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Relationships between mindfulness, flow dispositions and mental skills adoption: A cluster analytic approach

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Abstract

Objectives: This study examines the relationships between mindfulness, flow dispositions and mental skills adoption.
Design: Cluster analytic approach.
Methods: Participants in this study were 182 university student athletes. They were administered the Mindfulness/Mindlessness Scale [MMS; Bodner, T., & Langer, E. (2001). *Individual differences in mindfulness: The Langer Mindfulness Scale.* Poster session presented at the annual meeting of the American Psychological Society, Toronto, Ont., Canada], Dispositional Flow Scale 2 [DFS-2; Jackson, S. A., & Eklund, R. C. (2004). *The flow scale manual.* Morgantown, WV: Fitness Information Technology] and Test of Performance Strategies [TOPS; Thomas, P. R., Murphy, S. M., & Hardy, L. (1999). Test of performance strategies: Development and preliminary validation of a comprehensive measure of athletes' psychological skills. *Journal of Sports Sciences*, *17*, 697–711].
Results: Four distinctive mindfulness clusters were found based on their response on the MMS using cluster analysis. Marked differences in flow dispositions and mental skills adoption habits were observed between the high and the low mindfulness clusters. Those in the high mindfulness cluster scored significantly higher than the low mindfulness clusters in challenge–skill balance, merging of action and awareness, clear goals, concentration and loss of self-consciousness scores of the DFS-2 [Jackson, S.A., & Eklund, R.C. (2004). *The flow scale manual.* Morgantown, WV: Fitness Information Technology]. The high

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mindfulness clusters also scored significantly higher compared to the low mindfulness cluster in terms of attentional control, emotional control, goal setting and self-talk sub-scales of the TOPS.
Conclusions: This study suggests that athletes' flow dispositions and mental skills adoption could be differentiated using mindfulness. The findings have implications towards the understanding of flow and mental skills adoption within sport psychology.

Keywords: Present moment focus; Novelty seeking; Novelty producing; Flexibility; Engagement; Concentration

Introduction

Instructions such as "live in the here and now" and "focus on the present moment" have been linked to the psychology of peak performance in sport (e.g., Jackson & Delehanty, 1995; Jackson & Csikszentmihalyi, 1999; Orlick, 1990; Ravizza, 2002). Present moment focus strategy seems to increase the likelihood of successful performance as such strategy ensures that unnecessary distractions linked to past events or future events are momentarily suspended. Such a strategy enhances concentration on the task at hand and would in turn leads to better athletic performance. Several authors have recommended present moment focus as an effective performance enhancement strategy for athletes as it is intricately linked with concentration (e.g., Jackson & Delehanty, 1995; Jackson & Csikszentmihalyi, 1999; Orlick, 1990; Ravizza, 2002).

Despite the potential link between present moment focus and peak performance, little is done to examine athletes' present moment focus in relation to their performance in sports. To begin with, it is difficult to directly assess psychological state of present moment focus while the athletes are in action or in competition. Asking athletes in action whether they are focusing on the present moment will inevitably disrupt their attention toward the task at hand. An alternative for studying present moment focus is to examine the issue at the dispositional level. By examining the tendency to maintain present moment focus, research questions pertaining to the use of such strategy can be undertaken. Indeed, with the advent of mindfulness research in mainstream psychology (e.g., Baer, 2003), research of present moment focus in sport is now more viable. Mindfulness, defined as the non-judgmental focus of one's attention on the experience that occurs in the present moment (Kabat-Zinn, 1994; Linehan, 1993), could help address issues related to tendencies of present moment focus in sport psychology.

To the best of the authors' knowledge, mindfulness tendencies of athletes have not been extensively examined elsewhere. It is not known how athletes involved in competitive sports might differ in terms of mindfulness tendencies. The cluster analytic approach is adopted in this study to uncover clusters of athletes with different mindfulness characteristics before examining whether the construct is related to peak performance psychology. In summary, the purpose of the study is to use a cluster analytic approach to examine whether athletes' tendencies to be mindful of the present moment, flow dispositions and their habits of mental skills adoption are linked.

