific components of mindfulness training with the target outcome that may be associated with an increase in mindfulness (Teasdale, Segal, & Williams, 2003). Mindfulness training that focuses on enhancing attentional and emotional self-regulation via the use of formal and informal mindfulness exercises geared to the needs of athletes may significantly increase the propensity to experience the occurrence of flow more frequently. Increasing the propensity to experience flow may be valuable as flow is associated with well-being (Csikszentmihalyi, 1990) and performance (Jackson et al., 2001). Attempting to increase flow through mindfulness training may be useful in that this approach focuses on factors underlying the flow experience. Cayoun (2011) argues that to achieve heightened mindfulness, mindfulness trainees must show high levels of adherence through duration, intensity, and the frequency of participation in formal and informal mindfulness exercises. Carmody and Baer (2008) found that the more time spent on meditation exercises, the greater the increase in mindfulness and the greater the increase in well-being. Adherence is an important characteristic in its own right in facilitating acquisition of mindfulness skills (Cayoun, 2011) and can also be a marker of psychological engagement with training. In general, greater engagement with an activity is associated with more well-being and better performance (Ryan & Deci, 2000; Shimazu, Schaufeli, Kubota, & Kawakami, 2012).

Given the potential for mindfulness-based interventions to increase the experience of flow and possibly reduce the experience of sport anxiety and pessimism, in this study we examined the impact of an eight-week mindfulness-based intervention on mindfulness, flow, sport anxiety, and sport-related pessimistic attributions in competitive athletes. In addition, we explored these relationships with a focus on adherence as assessed through observance of recommended levels of formal and informal mindfulness training. Consistent with relevant literature, we expected that

1. Athletes who adhere at a high level to a recommended eight weeks of formal and informal mindfulness training with regular and committed action would show significantly greater increases in mindfulness and flow as opposed to those athletes who do not adhere to recommended training.
2. Participants who adhere to the mindfulness-based intervention training would show greater decreases in sport anxiety and sport-related pessimism.



## Methods

### Participants

After approval by the university human research institutional review board, athletes were recruited through announcements in local sporting clubs. Twelve competitive athletes from Australia participated in the study. Five were competitive road cyclists, and five were competitive cross-country mountain bike riders. One athlete was a competitive alpine downhill skier, and one was a competitive swimmer. The sample comprised 2 female and 10 male athletes with ages ranging from 17 to 52 years ( $M = 33.57$ ,  $SD = 12.50$ ).

### Measures

Participants completed the following measures at baseline and again after the eight-week mindfulness training.

**Flow in sport.** Flow in sport was evaluated using the 36-item Dispositional Flow Scale-2 (DFS-2; Jackson & Eklund, 2002). This scale measures the frequency with which a person typically experiences the occurrence of flow in sport or a physical activity. The scale comprises nine separate flow dimensions, with each subscale containing four items, that are assessed on a 5-point Likert scale, ranging from 1 (*Never*) to 5 (*Always*), with higher scores indicating greater frequency of flow. Flow scores can be calculated on a dimensional and global level (i.e., total score) and expressed as either a global sum or as an item mean score for each dimension. A mean score is typically used as it can be evaluated against the scale's anchor descriptors; thus scores in this study ranged from 1 to 5 for each dimension and composite subscales. Jackson and Eklund (2004) recommend that the transformation of time subscale is excluded when calculating the composite scores as it has only a modest association with global flow. In this study the decision was made to exclude the transformation of time subscale base upon this recommendation.

Internal consistencies of each of the DFS-2 subscales are reported to be adequate to high, with Cronbach's alphas ranging from .78 to .86 (Jackson & Eklund, 2002). In the current study, internal consistencies for the subscale scores were high as indicated by Cronbach's alphas ranging from .90 to .95. The global score (i.e., eight flow dimensions) had a Cronbach's alpha of .95, flow characteristics (i.e., five flow dimensions) had an Cronbach's alpha of .93, and the three-dimension flow conditions scale had a Cronbach's alpha of .90.

