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ORIGINAL PAPER

Mindfulness Promotes the Ability to Deliver Performance in Highly Demanding Situations

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Abstract Trait mindfulness helps people handle distress and improves their satisfaction with life. The aim of the present paper is to examine whether trait mindfulness also promotes positive functioning (i.e., performance) in highly demanding situations, such as in elite sports. Mindfulness has been shown to improve athletes' ability to perform well, i.e., to increase their performance-delivery. However, researchers are still speculating about the underlying mechanism. The present research examines whether trait mindfulness enhances the ability of elite athletes to trigger performance in demanding situations by generally reducing competition anxiety and diminishing its negative impact when it occurs. Participants were 133 elite athletes from 23 different sports. They completed measures of trait mindfulness, competition anxiety, and performance-delivery. Mediation, moderation, and moderated-mediation effects of mindfulness and competition anxiety on performance-delivery were tested. Our findings indicate that trait mindfulness is related to fewer performance worries and prevents the remaining worries from influencing athletes' behavior, thereby helping them to perform better. Implications and directions for further research are discussed. Apart from benefits for psychological health, instructing people to become more mindful might be a promising approach to help them optimize their performance in demanding situations.

Keywords Performance enhancement · Peak performance · Competition anxiety · Elite sport · Moderated mediation

Introduction

Mindfulness as a multidimensional trait means the general tendency to attend to present-moment experiences in everyday life in an accepting, nonjudgmental, and nonelaborating manner (Kabat-Zinn 2003). Empirical studies have shown that mindfulness can be trained and that it positively affects significant functions and processes in our lives (Grossman et al. 2004; Hofmann et al. 2010). However, do these effects also promote positive functioning in highly demanding situations? And if yes, how?

Elite athletes often experience situations that place high demands on their coordinative, physical, and psychological skills, and whether these skills can be performed or not determines success or failure (Birrer and Morgan 2010). Elite sports can be considered an extreme example of the kinds of situations that place high demands on peoples' behavior. There is preliminary evidence that trait mindfulness promotes the delivery of athletic performance (Gardner and Moore 2012; Gooding and Gardner 2009; Thompson et al. 2011).

Trait mindfulness may improve performance-delivery in demanding situations by decreasing competition anxiety. Trait anxiety includes a somatic and cognitive component. Cognitive anxiety refers to the general tendency to worry about oneself, the situation at hand, and potential negative consequences, whereas somatic anxiety encompasses the experience of autonomic arousal and nervousness (Morris et al. 1981). While some amounts of anxiety might even positively

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affect an athlete's performance (e.g., via enhanced effort and alertness, Hardy 1990), it generally impairs performance when pressure is high (e.g., via the loss of concentration or too much muscular tension, Hill et al. 2010; Martens et al. 1990). Athletes with high levels of trait anxiety are more likely to show decrements in performance in situations that are subjectively regarded as important by them, despite their will and capability to perform better (i.e., choking under pressure, Baumeister and Showers 1986). Competition anxiety was found to be negatively associated with trait mindfulness in elite and subelite athletes (Thienot et al. 2014).

Research shows that after mindfulness interventions, participants showed less anxiety-associated amygdala activity (Goldin and Gross 2010) and reported more trait mindfulness, which, in turn, predicted decrements in trait anxiety (Anderson et al. 2007; Shapiro et al. 2007). Possibly, by attending to negative experiences in an accepting manner, people become desensitized to unpleasant emotions that they would otherwise avoid, which makes these emotions less distressing (Keng et al. 2011). Mindfulness-based interventions for athletes (Gardner and Moore 2007) focus on fostering the acceptance rather than the change of negative emotions (like anxiety), because trying to change emotions and thoughts binds attentional resources needed for the current athletic task at hand (Gardner and Moore 2004). Thus, the reduction of anxiety after such interventions might be regarded as a side effect. In sum, the current research suggests that trait mindfulness may improve performance-delivery in demanding situations by decreasing competition anxiety.