In order to operationalize the concept of present moment focus for the current study, the two-component model of mindfulness proposed by Bishop et al. (2004) is presented here. The first component involves self-regulation of attention towards the immediate present moment, while the

second component pertains to the adoption of an orientation that is marked by curiosity, openness and acceptance (Bishop et al., 2004). The former describes mindfulness as a form of mental skill or state, while the latter accounts for personality characteristics that underlie mindfulness tendencies. Both are intricately linked. Studies suggests that individual's mindfulness state correspond to neurophysiology of the person's human brain (e.g., Dunn, Hartigan, & Mikulas, 1999; Ryback, 2006; Takahashi et al., 2005), thus hinting at the trainability of mindfulness through repetition of present moment focus. At the same time, there are differences in the degrees of mindfulness that can be accounted by personality differences (Bodner & Langer, 2001; Takahashi et al., 2005). The two-component model proposed by Bishop et al. (2004) is relevant for the present research as it covers both the states and dispositions of mindfulness. Both components are important for understanding mindfulness, as its trainability and personality characteristics are relevant for examining issues in peak performance psychology.

The first component of mindfulness proposed by Bishop et al. (2004) emphasizes the self-regulation of attention towards the present moment. Understandably, self-regulation is an important aspect of mental skill that facilitates peak performance and flow (e.g., Gardner & Moore, 2006). Several mental skills repertoires are commonly taught to athletes for enhancing self-regulation capabilities and performance. For example, self-talk strategy shuts out unnecessary cognitive processes to allow one to concentrate better (Hatzigeorgiadis, Theodorakis, & Zourbanos, 2004). Centering, a breathing technique used for producing physical balance and mental focus (Nideffer, 1992, p. 127), is another self-regulatory technique used for the maintenance of optimal arousal in sport (Rogerson & Hrycaiko, 2002). Similarly, goal setting can be considered as a self-regulatory technique as it helps athletes channel their energy more efficiently (Oettingen, Pak, & Schnetter, 2001).

While the application of mental skills such as self-talk, imagery and goal setting are usually done with purposes in mind (such as to self-regulate one's energy), mindful attention toward the present moment are purposeless acts associated with the temporary suspension of one's ego (Brown & Ryan, 2003; Ryan & Brown, 2003) and interpretation of experiences (Shapiro, Carlson, Astin, & Freedman, 2006). When an individual is mindful, he or she notices the unfolding moment non-judgmentally by refraining from assigning personal values to the process. This way the individual lets go of personal ego (Game, 2001), and other self-conscious thoughts. Thus, self-regulation of attention toward the present moment has also been associated with cognitive inhibition (Bishop et al., 2004). This distinction between sport-related mental skills executed with purposes in mind, and the purposeless and largely cognition-free mindfulness state, should be appreciated.

The second component of mindfulness pertains to attitudes and orientations predictive of the self-regulatory aspect of mindfulness (Bishop et al., 2004). Individuals differ in their tendencies in maintaining mindfulness, and it appears that openness to experience accounts for individual differences in mindfulness (Bodner & Langer, 2001). Bodner and Langer (2001) offer four mindfulness characteristics for predicting mindfulness tendencies. Since Bodner and Langer's (2001) conceptualization of mindfulness characteristics is adopted in the current research for the purpose of clustering athletes, these four specific aspects of mindfulness characteristics are further elaborated.