**Sport anxiety.** Sport anxiety was assessed using the Sports Anxiety Scale-2 (SAS-2; Smith, Smoll, Cumming, & Grossbard, 2006). This scale consists of 15 items that measure general sport performance anxiety on three dimensions: somatic anxiety, worry, and concentration disruption (five items each), with items assessed on a 4-point Likert scale, ranging from 1 (*Not at all*) to 4 (*Very much*). Scores can range from 15 to 60 with higher summed scores representing higher sport performance anxiety. Internal consistency reliabilities of the SAS-2 subscales of somatic anxiety, worry, and concentration disruption are reported to be adequate to high, with Cronbach's alphas of .76, .90, and .85, respectively, and high for the total SAS-2 score, with a Cronbach's alpha of .87 (Smith et al., 2006). In this study, internal consistencies of the SAS-2 subscale scores were high, with Cronbach's

alphas of .87, .96, and .96, respectively, and high for the total SAS-2 score, with a Cronbach's alpha of .97.

**Mindfulness.** Mindfulness was assessed using the Five Facet Mindfulness Questionnaire (FFMQ; Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). The scale measures an individual's general tendency to be mindful in daily life. The FFMQ consists of 39 items assessing five facets of mindfulness: observing, describing, acting with awareness, nonjudging of inner experience, and nonreactivity to inner experience, with items for each subscale being assessed on a 5-point Likert scale, ranging from 1 (*Never or very rarely true*) to 5 (*Very often or always true*). Total scores can range from 39 to 195, with higher scores representing higher levels of mindfulness. The FFMQ is reported to have adequate to high internal consistency with coefficient alphas ranging from .75 to .91 (Baer et al., 2008). In the current study, the five facets of the FFMQ and the total FFMQ score showed high internal consistency, with Cronbach's alphas ranging from .81 to .96.

**Sport-related pessimism.** Sport-related pessimism was assessed using the short form of the Sport Attributional Style Scale (SASS; Hanrahan, Grove, & Hattie, 1989). This scale consists of 10 items that describe five positive and five negative hypothetical events in sport (Hanrahan & Grove, 1990). Respondents are asked to vividly imagine themselves involved in each of the situations and to write down the single most likely cause of the event experienced if that event had happened to them. Causal attributions according to the five causal dimensions of internality, stability, globality, controllability, and intentionality are assessed using a 7-point Likert scale that differs in anchoring descriptors for each causal dimension. For example, for the causal dimension of internality item response ranges from 1 (*Totally due to other people or circumstances*) to 7 (*Totally due to me*). In accordance with the recommendations of Hanrahan and Grove (1990), in this study a pessimism composite score was calculated separately for positive (i.e., reverse scored) and negative scores on the dimensions of internality, stability, and globality by summing the items. Thus scores can range from 30 to 210, with higher scores representing greater use of a pessimistic explanation style.

Internal consistency reliabilities of the subscale scores are reported to be adequate with coefficient alphas reported to be .74 and .72 for positive and negative events, respectively (Hanrahan & Grove, 1990). In this study, the internal consistency of the pessimism composite score was high with a Cronbach's alpha of .85, and Cronbach's alphas ranging from .80 to .94 for the positive and negative subscales of internality, stability, and globality.

Participants also completed the following measures during the course of the eight-week training. The scale is sensitive to interventions intended to change sport-related attribution style as evidenced by a study using a cognitive-behavioral intervention with rugby players (Parkes & Mallett, 2011).

**Mindfulness intervention log workbook.** At the start of each week of the eight-week mindfulness intervention, athletes were provided with a workbook—an adaptation from the workbook used in the mindfulness-integrated cognitive behavior therapy (MiCBT, Cayoun [2011]) protocol, modified for the current use in sample of nonclinical athletes—in which they logged each day's practice of formal mindful meditation training. In addition, the workbook provided space for participants to



make diary comments regarding any feeling, thought, or problem that may have arisen over the week's mindfulness training.

Several questions asked about adherence and benefits pertaining to meditation practice for the week. Participants were asked, "Were you able to practice the mindfulness training? Yes/No." Participants were also asked to indicate how many times they practiced during the last week. Another question in relation to home practice of formal meditation training asked participants to rate the extent to which they could feel body sensations on a scale ranging from 0 to 10. A fourth question asked participants to rate the extent to which they benefited from practicing mindfulness on a 0–14 scale.

Finally, participants were asked each week to provide narrative responses to the following questions: "Do you feel your mindfulness practice, to date, has impacted upon your recent athletic experiences either in training and/or racing?"