Other than the direct influence of mindfulness on competition anxiety, mindfulness might also have a moderating influence on the relationship between competition anxiety and performance-delivery in demanding situations, i.e., the level of mindfulness may ease the adverse impact of a given level of competition anxiety on performance-delivery in demanding situations. This concurs with research outside the field of sports that shows that trait mindfulness promotes more adaptive responses to stressful situations (Arch and Craske 2010), decreases the ability of unpleasant emotional experiences to elicit unhealthy behavior (Adams et al. 2015), and is associated with neural mechanisms that promote the observation of distress without acting upon it (Creswell et al. 2007). As a result, people are able to maintain adaptive behavior, for example, while being anxious.

Research that investigates how mindfulness may affect behavior indicates that trait mindfulness both inversely predicts negative emotions (i.e., perceived psychosocial stress) and moderates the relationship between negative emotions and *maladaptive* behavior (i.e., alcohol abuse, Adams et al. 2015). In the present research, we follow this moderated-mediation model to examine whether trait mindfulness is also associated with *performance-promoting* behavior in demanding situations. We tested the following three hypotheses: (1) Trait mindfulness is positively associated with the ability to deliver performance in demanding situations, (2) trait mindfulness is negatively associated with competition anxiety, which, in turn, is negatively associated with performance-delivery (mediation), and (3) trait mindfulness buffers the detrimental effects of anxiety on performance-delivery in demanding situations (moderation).

Method

Participants

The study sample consists of 133 athletes from 23 different sports (45.9 % male, $M_{age}=23.68$, $SD_{age}=6.12$, age range 17–53, 30.8 % team sports). Of these athletes, 30.8 % rated their current performance level as worldwide international top, 18.0 % as international top in Europe, 48.9 % as national top, and 2.3 % as lower than national top. Of the respondents, 94.7 % reported that they had represented their country in their respective sport. The mean hours of training per week were 14.63 ($SD=6.13$). The nine most common sports in the sample were cycling (13.5 %), floorball (9.8 %), orienteering (9.8 %), curling (9.8 %), athletics (9 %), judo (7.5 %), horse riding (5.3 %), handball (5.3 %), and shooting (4.5 %). Mean substitution was used to replace four missing data points.

Procedure

The research was conducted in accordance with APA ethical guidelines. All participants provided informed consent, and confidentiality and anonymity were assured. Twenty-five national sport associations were informed about the study in detail and asked to forward a link of an online survey to all members of their national teams. Of 838 athletes who received the link, 262 agreed to support our research by participating in one of two online surveys, to which they were randomly assigned. Athletes were told that they can take part in a sport psychological study that investigates the relation between different psychological variables. Participants were offered the possibility to receive a feedback of parts of their individual study results.

Measures

We measured trait mindfulness using the total scale of the 37-item Comprehensive Inventory of Mindfulness Experiences (CHIME, Bergomi et al. 2013, 2014). The participants rated how often they engaged in various behaviors or had certain experiences in the last 2 weeks on a 6-point Likert scale, ranging from 1 (*almost never*) to 6 (*almost always*). Sample items are "It is easy for me, to focus on what I am doing," and "When I have unpleasant thoughts and feelings, I can just

notice them, without immediately reacting to them." Bergomi et al. (2013, 2014) developed the CHIME, taking into account all aspects of mindfulness that are contained in all eight previously validated mindfulness questionnaires, and provided evidence for its reliability and validity. These aspects include the general tendency to focus attention on the current moment; not to react automatically to experiences; to face experience in an open way, rather than to distract oneself from it; and to respond to experiences in an accepting and nonjudgmental way. The Cronbach alpha in the study sample was 0.78.

We measured cognitive and somatic competition anxiety using two 4-item subscales of the Competition Anxiety Inventory Trait (CAI-T, Brand et al. 2009). The participants were asked to indicate their level of agreement with statements about different behaviors or specific experiences before competitions in general on a 4-point Likert scale, ranging from 1 (*not at all*) to 4 (*strongly*). Sample items for the two subscales are "Before competitions, I have self-doubts" (*cognitive competition anxiety*) and "Before competitions I feel nervous" (*somatic competition anxiety*). Brand et al. (2009) developed the CAI-T along the lines of the Sport Anxiety Scale (Smith et al. 1990) and provided psychometric support for the measure and its use in sports. The Cronbach alphas in the study sample were 0.84 (cognitive competition anxiety) and 0.72 (somatic competition anxiety).