These four mindfulness characteristics are novelty seeking, novelty producing, flexibility and engagement. Novelty seeking pertains to the orientation to "approach each environment as an

opportunity to learn something new and look specifically and actively for such opportunities'' (Bodner, 2000, p. 15). Novelty producing refers to the process of generating new and useful information upon the processing of information from the environment (Bodner, 2000). Flexibility is assessed through one's tendency to see situations from multiple perspectives, and is characterized by the ability to change perspectives easily (Bodner, 2000). Lastly, engagement is related to one's tendency to notice details of his or her environment. When one is engaged with something, there is intense attention towards its fine details (Bodner, 2000), thus the close similarity between engagement and concentration. These four characteristics proposed by Bodner and Langer (2001) concur with Bishop et al.'s (2004) conceptualization of curiosity, openness and acceptance within the mindfulness framework.

Research that investigates the link between mindfulness and mental skills adoption in sport is limited. In an earlier attempt to study mindfulness among athletes, Gardner and Moore (2004) presented two case studies highlighting the potential efficacy of their mindfulness-based intervention program in which they termed the Mindfulness–Acceptance–Commitment approach. They report that training in the form of scheduled self-regulation of present moment awareness, which includes mindful awareness of breath and bodily movements, enhanced their participants' athletic performance and enjoyment (Gardner & Moore, 2004). Specifically, Gardner and Moore (2004) cite acceptance of negative thoughts, reduced worrying, increased enjoyment, concentration and persistence as some of the positive outcomes of their mindfulness-based intervention program. The observations from their studies hinted that mindfulness can be trained and some positive attitudinal changes can be derived as a result of mindfulness-based interventions. It is, however, not known if one's tendency in adopting mental skills is also in turn associated with mindfulness. If so, mindfulness might help explain why some athletes are more likely to adopt mental skill compared to the others (e.g., Harwood, Cumming, & Fletcher, 2004). Further studies are warranted.

There is also a lack of research addressing the relationship between flow and mindfulness. In a study based on a non-athlete sample, Clark (2002) examined the impact of self-regulated attention control (or mindfulness) on the time spent in flow. Specifically, his study examined the impact of a mindfulness training protocol (based on a self-regulated attention regulation intervention program) on daily flow experiences in a sample of graduate students. Mindfulness meditation and attention control strategies, based on the works of Kabat-Zinn and Nideffer respectively, were taught to the participants as part of the research protocol (Clark, 2002). Experience sampling method (ESM) was used for assessing the participants' flow experience during their daily life before and after the training protocol. Three out of the six participants experienced treatment effects, suggesting that mindfulness training may help some individuals in increasing the time spent in flow during the course of their day. Some individuals appeared to have benefited from the prescribed mindfulness training more notably than the others. As this study was conducted on a non-athlete sample, whether athletes' propensity to be mindful is related to the tendency to experience flow in sport is not known.

Given the lack of empirical support on the relation between mindfulness and performance psychology in sport, there is a need to examine this issue in greater detail. The purpose of this study is to examine the relationships between mindfulness, flow and mental skills adoption. While we borrowed the conceptualizations of mindfulness provided by Bishop et al. (2004) as the overarching theoretical framework, individual differences in terms of mindfulness propensities are

assessed based on Bodner and Langer's (2001) work on mindfulness. Participants who display higher novelty seeking, novelty producing, flexibility and engagement characteristics are deemed to be more mindful than those who are significantly weaker in these characteristics. Whether those who are deemed more mindful also have stronger flow dispositions and mental skills adoption habits is of key interest in this study. Differences in terms of specific flow dispositions and mental skills that are observed between clusters are also discussed. To reiterate the aims of this study, these two specific research questions are posed:

(1) Would individuals who display stronger mindfulness characteristics as outlined by Bodner and Langer (2001) score higher in the flow disposition measures?

(2) Would individuals who display stronger mindfulness characteristics as outlined by Bodner and Langer (2001) score higher in the mental skills adoption measures?

Method

Participants

The sample comprised of a total of 182 university student athletes (80 women and 102 men, $M = 22.3$ years old, $SD = 1.98$) from a university in Singapore. The participants represented their university in the inter-varsity competitions and were drawn from a variety of 23 sports. There were 92 individual athletes, mainly from the Taekwondo, Malay martial arts, tenpin bowling and archery teams. The remaining 90 athletes were mostly from team sports such as soccer, rugby and dragon boating.