**Mindfulness intervention protocol.** The athletes participated in an eight-week mindfulness training program consisting of regular weekly mindfulness workshop sessions, home meditation training, and group mindful focus on movement exercises. The athletes participated as a group. The mindfulness training protocol was based on the MiCBT program formulated by Cayoun (2011). To maintain the fidelity of the MiCBT treatment protocol, the first author of the current study undertook supervised training in MiCBT foundation skills and conducted the workshops and mindful-spinning sessions. In addition, the same guided mindful meditation CD based on the MiCBT protocol was given to each participant.

The main adaptation of the mindful focus on movement exercise was a cycling-specific informal mindfulness exercise termed mindful spinning which was aimed at the majority of athletes who were cyclists. This exercise was performed on stationary cycles and was intended to help integrate attentional and emotional self-regulation skill into sport training and competitive environments. Mindful spinning was conducted in a small group setting on fixed-drive spin bikes with tension adjustment capabilities. This training provided a guided setting in which the cyclists were encouraged to observe and acknowledge any physical sensations and related thoughts in a nonjudgmental and nonreactive manner. A comparable alternative was provided for the swimmer and skier. The swimmer practiced mindful stroking, and the skier practiced mindful balancing, edging, and pressure control. This was practiced during warm-up for the relevant sport. All participants were encouraged to use mindful focus on relevant sport movements whenever possible in their daily training to increase generalizability of mindfulness to their sport.

The eight weekly workshop sessions focused on the presentation of information related to mindfulness meditation practice and the discussion of home formal meditation and informal mindful spinning or alternative practice experience. Information each week focused on core concepts relating to mindfulness and meditation practice and mindful integrated cognitive behavioral principles, such as the concepts of nonjudgmental exposure to stimuli and extinction. Any difficulties occurring in relation to weekly meditation practice were discussed, followed by suggestions and strategies for increasing adherence and ease of meditation at home and in workshop sessions.

Attendance at workshop sessions was recorded. In weekly workbooks each of the participants kept a record of minutes meditated immediately after each home

meditation session. Participants were also asked to fill in an interoception form after each workshop meditation session (see MiCBT manual, Cayoun, 2011). The interoception form was used to encourage reflection on awareness of body sensations, but these forms also provided an evaluation of weekly mindfulness progression.

The mean number of sessions attended for the high adherence group was 7.4 ( $SD = .89$ ; range was 6–8). The mean number of minutes spent meditating as recorded in the workbooks was 986 ( $SD = 396$ ). The mean number of sessions attended by the low adherence group was 3.1 ( $SD = 1.95$ ; range was 1–6). The mean number of minutes spent meditating was 143 ( $SD = 127$ ). Visual inspection of the interoception forms provided a rough estimate of internalization of aspects of mindfulness. For the high adherence group, the amount of shaded area of the back and front of the body silhouettes, indicating awareness of body sensation, during the first week of the program was on average 20% across participants. At week 4 it was 60%, and by the last week of the program it was 80%. For the low adherence group at the first week of the program interoceptive awareness was at 20%. At week 4 it was 40%, and by the last week of the program it was 30%. However, for the low adherence group the interoception data were based on what information was available as many of the participants in this group only occasionally attended weekly workshop sessions.

As recommended in the MiCBT manual (Cayoun, 2011), mindfulness concepts were discussed in small group (five or less) settings that focused on weekly experiences in relation to everyday mindfulness training as well as any problems encountered or personal positive mindful experiences that participants wished to share. Discussion also focused on how attentional and emotional regulation skills could be best assimilated into sports practice. Following discussion, a 15-minute guided formal meditation was practiced.

To help athletes track their change in ability to be mindfully attentive and aware of body sensation, after each week's in-class 15-minute guided formal meditation practice, each participant filled in an interoception form (reporting feeling of body sensations) immediately after practice. The form allowed participants to indicate on a two-sided body silhouette (front and back outline of body) the extent in percentage to which they were aware of feeling sensations during the progressive focused body scan meditation practice by coloring in the relevant segmented body areas. Daily home meditation sessions involved the use of CDs obtained from the MiCBT program (Cayoun, 2011). The CDs contained guided mindful meditation instructions for practices such as mindfulness of breath and a progressive range of body scan meditations. Participants were asked to practice—and keep records of adherence in the workbook supplied—the assigned home meditation given for the week for 30 minutes per day.