We assessed the ability to deliver performance in demanding situations using a self-generated three-item measure. The participants were asked to rate how often they engaged in specific types of behaviors in important situations in games or competitions in the last 3 months on a 5-point Likert scale, ranging from 1 (*never*) to 5 (*always*). The wording of the three items was as follows: "In the last three months, I could perform when it really mattered," "In the last three months, I failed in crucial situations (inversed)," and "In the last three months, I couldn't handle the pressure during important moments (inversed)." The reliability analysis showed a Cronbach alpha of 0.67.

Data Analysis

Bivariate correlations between all the study variables were tested using Pearson's correlation analysis. Similar to other studies that tested moderated-mediation models (e.g., Berndt et al. 2013), further analysis progressed in three steps (for details, see the "Results" section). First, we conducted *parallel multiple mediation analysis* to assess the effect of trait mindfulness on performance-delivery in demanding situations, both directly and indirectly, through cognitive and somatic competition anxiety, using path-analytic approaches (Preacher and Hayes 2008). Then, we estimated the extent to which trait mindfulness moderated the effect of cognitive and somatic competition anxiety on performance-delivery using *moderated ordinary least-squares (OLS) regression analysis* (Hayes and Matthes 2009). Finally, we combined the mediation and moderation results and examined the conditional indirect effect of trait mindfulness on performance-delivery in demanding situations through competition anxiety as a function of trait mindfulness, using the *moderated-mediation approach* described in Preacher et al. (2007). All analyses were conducted using SPSS version 22 software for Windows.

Results

The means, standard deviations, and Pearson correlations between the scales are presented in Table 1.

Parallel Multiple Mediation

Parallel multiple mediator analysis using OLS path analysis indicated that trait mindfulness was indirectly associated with performance-delivery in demanding situations through its effect on cognitive competition anxiety. As suggested by Hayes (2013), all the regression coefficients are reported in unstandardized form. As can be seen in Table 2, trait mindfulness was associated with performance-delivery ($c = 0.52$, $p < 0.01$, model 1, Table 2). In addition, increased reports of mindfulness were associated with reduced cognitive ($a_1 = -0.81$, $p < 0.01$) and somatic ($a_2 = -0.46$, $p < 0.01$) anxiety before a competition (models 2 and 3, Table 2). Although cognitive competition anxiety was associated with decreased self-reported ability to deliver performance in situations with high demands ($b_1 = -0.34$, $p < 0.01$), somatic competition anxiety was not ($b_2 = -0.01$, $p = 0.91$, model 4, Table 2). Bias-corrected bootstrap confidence intervals (CIs) based on 5000 bootstrap samples revealed a significant positive indirect effect of trait mindfulness on performance-delivery in demanding situations through cognitive competition anxiety ($a_1 b_1 = 0.27$, 95 % CI [0.13, 0.47]) but not through somatic competition anxiety ($a_2 b_2 = 0.00$, 95 % CI [−0.09, 0.10]). The effect of trait mindfulness on performance-delivery, independent of its effect on cognitive and somatic competition anxiety, was just under the conventional statistical limit of significance ($c' = 0.25$, $p = 0.08$).

Moderation

To test the ability of trait mindfulness to moderate the effect of competition anxiety on performance-delivery, we estimated two OLS regression models predicting the ability to deliver performance in demanding situations from trait mindfulness,

Table 1 Descriptive statistics and correlations (Pearson) between variables

	Mindfulness	Cog. comp. anxiety	Som. comp. anxiety	Performance-delivery
M	3.90	2.38	2.33	3.84
SD	0.38	0.68	0.60	0.61
Mindfulness	–			
Cog. comp. anxiety	−0.45**	–		
Som. comp. anxiety	−0.29**	0.46**	–	
Performance-delivery	0.33**	−0.45**	−0.23**	–

Cog. comp. anxiety cognitive competition anxiety, *Som. comp. anxiety* somatic competition anxiety

**$p < 0.01$

cognitive competition anxiety, and their mean-centered interaction term (model 5, Table 2) and from trait mindfulness, somatic competition anxiety, and their mean-centered interaction term (model 6, Table 2), respectively. This analysis revealed that the effect of cognitive competition anxiety on the ability to deliver performance in demanding situations was moderated by trait mindfulness. In contrast, performance-delivery was not influenced by somatic competition anxiety or its interaction with trait mindfulness (see Table 2).