Procedure

Ethical clearance from the university ethical review board was obtained. The investigator contacted the team managers leading the respective university sports teams to request permission for collecting data from the athletes under their charge. Permission was readily granted, and in some cases the team managers were helpful in handing out an envelope containing the questionnaire to the athletes. The participants returned their completed questionnaire in the sealable envelope provided. All participants were told that no rewards were offered and that no punishment would occur if they refuse to participate. They were also informed that their participation in the study was voluntary and that they were free to withdraw at any time. In addition, they were assured that their responses would be kept confidential.

Instruments

Mindfulness/Mindlessness Scale (MMS)

Thirteen items from the 21-item MMS were utilized for the purpose of this study. The scale was originally developed by Bodner and Langer (2001) for the assessment of individual's mindfulness propensity. In its original 21-item form, there are four sub-scales in the questionnaire: *novelty seeking* (6 items), *novelty producing* (6 items), *flexibility* (4 items) and *engagement* (5 items). The questionnaire adopts a 7-point Likert-type response format. The response may range from 1 to 7,

with 1 being "Strongly Disagree" to 7 "Strongly Agree". The scores on the sub-scales reflect the respective tendencies, and individuals are found to differ in these tendencies (Bodner & Langer, 2001).

In terms of the psychometrics of the 21-item scale, the Cronbach's alpha values based on all the pooled covariance matrix have been reported as .83 and .85, respectively, in two previous studies (Bodner & Langer, 2001). Bodner and Langer (2001) have established the convergent and discriminant construct validity for the 21-item MMS, and the results of the confirmatory factor analysis (CFA) supported the factor structure of the MMS (χ^2 (183) = 818.38, $p < .0001$, GFI = .97, RMSEA = .057). However, Haigh (2006) found that the original four-factor model proposed by Bodner and Langer (2001) were not replicable in her study when she examined the psychometrics of the scale. This suggests that it is possible for people of various demographic variables (age, race, IQ, SES) to interpret the items on the MMS differently (Haigh, 2006).

As the development of MMS was done primarily in America (Bodner & Langer, 2001), it is therefore important to be mindful of the potential cultural implications associated with the use of the scale in the current non-westerners sample. Initial factor analysis done on a similar data set found that the 21-item scale loads in more than four factors (Kee, 2006). Eight items that affects the construct validity of questionnaire were thus omitted in that study. In this study, we adopt the remaining 13 items retained by Kee (2006): *novelty seeking* (3 items), *novelty producing* (4 items), *flexibility* (3 items) and *engagement* (3 items). Despite the potential weakness associated with the omission of original items, we deemed that MMS is the best available tool for the current research given its underlying theoretical framework.

Dispositional Flow Scale (DFS-2)

DFS-2 (Jackson & Eklund, 2004) is a 36-item questionnaire used for assessing individual's propensity in experiencing flow. When responding to the questionnaire, the respondent has to recall how he or she felt during previous participation in a specific activity. The questionnaire adopts a 5-point Likert-type response format, with response ranging from 1 "Never" to 5 "Always". The nine dispositions of flow, namely challenge–skill balance, action–awareness merging, clear goals, unambiguous feedback, concentration on the task, sense of control, loss of self-consciousness, transformation of time and autotelic experience are assessed through DFS-2. By summing up all the scores, a global flow score can also be derived to represent the individual's overall propensity to experience flow. The higher the score, the more likely the individual will experience flow.