## Procedure

Inclusion criteria for the study were that the athletes needed to be actively competing at least at a club level of competition in their chosen sport and be 16 years of age or older. The single exclusion criterion was current and ongoing involvement in formal mindfulness meditation practice since the study was seeking participants who were predominantly inexperienced mindful meditators.



Athletes were recruited from a list of 20 cyclists who previously served as wait-list control subjects for a randomized control trial that was run 12 weeks before the current intervention study. In addition, two competitive athletes—one international level alpine skier and one ex-Australian national level swimmer—were included in the study. From the available recruitment pool, 12 athletes gave their informed consent to participate in the study.

Grouping of participants into either low or high adherence was determined by a continuous *Z* score for adherence that was calculated by adding the *z* scores for overall participant attendance of workshop sessions and a *z* score for overall participant minutes spent meditating, then divided by two. This provided a mean split of zero. The seven participants with negative scores were categorized as the low adherence participants. The five participants with positive scores were categorized as high adherence participants.

**Statistical analyses.** Analysis of covariance (ANCOVA), as recommended by Tabachnick and Fidell (2001) for comparison of groups when pre- and posttests are available, tested the hypotheses that athletes who adhere at a high level with a recommended eight weeks of formal and informal mindfulness training with regular and committed action would show significant differences in mindfulness and flow and greater decreases in sport anxiety and sport-related pessimism compared with athletes who do not adhere to recommended training. Follow-up *t* tests examined the change from pre to post among the high adherence and low adherence athletes separately. It should be noted that the sample size was very small, and thus the results of these tests may not be robust and there is an increased chance of Type II error. Effect sizes for ANCOVA results and *t* test results correspond to the type of statistic (Tabachnick & Fidell, 2001). As a supplementary analysis, adherence scores were correlated with mindfulness, flow, sport anxiety, and pessimism change scores.

## Results

### Effect of the Mindfulness Intervention

Table 1 shows the means and standard deviations of the key study variables obtained from competitive athletes in the low adherence to mindfulness training group and high adherence to mindfulness training group. There was no significant difference found between groups at pretest on any key study variables. *t*-test results for comparison of the pretest scores of those who were high versus low adherence were as follows: mindfulness,  $t(10) = -.83$ ; flow conditions,  $t(10) = .48$ ; flow characteristics  $t(10) = -.01$ ; anxiety  $t(10) = 1.6$ ; pessimism,  $t(10) = .92$ .

Before conducting the ANCOVAs to examine differences between the low and high adherence participants, preliminary analyses examined whether assumptions relating to appropriateness of this statistical analysis were met. The Shapiro–Wilk statistics and histograms for each group indicated that the ANCOVA assumption of normality was supported for all analyses performed across all variables as described later. Scatterplots indicated that the relationship between the respective covariates (time one) at the start and the dependent variables, at time two, at the end of the of the eight-week intervention were linear. The assumption of homogeneity

**Table 1 Low and High Adherence Mindfulness Training Group Means and Standard Deviations Pre and Post**

Variables	High Adherence Mindfulness Training Group ( <i>n</i> = 5)				Low Adherence Mindfulness Training Group ( <i>n</i> = 7)			
	Pre		Post		Pre		Post	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Mindfulness	128.40	17.45	138.00	8.06	120.59	15.49	119.00	15.23
Flow conditions	3.80	.33	4.08	.15	3.57	.53	3.52	.56
Flow characteristics	3.56	.58	3.87	.29	3.69	.37	3.53	.33
Global flow	3.65	.45	3.95	.23	3.64	.42	3.53	.39
Anxiety total	24.6	9.09	22.40	6.65	33.14	9.11	35.42	7.20
Pessimism	107.40	14.79	98.60	13.27	114.85	13.05	116.42	9.93

*Note.* Mindfulness = FFMQ scale total; Flow conditions = three-dimension composite of preflow conditions; Flow characteristics (five-dimension composite of flow frequency); Global flow (eight-dimension model); Anxiety total = SAS-2 total for sport specific anxiety; SASQ pessimism = pessimistic attribution style.



of regression slopes was found to be not in violation based on the absence of a significant (all assumption testing evaluated at a significance level of,  $p < .001$ ) on all IV-by-covariate interactions. Further, assumption of homogeneity of variance was also not in violation as nonsignificant Levene's tests were found to be present across all the respective analyses.

