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The Effect of Mindfulness Training on Athletes' Flow: An Initial Investigation

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This study investigated the relationship between mindfulness training (a nonjudgmental attentional training technique) and flow experiences in athletes. Participants were 13 university athletes (M = 21 years), assigned either to a control group or an experimental group. Flow experiences were assessed before and after the intervention. ANOVA (group x time) of global scores on the Flow State Scale-2 (FSS-2; Jackson & Eklund, 2004) showed a significant interaction (F =11.49, p < .05). Follow-up t tests indicated no significant difference (p > .05) between the experimental and control groups' FSS-2 global scores at the baseline training session, but a large difference (p < .05, d = 1.66) at a follow-up training session. Significant interaction effects were also observed for FSS-2 subscales scores for the flow dimensions of "Clear Goals" (F =18.73, p < .05) and "Sense of Control" (F = 14.61, p < .05). Following an evaluation of the strengths and weaknesses of this study, the theoretical significance of the results is assessed and the promise for the application of mindfulness training in performance enhancement is discussed.

Concentration, or the ability to focus on the task at hand while ignoring distractions, is a crucial prerequisite of successful performance in sport (Moran, 2009). An emerging technique for improving concentration is "mindfulness" training, an attentional focusing strategy that originated in the Buddhist meditative tradition (Erisman & Roemer, 2010) but that first received empirical research attention in cognitive behavior therapy (Segal, Williams, & Teasdale, 2002). According to Kabat-Zinn (2005), mindfulness involves "an openhearted, moment-to-moment, non-judgmental awareness" (p. 24) of oneself and the world. This nonjudgmental orientation means that mindfulness training differs from other cognitive control techniques such as thought suppression (Wegner, Schneider, Carter, & White, 1987) by urging *acceptance* rather than attempted suppression or elimination of distracting thoughts and emotions (Bowen, Witkiewitz, Dillworth, & Marlatt, 2007; Kavanagh, Andrade, & May 2004). Mindfulness training also differs from thought

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suppression by virtue of its emphasis on somatic awareness. Thus mindfulness interventions typically include body-centered exercises such as “focused breathing” (e.g., see Arch & Craske, 2006). The relationship between mindfulness training and the attentional strategy of “association” (Morgan, 1978) is less clear-cut, however. This latter strategy involves training athletes (especially those in endurance events such as marathon running) to focus on bodily processes and somatic cues such as “respiration, temperature, heaviness in the calves and thighs and abdominal sensations” (p. 39). At first glance, this strategy seems very similar to mindfulness training. However, a possible difference between these attentional strategies is that whereas association involves deliberate engagement with somatic cues, mindfulness training encourages a more passive and nonjudgmental acceptance of them. With these conceptual distinctions in mind, the current study attempted to investigate the effect of mindfulness training on athletes’ flow experiences.

Mindfulness involves bringing one’s complete attention to the present experience on a moment-to-moment basis and accepting the given situation (Marlatt & Kristeller, 1999; Nhat Hanh, 1975). It involves paying attention to one’s body and becoming aware of all the different sensations and thoughts involved in one’s actions at each moment (Neale, 2007). Kabat-Zinn (1982) was one of the first to popularize mindfulness as a paradigm in Western health care using the technique to treat such psychological disorders as depression and anxiety.