To better understand the nature of the interaction between trait mindfulness and cognitive competition anxiety, we estimated conditional effects (simple slopes) of cognitive competition anxiety on performance-delivery using the "pick-a-point" approach (Hayes and Matthes 2009), with the sample mean and ±1 SD from the mean representing "moderate," "high," and "low" trait mindfulness. Cognitive competition anxiety was significantly and negatively related to the ability to deliver performance in situations with high demands at low, moderate, and high trait mindfulness, with the effect approaching zero as trait mindfulness increased. The conditional effects were −0.48, −0.35, and −0.22 at low, moderate, and high values of trait mindfulness, respectively (all $ps < 0.05$; see Fig. 1).

Moderated Mediation

As we found support for both the mediation and moderation hypotheses, we next examined a moderated-mediation model. Combining the methods described above, the moderated-mediation model (i.e., conditional indirect effect model) examined whether the indirect effect of trait mindfulness on performance-delivery in demanding situations through cognitive and somatic competition anxiety was conditional on the athlete's level of trait mindfulness (see model 1 in Preacher et al. 2007). We estimated an OLS regression model predicting performance-delivery from trait mindfulness, cognitive and somatic competition anxiety, the mean-centered products of trait mindfulness, and cognitive competition anxiety, as well as trait mindfulness and somatic competition anxiety. The results of this estimation are presented in Table 2 (model 7) and Fig. 2. Despite the absence of an indirect effect of trait mindfulness on performance-delivery through somatic anxiety and the absence of a significant

Table 2 OLS regression model coefficients (standard errors in parentheses; $N = 133$)

Outcome →	Performance-delivery Model 1	Cog. comp. anxiety Model 2	Som. comp. anxiety Model 3	Performance-delivery			
				Model 4	Model 5	Model 6	Model 7
Mindfulness	0.52** (0.13)	−0.81** (0.14)	−0.46** (0.13)	0.25 (0.14)	0.23 (0.14)	0.46** (0.14)	0.25 (0.14)
Cog. comp. anxiety				−0.34** (0.08)	−0.35** (0.08)		−0.35** (0.08)
Som. comp. anxiety				−0.01 (0.09)		−0.15 (0.09)	0.02 (0.09)
Mind. × CA					0.34* (0.16)		0.47* (0.19)
Mind. × SA						0.02 (0.21)	−0.32 (0.23)
Constant	1.80** (0.51)	5.53** (0.54)	4.14** (0.52)	3.71** (0.67)	3.88** (0.05)	3.84** (0.05)	3.87** (0.05)
R^2	0.11**	0.21**	0.09**	0.23**	0.25**	0.13**	0.26**

In models with interactions, the variables were mean centered prior to the analysis. All the regression coefficients are in unstandardized form

Cog. comp. anxiety cognitive competition anxiety, *Som. comp. anxiety* somatic competition anxiety, *Mind.* mindfulness, *CA* cognitive competition anxiety, *SA* somatic competition anxiety

*$p < 0.05$; **$p < 0.01$

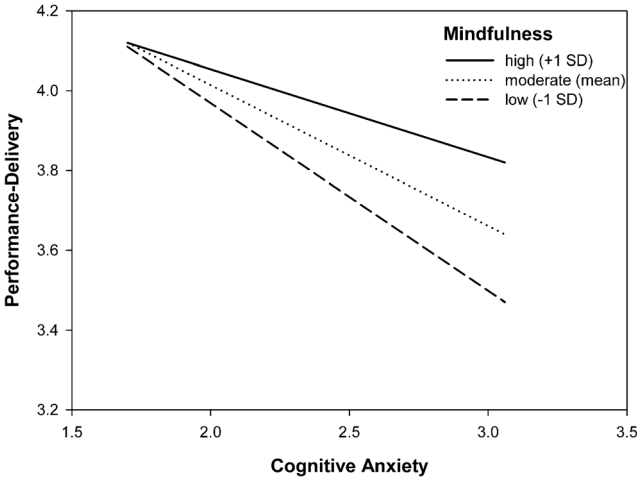

Fig. 1 Moderation of the effect of cognitive competition anxiety on performance-delivery in demanding situations by trait mindfulness