Athletes in the high adherence mindfulness training group showed significant differences in mindfulness than the low adherence athletes, as shown by an ANCOVA in which group membership was the independent variable, baseline mindfulness was a covariate, and posttest mindfulness was the dependent variable:  $F(1, 9) = 8.69, p = .016$ , and partial  $\eta^2 = .491$ , a large effect size according to Cohen (1992). The increase in mindfulness from baseline to posttest in the high adherence group athletes had a large effect size, although with the small  $N$  of four, this increase was not significant,  $t(4) = -1.59, p = .186$  two-tailed, 95% CI  $[-26.32, 7.12]$ ,  $d = .79$ . For the low adherence group there was a small decrease in mindfulness from pre- to posttest,  $t(6) = .78, p = .456$  two-tailed, 95% CI  $[-3.30, 6.49]$ ,  $d = .28$ .

In an ANCOVA in which group membership was the independent variable, pretest global flow was a covariate, and posttest global flow was the dependent variable, athletes in the high adherence mindfulness training group showed significant differences in the frequency of global flow relative to low adherence mindfulness training athletes,  $F(1, 9) = 6.75, p = .029$ , partial  $\eta^2 = .429$ . The effect size of the increase in frequency of global flow for the high adherence group was substantial but not significant,  $t(4) = -2.128, p = .10$  two-tailed, 95% CI  $[-.69, -.09]$ ,  $d = 1.10$ . In the low adherence group there was a nonsignificant decrease in global flow from pre- to posttest,  $t(6) = .86, p = .424$  two-tailed, 95% CI  $[-.21, .44]$ ,  $d = .30$ .

In an ANCOVA in which group membership was the independent variable, pretest flow conditions the covariate, and posttest flow conditions the dependent variable, athletes in the high adherence mindfulness training group showed a trend toward differences in the frequency of flow conditions compared with low adherence mindfulness training athletes,  $F(1, 9) = 3.75, p = .085$ , partial  $\eta^2 = .294$ , and the effect size for the increase was large but not significant,  $t(4) = -1.88, p = .133$  two-tailed, 95% CI  $[-.70, .13]$ ,  $d = .79$ . In the low adherence group there was a small nonsignificant decrease in the frequency of flow conditions from pre- to posttest,  $t(6) = .31, p = .769$  two-tailed, 95% CI  $[-.33, .42]$ ,  $d = .11$ .

In an ANCOVA in which group membership was the independent variable, pretest frequency of flow characteristics the covariate, and posttest flow characteristics the dependent variable, athletes in the high adherence mindfulness training group also showed significant differences in frequency of flow characteristics experienced relative to low adherence mindfulness training athletes,  $F(1, 9) = 7.27, p = .025$ , partial  $\eta^2 = .447$ . The effect size for the increase in the frequency of flow characteristics experienced among the high adherence group athletes was large but not significant,  $t(4) = -2.02, p = .114$  two-tailed, 95% CI  $[-.73, .12]$ ,  $d = 1.32$ . In the low adherence group there was a small decrease in the frequency of flow characteristics from pre- to posttest,  $t(6) = 1.19, p = .276$  two-tailed, 95% CI  $[-.16, .48]$ ,  $d = .43$ .

An ANCOVA controlling for baseline pessimism levels showed athletes in the high adherence mindfulness training group showed a difference in pessimistic attributional style at posttest relative to low adherence mindfulness training athletes,  $F(1, 9) = 5.41, p = .045$ , partial  $\eta^2 = .375$ . A two-tailed  $t$  test showed a statistically

nonsignificant decrease in pessimism between pre- and posttest in the high adherence mindfulness training group athletes,  $t(4) = .84$ ,  $p = .450$ , 95% CI [-20.44, 38.04], with a low to medium effect size,  $d = .34$ . In the low adherence group, there was a small nonsignificant increase in pessimism from pre- to posttest,  $t(6) = -.47$ ,  $p = .644$  two-tailed, 95% CI [-9.49, 6.34],  $d = .18$ .