Although thought suppression may improve attentional focus in athletes under certain circumstances (Dugdale & Eklund, 2002), it may produce “paradoxical” or counter-intentional effects as a self-control strategy (Wegner et al., 1987). For example, when people who are anxious or otherwise cognitively overloaded receive instructions *not* to overshoot the hole when golf putting, they often end up actually overshooting the hole in question (Wegner, Ansfield & Pilloff, 1998; see also Beilock, Afremow, Rabe & Carr, 2001). One explanation of this finding is that thought suppression triggers a meta-cognitive scanning process whereby the mind searches for signs of the unwanted instruction and brings it to awareness when detected. Not surprisingly, ironic processes impair sport performance (e.g., see Binsch, Oudjeans, Bakker & Savelsbergh, 2009; Woodman & Davis, 2008). For example, in Bertollo, Saltarelli, and Robazza’s (2009) study of the mental preparation strategies used by Italy’s 2004 Olympic pentathlon squad, one of the athletes revealed that “in some circumstances, my intention is not to do the best but to avoid making a bad shot. *That is when I make a bad shot. When I think about avoiding the error, I make the error*” (p. 252, italics ours). In contrast to thought suppression techniques that require athletes to block out distracting thoughts, mindfulness training is based on the premise that such thoughts are natural events taking place in the mind—that regularly come and go—and should be viewed as expected features of human existence (Gardner & Moore, 2004). Therefore, accepting a given situation without judging it, and living it with full awareness, is an integral element of mindfulness practice. Clearly, using this form of mindfulness in competitive situations could have a positive effect on an athlete’s performance because it encourages focusing on the present moment rather than thinking too far ahead. For example, consider what Bradley Wiggins (Britain’s Olympic gold-medalist in cycling in 2008) revealed: “I never think too far ahead. How can you think three days ahead when you’ve got two days in-between? That’s how you cock things up” (cited in Williams, 2009), Interestingly, Gardner and Moore (2007) suggested that mindfulness is a trainable attention-related skill that helps people to maintain their focus on the present moment.

In an effort to improve sporting performance through enhanced attention, Gardner and Moore (2004) employed a 12-week mindfulness training program with two athletes. They found that, after completing the program, a 22 year-old male intercollegiate swimmer, with a history of anxiety and underperformance, worried less—as measured by the Sport Anxiety Scale (Smith, Smoll, & Schutz, 1990). In addition, the client increased his willingness to act in pursuit of his sporting goals. With four weeks of follow-up mindfulness training, the swimmer also managed to win two competitions and achieve two personal best times. This mindfulness training program was also employed with a 37 year-old masters-level female power weightlifter, who had reached a plateau in her performance across two seasons. After six weeks of the mindfulness intervention, she lifted 15% beyond her previous masters-level best.

Although case studies of one or two athletes do not provide conclusive empirical data regarding intervention effectiveness, they can, at the early stages of intervention evaluation research, help to guide development of methodological protocols. Furthermore, they can facilitate the elaboration of hypotheses to be tested in later controlled research (Gardner & Moore, 2004). Unfortunately, to date, there has been no attempt to carry out an experimental study on the effects of mindfulness training on a larger group of athletes than the two-person sample used by Gardner and Moore (2004). Therefore, the current study addresses a major gap in this field.

Mindfulness and Flow

The construct of 'flow' refers to a highly coveted yet elusive state of mind that is characterized by complete absorption in the task at hand as well as by enhanced skilled performance. This construct has been studied regularly in sport psychology and can be measured in both training and competition (e.g., see Csikszentmihalyi & Csikszentmihalyi,1988; Jackson, 1995; Jackson & Kimiecik, 2008; Kimiecik & Jackson, 2002). It is purported to include nine dimensions: challenge-skill balance, action-awareness merging, clear goals, unambiguous feedback, concentration on task, sense of control, loss of self-consciousness, time transformation, and autotelic experience (Jackson, 1995). By exploring the psychosocial factors that enhance, inhibit, or disrupt flow, sport psychology practitioners and coaches may be able to help athletes to achieve optimal experience more frequently, which, in turn, should ultimately enhance performance (Kimiecik & Stein, 1992). As a result, it is not surprising that a substantial number of studies have been conducted to investigate potential facilitators and disruptors of flow. For example, with regard to facilitators, the elite athletes interviewed by Jackson (1995) proposed that concentration was a pivotal factor influencing their flow experience. Conversely, these athletes reported that the main cognitive hindrances to flow were thinking too much, being over-concerned with what others were doing, worrying about what others were thinking about oneself, and worrying about other competitors.