trait mindfulness × somatic anxiety interaction term, we decided to leave somatic anxiety in the model, as we wanted to examine the complete moderated-mediation model including all the variables (the model without somatic anxiety revealed the same results). To test whether these indirect effects differed from zero at specific values of the moderator (again the sample mean and ±1 SD from the mean), we conducted and tested conditional indirect effects using 5000 bootstrap estimates for the construction of 95 % bias-corrected CIs for the conditional indirect effects.

The indirect effect of trait mindfulness on the ability to deliver performance in demanding situations through cognitive competition anxiety was positive for athletes with low (0.43, 95 % CI [0.21, 0.72]) and moderate (0.28, 95 % CI [0.14, 0.49]) levels of mindfulness. However, this indirect effect was no different from zero for athletes with high levels of mindfulness (0.14, 95 % CI [−0.02, 0.33]). The indirect

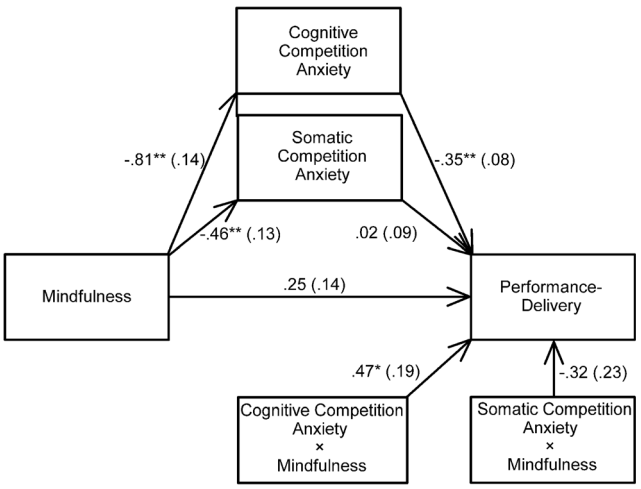

Fig. 2 Results of regression analyses for moderated mediation (unstandardized regression coefficients, standard errors in *brackets*). *One asterisk* $p < 0.05$; *Two asterisks* $p < 0.01$

effect of trait mindfulness on performance-delivery in demanding situations through somatic anxiety was not different from zero, regardless of the level of trait mindfulness (−0.06, 95 % CI [−0.27, 0.07]; −0.01, 95 % CI [−0.12, 0.09]; and −0.05, 95 % CI [−0.04, 0.22] at low, moderate, and high values of trait mindfulness, respectively.

Discussion

Our findings partly confirmed the hypotheses that the association between trait mindfulness and a better ability to deliver performance in demanding situations was mediated by anxiety. Trait mindfulness was associated with subjectively perceived athletic performance by negatively predicting cognitive but not somatic anxiety. Trait mindfulness was negatively correlated with cognitive and somatic anxiety. This finding is in line with previous research, which shows that trait mindfulness is related to a low frequency of worrisome thoughts (Frewen et al. 2008) and that mindfulness practice leads to a reduction of worries and physiological arousal (Delgado et al. 2010). While cognitive competition anxiety was negatively associated with performance-delivery in demanding situations, somatic competition anxiety was not. This suggests that the cognitive aspects of anxiety are closely associated with performance decrements but not mere felt arousal. Somatic anxiety might impair athletic performance in demanding situations only when experienced as debilitative (Swain and Jones 1996), in combination with high cognitive anxiety (Hardy 1990), or in athletes with low self-confidence (Hardy et al. 2004).