An ANCOVA controlling for baseline anxiety showed that high adherence mindfulness training group athletes were significantly less anxious than the low adherence mindfulness training athletes at posttest,  $F(1, 9) = 5.39$ ,  $p = .045$ , partial  $\eta^2 = .375$ . The decrease in anxiety among the high adherence mindfulness training group athletes was statistically nonsignificant between pre- and posttest,  $t(4) = .55$ ,  $p = .611$ , 95% CI [-4.84, 7.24], with a low effect size,  $d = .25$ . The low adherence group athletes again had a small nonsignificant increase in anxiety from pre- to posttest,  $t(6) = -1.02$ ,  $p = .348$  two-tailed, 95% CI [-7.77, 3.20],  $d = .38$ .

In a supplementary analysis of how adherence related to the key proposed change agent of increase in mindfulness, we examined how a continuous participant adherence score, calculated as the composite of z scores for number of workshop sessions attended and minutes spent in meditation, related to change in mindfulness. The association was not significant,  $r(11) = .40$ ,  $p = .10$ , with 16% of variance in change in mindfulness accounted for by adherence.

## Changes in Mindfulness, Flow, Anxiety, and Pessimism Among All Athletes

Change scores in mindfulness, flow, anxiety, and pessimism in the 12 participants were calculated by subtracting the pretest scores from the posttest scores. Table 2 shows the correlations between these change scores, with significance testing set at a two-tailed level of analysis. Increase in mindfulness was associated with increase in frequency of global flow,  $r(10) = .66$ ,  $p < .05$ , and the factors of flow characteristics,  $r(10) = .71$ ,  $p < .01$ , and decrease in pessimism,  $r(10) = .61$ ,  $p < .05$ . Increase in global flow was associated with a decrease in the anxiety concentration factor,  $r(10) = .71$ ,  $p < .05$ , and a decrease in pessimism,  $r(10) = .61$ ,  $p < .05$ .

Table 3 contains qualitative narrative examples of the comments extracted from participants' final workbooks in response to the question: "Do you feel your mindfulness practice, to date, has impacted upon your recent athletic experiences either in training and/or racing?"

## Discussion

The present study investigated the impact of adhering to mindfulness training on the experience of flow, sport anxiety, and sport-related pessimism in competitive athletes. Key findings were that athletes who adhered to the mindfulness training protocol showed differences in in mindfulness, flow, anxiety, and pessimism relative to participants who engaged only marginally with the mindfulness training. Correlation of change scores showed that greater increases in mindfulness between baseline and posttest were associated with larger increases in flow and larger decreases in pessimism. Greater increases in flow were associated with larger decreases in anxiety concentration and pessimism. These findings regarding



**Table 2 Correlations, Means, and Standard Deviations for Change Scores from Baseline to Post ( $n = 12$ )**

Measures	1	2	3	4	5	6	7	8	9	M	SD
1. Mindfulness		.498	.712**	.659*	-.379	-.368	-.196	-.328	-.614*	3.06	11.69
2. Flow conditions			.835**	.933**	-.553	-.117	-.361	-.745**	-.536	.09	.40
3. Flow characteristics				.977**	-.411	.062	-.177	-.637*	-.619*	.03	.41
4. Global flow					-.483	-.086	-.255	-.705*	-.612*	.05	.39
5. Anxiety total						.704*	.909**	.790**	.408	.83	5.57
6. Anxiety somatic							.638*	.175	.374	-.33	2.14
7. Anxiety worry								.597*	.338	-.33	2.01
8. Anxiety concentration									.281	.88	2.82
9. Pessimism										-2.75	16.43

*Note.* Mindfulness = FFMQ scale total; Flow conditions = three-dimension composite of preflow conditions; Flow characteristics = Characteristics defining a flow experience (five-dimension composite of flow frequency); Global flow (eight-dimension model); Anxiety total = SAS-2 total for sport specific anxiety; Anxiety somatic = SAS-2 somatic anxiety subscale; Anxiety worry = SAS-2 worry anxiety subscale; SAS-2 somatic anxiety subscale; Anxiety concentration = SAS-2 anxiety concentration disruption subscale; SASQ Pessimism = SASQ pessimistic attribution style. Mindfulness-exposure = total time in minutes spent in formal and informal mindfulness training.

\* Indicates a statistically significant correlation ( $p < .05$ , two tailed). \*\* Indicates a statistically significant correlation ( $p < .01$ , two tailed).