Jackson's (1995) evidence suggests that flow requires a present-moment, non-self-conscious concentration on a particular task. Not surprisingly, therefore, a number of authors have recommended that maintaining a present moment focus is an effective strategy for achieving peak performance and flow (Orlick, 1990; Jackson

& Csikszentmihalyi, 1999). Despite the obvious conceptual similarity between mindfulness and flow (as both constructs emphasize the importance of focusing on the present moment), little research has been conducted to examine the relationship between athletes' nonjudgmental awareness of the present moment and their possible experiences of flow. Kee and Wang (2008) employed a cluster analysis to examine the relationships between flow, mindfulness and mental skills adoption in 182 college athletes. They found that athletes with the propensity to be more mindful reported higher flow scores. Given the cross-sectional design of Kee and Wang's study, however, it cannot be concluded that mindfulness actually *caused* athletes to experience greater flow. As a result, there is a need for research examining the effect of mindfulness training on athletes' flow experiences. The current study was designed to fill this gap in the research literature. Based on previous qualitative (Jackson, 1995) and quantitative (Kee & Wang, 2008) evidence linking mindfulness and flow experiences, we hypothesized that athletes who participated in a mindfulness training program would experience greater flow than they did before the intervention. We also predicted that mindfulness-trained athletes would experience greater flow than athletes who did not participate in the mindfulness training program.

Method

Participants

Thirteen athletes (mean age = 21.00 years, *SD* = 1.68 years, range 19–25 years) from a University 'High Performance Centre' volunteered to participate. Athletes were competing at national and/or international levels and had participated in their particular sport for an average of 8.69 years (*SD* = 2.43).

Measures

The Flow State Scale-2 (FSS-2), developed by Jackson and Eklund (2002), was used to measure athletes' flow experiences during training for their sport. We focused on athletes' flow experiences during training because to date, the vast majority of research on flow has examined sport performance in competitive situations. Nevertheless, in their conceptual analysis of flow and its relationship to attention and the exertion of effort, Connolly and Tenenbaum (2010) suggested that flow can occur "in the midst of practice or competition" (p. 1123). So, assessing athletes' flow experiences during training fills a gap in the literature.

The FFS-2 questionnaire is a 36-item, multifactor psychometric instrument "designed to be answered after a specific event to assess the experience of flow in that event" (Jackson & Kimiecik, 2008, p. 395). According to Jackson and Eklund (2002) the FSS-2 can be administered follow a variety of physical activities, including competitive and noncompetitive events. The questionnaire is designed to measure nine different dimensions of flow. An example item was "I knew clearly what I wanted to do." Participants in this study rated each item on a five-point Likert scale, ranging from 1 (*strongly disagree)* to 5 (*strongly agree*). Each FSS-2 questionnaire was completed immediately following a training session and participants were asked to answer each item in relation to their experiences in that session. The 36 item scores were summed to produce a global flow state score. The higher the flow score, the more intense the flow experiences are believed to be.

Jackson and Eklund (2002, 2004) provided evidence that supported the reliability (mean subscale $\alpha = .85$) and validity of the FSS-2. Germane to the focus on this study, this scale has been successfully used to measure collegiate students' flow experiences (Hall, Smith & Nelson, 2007).

The Cognitive and Affective Mindfulness Scale—Revised (CAMS-R), developed by Feldman and colleagues using university students (Feldman, Hayes, Kumar, Greeson & Laurenceau, 2007), was used to measure athletes' mindful approaches to thoughts and feelings. This scale consisted of 12 items (e.g., "It is easy for me to concentrate on what I am doing") designed to assess participants' mindfulness. Participants rated each item on a four-point Likert scale, ranging from 1 (*rarely/not at all)* to 4 (*almost always*). A total mindfulness score was formed by summing the scores from each item; the higher a CAMS-R score, the more mindful the participant. Previous research with student samples (Baer, Smith, Hopkins, Krietemeyer & Toney, 2006) has demonstrated acceptable internal consistency ($\alpha = .81$) in the CAMS-R. In addition, Feldman et al. (2007) found that the CAMS-R was strongly correlated with other mindfulness scales such as the Mindful Attention Awareness Scale (Brown & Ryan, 2003) and the Freiburg Mindfulness Inventory (Walach, Buchheld, Buttenmuller, Kleinknecht, & Shmidt, 2006), thereby demonstrating good construct validity. The psychometric properties of the CAMS-R have not previously been examined in sport. We adapted the instructions for the scale by encouraging participants to consider the items in the context of their given sport.