Jackson and Eklund (2004) provide sufficient evidence to suggest that DFS-2 is a suitable tool for studying flow dispositions. In a previous study using DFS-2 involving 386 participants aged between 17 and 72 years old, the internal consistency of the instrument was reported to range from .81 to .90, with a mean alpha of .85 (Jackson & Eklund, 2002). Another cross validation study done on the instrument that involved 574 respondents revealed reliability estimates of .78–.86, with a mean alpha of .82 observed (Jackson & Eklund, 2002). The instrument is deemed to have good construct validity based on the results reported in the various studies (Jackson & Eklund, 2004), and can be accepted as a reliable and valid instrument for studying flow dispositions in the current sample.

Test of Performance Strategies (TOPS)

TOPS was developed by Thomas, Murphy and Hardy (1999) to measure athletes' adoption of mental skills and strategies in competition and in training. In this study, as the focus is placed on the dispositions of individuals in terms of mindfulness, flow and mental skills adoption, to maintain the consistency in the research design, only the items pertaining to mental skills adoption during training were examined. It is also assumed that mental skills adopted during training are largely transferable to competition.

The instrument for assessing mental skills adoption during training has eight sub-scales: activation, relaxation, imagery, goal setting, self-talk, emotional control, attentional control and automaticity. These sub-scales refer to aspects of mental skills training that are well documented in the literature. In the preliminary validation of the instrument based on 472 athletes, Thomas et al. (1999) found that the internal consistency of the sub-scales ranged from .66 to .81. In a recent CFA of the instrument in an adolescent sample, Lane, Harwood, Terry and Karageorghis (2004) found that both the competition and practice items did not fit the measurement model adequately, although the competition model showed better fit than the practice model. However, at the sub-scale level, imagery, goal setting, self-talk, emotional control and attentional control showed good fit for the practice model in CFA. Thus, we selected only these five sub-scales as dependent variables in the present study.

Data analyses

This is the first study using MMS in the sport context; therefore, there is a need to examine its construct validity. CFA was conducted on the MMS using EQS for Windows 6.1 (Bentler, 2005). The method of estimation used was maximum likelihood derived from covariance matrices, and pairwise deletion was used for missing data. Only one case was deleted owing to missing data. Maximum likelihood estimation was chosen because all the univariate statistics were normally distributed with skewness and kurtosis values ranging between $+1$ and -1. Mardia's coefficient was 38.83 and the normalized estimate was 13.23, indicating multivariate normality of the data.

The indices of fit provided by EQS were examined to evaluate the adequacy of the models. These include: χ^2/df (a value of less than 3 reflects acceptable fit, however, this value is dependent on the sample size), Standardised Root Mean Squared Residual (SRMR); and Root Mean Squared Error of Approximation (RMSEA) [for these two indices, the lower, the better the model, values close to .08 for SRMR and .06 for RMSEA represent a good fit between the model and the observed data (Hu & Bentler, 1999)], Non-Normed Fit Index (NNFI), Comparative Fit Index (CFI); Goodness-of-Fit Index (GFI); and Adjusted GFI (AGFI); [for the last four indices, values close to .95 and above are viewed as indication of good fit to the data (Hu & Bentler, 1999)].

Cluster analysis is useful in identifying homogenous groups or clusters based on the characteristics they possess. It is well suited for the present study as we seek to profile individual's propensities in mindfulness. Cluster analysis methods organize the observations into smaller numbers of groups that account for most variance based on the clustering algorithm chosen (Meece & Holt, 1993). In this way, rather than grouping similar variables, as in factor analysis, cluster analysis will group similar people. This should be of greater practical value in planning targeted interventions. Hair, Anderson, Tatham, and Black (1998) suggest that widely disparate

cluster sizes or clusters of only one or two cases need to be examined from a conceptual perspective. This can be done by comparing the actual results with the expectations formed in the research objectives.

In order to identify groups of athletes that responded similarly in terms of mindfulness characteristics, the four sub-scales in the MMS were used as the clustering variables. Before the cluster analysis was performed, all the variables were standardized using z scores (mean of 0 and a standard deviation of 1).