**Table 3 Examples of Log Entries of Low and High Adherence Participants at End of Training**

<b>Low Engaged Participant Comments at the End of Week Eight of the Mindfulness Intervention</b>	<b>High Engaged Participant Comments at the End of Week Eight of the Mindfulness Intervention</b>
<ul style="list-style-type: none"><li>• Partially, but not much flow.</li><li>• Not sure.</li><li>• Not really.</li><li>• Unsure.</li></ul>	<ul style="list-style-type: none"><li>• I am able to concentrate and focus more on the present task at hand, and not dwell on others or future directions.</li><li>• It sure has! I am more focused and am experiencing the present moment more than ever.</li><li>• Yes, I feel willing, responsive and capable of handling what comes my way.</li><li>• Yes, I feel more in control and stable, more proactive, less reactive.</li><li>• I believe there has been benefit but has been gained through capacity to focus on task.</li><li>• Yes it has helped me deal with my nerves in a positive way and alter my perception of "pain."</li></ul>

*Note.* The narrative entries are in response to the question "Do you feel your mindfulness practice, to date, has impacted upon your recent athletic experiences either in training and/or racing?"

an eight-week sport-specific mindfulness training program extend the promising previous findings of the effects of mindfulness training on flow among athletes (Aherne et al., 2011; Briegel-Jones et al., 2013).

The results regarding greater acquisition of mindfulness skills among the high adherence group support Cayoun's (2011) suggestion that frequency, accuracy, and duration of training is important. Adherence to training and engagement with training are related but distinct concepts in that adherence describes the following of a protocol, while engagement describes psychological involvement in a task (Reeve, Jang, Carrell, Jeon, & Barch, 2004; Ryan & Deci, 2000). In the current study, both adherence to the protocol and psychological engagement with mindfulness training may have contributed to the benefits of the training. Mindfulness interventions for athletes might try to incorporate features to enhance participants' adherence to training and psychological engagement with training. As Ryan and Deci (2000) point out, more autonomous and self-determined motivation can result in greater engagement. Such self-determined motivation can be fueled by basic needs such as the need for competence (Ryan & Deci, 2000). To facilitate athletes' adherence to and engagement with mindfulness training, it might be useful to build in athletes' self-determined motivation.

The results also suggest interrelationships between changes in mindfulness, flow, and sport-related anxiety and pessimism. Increasing mindfulness and flow among athletes may help reduce the detrimental experiences of anxiety and pessimism.



The results of this study need to be interpreted with some caution given several limitations. First, the sample size was very small. The small sample sizes in the ANCOVAs and t tests increase the chance of Type II error, which involves not identifying actual differences or associations because of lack of power. In conjunction with this, the eta-square and Cohen's d results may not be robust. Second, assessment of some constructs represented in the research is difficult. As Jackson and Marsh (1996) and Csikszentmihalyi (1992) point out, the subjective experience of flow can be quite difficult to assess. Mindfulness can also be conceptualized and assessed in different ways, including approaches based primarily on Buddhist phenomenology and approaches grounded in recent Western approaches (Grossman, 2011). Valid and reliable measures of mindfulness and flow were used in this study, but they may not have adequately captured the ephemeral experience of flow entirely. Third, the current study did not use an experimental control design; thus there is a lack of clarity as to the extent to which regular weekly contact may have contributed to the benefits obtained in the high adherence group. It could be argued that the low adherence participants served as a reasonable pseudo control group as they were provided with equal opportunity for training and practice over the course of the eight weeks.

## Conclusion

In conclusion, the results of this study indicate that a tailored eight-week mindfulness program that includes a component of a mindful focus on movement exercise for athletes was beneficial for engaged competitive athletes. Increases in mindfulness were associated with increases in flow and decreases in pessimism. The results have practical implications regarding mindfulness training for athletes and provide a foundation for future research and more large-scale research.

The results of the current study, together with those of several previous studies, suggest that mindfulness training may increase athletes' flow experience, which in other research has been related to performance and well-being (Csikszentmihalyi, 1990; Nakamura & Csikszentmihalyi, 2005). Because of connections between greater mindfulness and less pessimism and aspects of anxiety, training in mindfulness might be especially beneficial for athletes expecting poor outcomes in their sport or athletes whose anxiety interferes with sport-related concentration. Future research might investigate methods of increasing athletes' adherence and engagement with mindfulness training. Self-determination theory (Ryan & Deci, 2000) provides a possible foundation for such research.

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