Procedure

Clearance from University College Dublin's, ethical review board was obtained before participant recruitment. The manager of the university's High Performance Centre (HPC) granted permission to invite athletes to participate in the study. The HPC is a center for elite university athletes and membership in this center was a requirement for selection in this study. Fourteen randomly selected athletes from the list of 200 athletes associated with the HPC were "invited to participate in a sport psychology experiment that may or may not require them to carry out a program involving training of a psychological skill". Thirteen of these athletes provided informed consent and voluntarily participated in the study.

Participants were stratified according to sport and gender and then randomly assigned to either the experimental ($n = 6$) or control ($n = 7$) condition. The athletes in the experimental group were two male rugby players, one male tennis player, one male hammer thrower, one female sprinter, and one female hockey player. The athletes in the control group were two male rugby players, one male middle distance runner, one male sprinter, one male hockey player, one female hurdler and one female hockey player. All participants were asked to complete the CAMS-R during a quiet time, alone at home, and to return the completed questionnaire to the principal author within 24 hr. Participants also completed the FSS-2 immediately following a training session and were instructed to respond to the items while recalling their experiences during that training session.

Once the CAMS-R and FSS-2 had been collected, the six athletes in the experimental group began mindfulness training. They received a one page information sheet explaining the nature and characteristics of mindfulness and the ways in which mindfulness training could be applied to sport. This sheet identified Jon Kabat-Zinn as a key proponent of mindfulness training and informed the athletes that they would receive his coauthored CD entitled "Guided Meditation Practices" (Williams, Teasdale, Segal & Kabat-Zinn, 2007). This CD was used to guide the athletes through their six weeks of mindfulness training. Four specific exercises from the CD were included in the program: "Breath," "Breath and Body," "Standing Yoga" and "Body Scan." These exercises were chosen for two reasons. First, they were similar to the ones that were successfully employed by Gardner and Moore (2004). Second, they reflect the type of somatic awareness training that is characteristic of mindfulness interventions in the research literature (e.g., see Arch & Craske, 2006).

The four mindfulness exercises may be described as follows. First, "Breath" encouraged participants to become aware of their breathing patterns. Second, "Breath and Body" incorporated both breathing patterns and bodily sensations. Third, "Standing Yoga" elicited awareness of breathing and bodily sensations through a series of stretches. Finally, "Body Scan" involved participants becoming aware of each individual bodily part, one at a time, from lower to upper body. The first three of these exercises lasted approximately 10 min each and participants were instructed to complete them once a day on specified days of the week. The fourth exercise ("Body Scan") took the longest duration (approximately 30 min) and participants were instructed to complete it twice per week on specified days. All four exercises were designed to improve participants' awareness of how their bodies were feeling at any given moment and to improve their ability to focus on their bodily processes as they occurred. To facilitate training exercise compliance, participants in the experimental group received a scheduled timetable with a calendar of their exercises to tick off as they were completed. The timetable was merely a tool to help participants to keep track of the exercises they had done and no manipulation check on this aspect of training was carried out after the program. All six of these participants in the experimental group also accepted an offer of a daily text message to remind them to complete their mindfulness exercises. This text message included reminders that participants were advised to use to employ the mindfulness techniques during sport training.

Athletes in the control condition were not provided any additional instruction or attention. Indeed, no contact was made with these athletes during the time that experimental group athletes were completing their mindfulness training.

At the end of the six week period, participants in the control and experimental groups completed the CAMS-R again. They also completed the FSS-2 after a training session that was similar in physical intensity (as judged by the athletes) to the session of the first week. It was important to administer this latter questionnaire after a similar training session to that encountered previously because differences in the content of the sessions could have introduced unwanted error variance. At the end of the study, athletes from the control group were offered the mindfulness CD and training timetable to carry out by themselves.

Analysis

We first screened the data for missing or out-of-range values and evaluated the normality of the data. We then conducted a manipulation check using a 2 × 2 repeated-measures ANOVA, with "time" as the within-subject factor and "group" as the between-subject factor. The dependent variable in this manipulation check was the participant's score on the CAMS-R. An interaction effect and follow-up tests showing increases in the experimental group's CAMS-R scores over time and no change in the control group's CAMS-R scores would indicate that the training program had successfully increased only the experimental group's mindfulness (suggesting that the manipulation was successful).