Our results show that not all athletes with high levels of cognitive competition anxiety reported impaired ability to deliver performance in demanding situations. Therefore, testing potential moderators seemed worthwhile. As expected, trait mindfulness buffered the negative effect of cognitive competition anxiety on performance-delivery (i.e., athletes with a high level of trait mindfulness reported fewer performance decrements due to cognitive anxiety). These findings suggest that trait mindfulness has a protective effect: People can cognitively be very anxious but still be able to perform. Two different mechanisms may lead to this positive outcome. First, studies have shown that trait mindfulness helps people to let go of worry-related thoughts (Frewen et al. 2008) and that mindfulness practice prevents the deterioration of working memory capacity during periods of high stress (Jha et al. 2010). Therefore, athletes are less likely to overwhelm their working memory system (i.e., with worries), which would increase the risk of a bad performance due to distraction (Eysenck and Calvo 1992). The second explanation is provided by findings showing that trait mindfulness promotes in-the-moment and nonjudgmental activity, resulting in a capacity to automatically engage in well-learned motor skills (Kaufman

et al. 2009). Therefore, athletes are less likely to explicitly monitor skill execution, which could lead to a drop in performance due to focusing on their own movements (i.e., reinvestment, Masters and Maxwell 2008).

The study also showed that the positive indirect effect of trait mindfulness on the ability to deliver performance through cognitive competition anxiety was dependent on the level of trait mindfulness. Athletes with low-to-moderate trait mindfulness reported anxiety-based performance decrements, whereas athletes with high trait mindfulness did not. These results are in agreement with similar models of moderated meditation that found that the indirect effect of mindfulness on an outcome is dependent on the level of mindfulness (Adams et al. 2015). Thus, it may be promising to use the moderated-mediation model presented herein to examine other potential mechanisms of how mindfulness may positively affect behavior, i.e., through generally reducing negative thoughts and emotions and by reducing their influence on behavior.

Limitations and Further Research

The main limitations of the current study are its cross-sectional design, which does not allow for inferring causal relations between the variables, and the exclusive use of self-report inventories. The performance-delivery scale is a measure of an athlete's perception of his or her performance rather than a direct measure of performance. This perception of past performance could be significantly influenced by personal traits such as anxiety. Additionally, limiting the experience of performance to the last 3 months may not have included a truly high-performance situation for all athletes.

Further research will need to address these limitations, for example, by using longitudinal designs and including several and behavioral measures of performance. The presented model should be tested in one specific game or competition of high pressure or in an experimental performance situation with pressure induction. It will also be important to examine other mechanisms of action concerning the impact of mindfulness on performance-promoting behavior in demanding situations and how mindfulness can be practiced efficiently. Future research should also look at the influence of single aspects of mindfulness (e.g., focusing on the present moment, not reacting automatically to experiences, and accepting own thoughts and emotions) by using a larger number of participants and by measuring these aspects with multiple reliable and valid scales. Finally, it would be interesting to determine what "dose" of mindfulness practice is needed to increase trait mindfulness and ultimately increase performance (dose-response) and to determine whether people might be able to improve behavior (i.e., behave in a goal-orientated manner) in other performance environments (surgery, military, the performing arts, business, etc.) because they are mindful.

Despite the aforementioned limitations, our findings are important for everyone who wants to optimize his or her behavior in challenging situations, such as elite athletes, performing artists, or surgeons, as well as for people who try to help others optimize performance, for example, sport psychologists or coaches. In highly competitive environments, such as elite sports, everyone will experience negative emotions to some degree (Haberl and Peterson 2006). However, the most successful performers succeed by showing their best, even when they are experiencing unpleasant emotions or having negative thoughts. Thus, (sport) psychologists should teach clients not only how to change negative states but also how to perform well in a negative affective state. In this respect, we are convinced that mindfulness practice is a promising approach and that developing and validating mindfulness-based intervention programs for (elite) performers can help increase their trait mindfulness. This could help them to perform in challenging situations because it not only reduces negative affective states generally but also diminishes the influence of such states on behavior.

Compliance with Ethical Standards The research was conducted in accordance with APA ethical guidelines. All participants provided informed consent, and confidentiality and anonymity were assured.

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