In the main analyses, we conducted a series of 2 × 2 repeated-measures ANOVA. "Group" was the between-subject factor and "time" was the within subject factor in all analyses. In the first analysis, global flow score on the FSS-2 was the dependent variable. Since the typical type-I error protecting multivariate test (i.e., MANOVA) could not be performed with such a small sample, this analysis of global flow scores provided an initial omnibus test of the impact of the intervention on flow scores. In the nine subsequent analyses, each one of the nine FSS-2 subscale scores served as the dependent variable. A significant interaction and follow-up tests showing increases in FSS-2 scores in the experimental group, but not in the control group, would indicate that the training program had successfully increased only the experimental group's flow.

Results

Preliminary Analyses

There were no missing or out of range values and the data were univariately normally distributed (with normalized skewness and kurtosis values less than 1.96). The 2 × 2 ANOVA, with the CAMS-R data as the dependent variable, showed no significant effects of group, $F\ (1,11) = .91$, $p = .36$ or time, $F\ (1,11) = 3.72$, $p > .05$, but a significant group x time interaction, $F\ (1,11) = 7.95$, $p < .05$, partial $\eta^2 = .41$. Follow-up *t* tests indicated no significant difference ($p > .05$) between the CAMS-R scores of the experimental and control groups at baseline, but a large difference ($p < .05$, $d = 1.02$) at follow-up (by convention, an effect size greater than 0.8 is deemed "large"; see McCartney & Rosenthal, 2000). Furthermore, the increase in mindfulness scores from Time 1 to Time 2 was large ($p < .01$, $d = 1.13$) for the experimental group, but nonsignificant ($p > .05$) for the control group. These results suggested that the mindfulness training program had successfully enhanced only the experimental group's mindfulness scores (i.e., the manipulation was successful). See Table 1 for mean values.

Main analyses

The 2 × 2 ANOVA with the FSS-2 global scores as the dependent variable showed no significant effects of group, $F\ (1,11) = 1.44$, $p > .05$. Time showed a significant main effect, however, with $F\ (1,11) = 9.72$, $p < .05$. There was also a significant group x time interaction, $F\ (1,11) = 11.49$, $p < .05$, partial $\eta^2 = .51$. Follow-up *t* tests indicated no significant difference ($p > .05$) between the experimental and control groups' FSS-2 global scores at the baseline training session, but a large difference ($p < .05$, $d = 1.66$) between them at follow-up training session. Furthermore, the increase in FSS-2 global scores from Time 1 to Time 2 was large ($p < .01$, $d = 1.56$) for the experimental group, but nonsignificant ($p > .05$) for the control group.

We also conducted separate repeated measure ANOVAs for each of the nine FSS-2 subscale scores, representing the nine different dimensions of flow (Jackson, 1995). Mean scores are provided in Table 1. ANOVA details can be viewed in Table 2. We observed significant interaction effects for two of the nine

Table 1 Mean Mindfulness and Flow Scores at Time 1 and Time 2

Time	Group	Mindfulness	Global Flow	Sense of Control	Loss of Self-Conciousness	Time Transformation	Autotelic Experience
Time 1	Experimental	32.33 (4.27)	127.17 (15.39)	14.50 (2.17)	12.83 (4.67)	11.67 (2.34)	15.17 (3.61)
	Control	33.57 (1.62)	132.57 (10.47)	15.86 (1.68)	11.57 (2.15)	14.71(2.81)	15.5714 (1.27)
Time 2	Experimental	37.67 (5.09)	151.00 (15.18)	17.17 (1.47)	15.33 (3.56)	14.17 (3.31)	17.83 (2.14)
	Control	32.57 (4.89)	131.57 (8.00)	15.00 (.82)	12.00 (2.58)	13.29 (2.87)	15.14 (1.21)
Time	**Group**	**Challenge-Skill Balance**	**Action-Awareness Merging**	**Clear Goals**	**Unambiguous Feedback**	**Concentration on Task**	
Time 1	Experimental	16.17 (1.94)	13.83 (2.40)	15.83 (1.60)	16.50 (1.38)	10.67 (2.74)	
	Control	16.00 (1.63)	13.29 (1.38)	15.86 (2.34)	16.43 (1.62)	12.14 (2.85)	
Time 2	Experimental	18.00 (2.00)	17.17 (2.32)	18.67 (1.37)	17.50 (1.87)	15.17 (2.79)	
	Control	16.00 (1.00)	14.43 (.98)	15.29 (2.14)	15.43 (1.13)	15.00 (1.29)	

Note: Standard deviations listed in parentheses. Theoretical minimum and maximum values for the Mindfulness scores are 12 and 48, respectively. Theoretical minimum and maximum values for the Global Flow scores are 36 and 180, respectively. Theoretical minimum and maximum values for the Flow subscale scores are 4 and 20, respectively.

Table 2 Group x Time Interaction Effects

Dependent Variable	Mean Squares	F	p	η^2
Challenge-skill balance	5.429	2.178	.17	.17
Action-awareness merging	7.751	2.298	.16	.17
Clear goals	18.726	11.925	.01	.52
Unambiguous feedback	6.462	4.442	.06	.29
Concentration on task	4.360	.937	.35	.08
Sense of control	20.059	14.617	<.01	.57
Loss of self-consciousness	6.931	1.347	.27	.11
Time transformation	78.616	5.092	.05	.32
Autotelic experience	19.788	1.313	.276	.11

Note: *df* for each interaction effect = 1. *df* for each error term = 11. Main effects do not relate to the study hypotheses and are, therefore, not provided. Interested readers may contact the third author for details.

dimensions ("Clear Goals" and "Sense of Control"), with the "Unambiguous Feedback" subscale showing a marginal interaction. Follow-up *t* tests revealed no significant differences between the experimental and control groups at baseline, but at follow-up the experimental group scores were higher than the control group scores on the "Clear Goals," "Sense of Control," and "Unambiguous Feedback" subscales. These differences were large—as indicated by an effect size (Cohen's *d*) greater than 1. In addition, post hoc analyses of the "Clear Goals" and "Sense of Control" data indicated that the changes in these subscale scores from Time 1 to Time 2 were large ($p < .01$, $d > 1.4$) for the experimental group, but nonsignificant ($p > .05$) for the control group. Changes in the "Unambiguous Feedback" scores from Time 1 to Time 2 were moderate ($d = .61$) and marginally significant ($p = .11$) in the experimental group, but nonsignificant ($p > .05$) in the control group.

A significant interaction was also observed in relation to the time transformation subscale scores. However, this effect was due to a significant difference between the two groups at baseline; no between group difference was observed following the intervention. Repeated-measures ANOVAs of the other six FSS-2 subscales showed no significant interaction of group and time ($p > .10$), suggesting that mindfulness training had not produced changes in these flow dimensions. Accordingly, follow-up *t* tests were not conducted.

Discussion

The aim of the present experiment was to test the effect of a mindfulness training program on athletes' flow experiences during competitive sport training. The twin hypotheses that athletes who underwent this training would experience greater flow than they did before the program, and would experience greater flow than athletes who did *not* participate in the training, were partially supported. Indeed, athletes who underwent mindfulness training reported increases not only in global flow scores but also on the flow dimensions of "Clear Goals" and "Sense of Control". The other flow subscale scores measured by the Flow State Scale-2, however, did not appear to be influenced by the intervention.

The findings of this study are broadly consistent with those of the two case studies reported in Gardner and Moore (2004). Specifically, just as these authors noted improvements in their two athletes' performances following mindfulness training, our experiment showed that such training led to increases in certain aspects of peak performance. There are at least two important differences between Gardner and Moore's (2004) study and ours, however. First, whereas Gardner and Moore's case studies involve single-case, selective "examples" (p. 716), our results are based on an experimental design involving *group* comparisons. Second, whereas the two athletes described in Gardner and Moore's (2004) case studies were "problem" sports performers (i.e., they had sought professional help from sport psychologists), the athletes in our experiment were not selected because they had acknowledged or reported any particular problem. As a result, our findings extend previous research by suggesting that mindfulness training may be beneficial to a broader range of athletes—not just those who report having problems with the mental aspects of their athletic performance.

Our findings are also broadly consistent with the results of research conducted by Kee and Wang (2008). These latter authors found that athletes who scored highly in mindfulness reported greater scores for the flow dimensions of "clear goals" and "sense of control" than did athletes with lower mindfulness scores. Our results and those from Kee and Wang's study are understandable given that these two latter dimensions of flow are related to the self-regulation of attention, which according to Bishop, Lau, Shapiro, Carlson, Anderson, Carmody et al. (2004) is a key component of mindfulness. Thus, with a heightened self-regulation of attention, those who are mindful are more likely to be aware of their goals. Likewise, the heightened sense of control in mindful athletes is consistent with Bishop et al.'s (2004) contention that mindfulness is directly related to the self-regulation of attention.

A noticeable difference between our results and those of Kee and Wang (2008), however, is that we did not find that mindfulness training led to increased scores on the flow subscales of "challenge-skill balance", "concentration", and "loss of self-consciousness". One possible explanation for this discrepancy is that it may stem from the use of different types of flow instrument in the studies concerned. Specifically, whereas Kee and Wang (2008) used a *dispositional* measure of flow, the current study used a *situation-specific* scale. These instruments are complementary, not equivalent (Jackson & Kimiecik, 2008)—meaning that the appraisal of flow experiences by these instruments may be somewhat different. Another possible explanation of the discrepancy between the findings of Kee and Wang (2008) and those of our experiment is methodological in nature. Specifically, the possibility of Type II error resulting from the small sample size of the current study may have been a constraining factor in the current study. Indeed, while no *significant* changes in the flow dimensions of challenge-skill balance, concentration, or loss of self-consciousness were observed, examination of the relevant within subject effect sizes for the experimental group suggested that increases may have occurred (d = .6–1.6). Further research employing larger samples, and thus greater statistical power, will be needed to confirm these findings. We caution that it would be premature to conclude that mindfulness does not influence the aspects of flow for which statistically significant effects were not detected in this exploratory study.

A second weakness of the current study stemmed from the fact that we did not include a distracter task for the athletes in the control group. Because of this limitation, we cannot be sure that the experimental group's increases in flow scores were not, at least partly, due simply to the effects of increased attention from the experimenter. A third weakness of the present experiment was that our manipulation check was designed to assess the efficacy of the intervention program (i.e., mindfulness training) rather than the degree to which participants actually adhered to the practice of mindfulness training,

Despite these limitations, the current study provides promising evidence for practitioners. Specifically, the effectiveness of the six-week mindfulness training intervention that we employed was highlighted by three key features of our experiment. First, all athletes completed the intervention program. Second, there were sizeable increases in global flow scores among participants. Finally, significant increases also occurred in the case of the flow dimensions of clear goals and sense of control. Clearly, additional research employing larger samples and controlling for the potential effects of increased attention by the experimenter are needed before firm conclusions can be reached regarding the effect of mindfulness training on flow. In addition, researchers may wish to investigate the possibility that mindfulness training programs delivered over a period of time greater than six weeks, as well as programs delivered one-on-one by a sport psychology practitioner may produce even greater flow enhancement among athletes.

Furthermore, future studies are required to investigate how, when and for whom mindfulness interventions are most effective and to determine the precise mechanisms underlying the effects of mindfulness training on athletic performance. Finally, additional research is needed to investigate the cognitive benefits of mindfulness training. In this regard, Zaidan, Johnson, Diamond, David, and Goolkasian (2010) discovered recently that only four days of mindfulness training improved participants' cognitive processes (e.g., visuo-spatial processing, working memory and executive functioning) relative to an active control group. Clearly, this area of research deserves further research attention. In summary, based on the current study, we suggest that mindfulness training appears to be an appropriate method to help athletes to achieve a flow state and, therefore, seems likely to be an effective performance enhancement strategy as well.

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