There are two issues in using cluster analysis given the subjective nature of the cluster solution. The first relates to the stability and the second concerns validity of the cluster solution. Clustering using hierarchical and non-hierarchical methods yield different cluster results and there are pros and cons using either method (see Hair et al., 1998). To counter the stability issue, one solution is to use a two-stage clustering method (Hair et al., 1998; Wang, Chatzisarantis, Spray, & Biddle, 2002). First, a hierarchical clustering method was used to determine the number of clusters and initial cluster centers. Dendrogram and agglomeration schedules were generated to provide basis for determining the number of clusters. Second, using the cluster centers found in the first stage, a k-means clustering method was used to refine the clusters. In this way, the non-hierarchical method was able to verify the results from the hierarchical method. Ward's method with squared Euclidean distance was used to determine the number of cluster groups. This method had been found to outperform other methods in marketing and social sciences research (Punj & Stewart, 1983).

To validate the clusters solution, one approach is to cluster analyse two separate samples and compare the cluster solutions (Hair et al., 1998). However, if the sample size is small, researcher can select variable(s) not used to form the clusters to validate the cluster solution. In this study, the composite measure in flow dispositions was used to test the validity of the clusters. A one-way analysis of variance (ANOVA) was conducted to determine whether differences across clusters in terms of global flow can be found.

Two one-way multivariate analysis of variance (MANOVA) were conducted to determine if the clusters differ in flow dispositions and mental skills adoption. Box's tests and Levene's tests were used to check that the assumptions of equality of variances and covariances of the dependent variables have been met. If MANOVA showed any significant results, follow-up tests would be conducted using ANOVA and post hoc Tukey tests. Finally, participants' demographic characteristics, such as gender and types of sport played were analyzed to add insight to the cluster profiles. Two-way contingency table analysis using crosstabs were used to assess the relationship between these variables and the cluster groups.

Results

Psychometric properties of measurement tools

For the 13-item MMS, the results of the confirmatory factor analyses indicate that the four-factor first-order measurement model fit the data quite well [$\chi^2(59, N = 182) = 86.40$, $\chi^2/\mathrm{df} = 1.46$, NNFI = .943, CFI = .957, GFI = .932, AGFI = .892, SRMR = .054 and RMSEA = .051, 90% CI of RMSEA = .025–.073]. Cronbach's (1951) alpha coefficients showed that all the

sub-scales were internally consistent, except for flexibility ($\alpha = .73$ for novelty seeking, .75 for novelty production, .63 for flexibility and .72 for engagement). We chose to retain the flexibility sub-scale although the alpha is below the typical threshold of .70 because this is one essential component of mindfulness.

Descriptive statistics

Table 1 shows the internal reliability coefficients, correlations, means and standard deviations of the study variables. In general, this group of athletes displayed high scores in novelty seeking, flexibility and engagement. The athletes reported relatively high scores in overall dispositional flow measures. The variables from TOPS are relatively low (below 3.5 on a 5-point Likert scale). Moderate and positive association among novelty seeking, novelty producing and flexibility were observed. Engagement had small but significant positive correlation with the rest of the MMS variables. Individual's overall flow dispositions correlated moderately with novelty producing and flexibility. Moderate high relationships were also found between flow dispositions and attentional control and goal setting.

Correlations between individual flow dispositions were mostly moderate to high (r ranged from .04 to .70), with two-third of the correlation coefficients exceeding .30. Most of the flow dispositions yielded small-to-moderate relationships with novelty producing (r ranged from .20 to .37, except transformation of time, $r = -.01$) and flexibility (r ranged from .13 to .28, and no relationship with transformation of time).

Cluster analysis

From the agglomeration schedule, it was found that the merging of a four-cluster solution to a three-cluster solution created a bigger change in the coefficients (17%) than previous mergers (less than 12% change). This indicated that dissimilar clusters were being merged at this point. Therefore, a four-cluster solution may be optimal. This is supported by the dendrogram. In the next step, centroid values of the four clusters were used as initial seed points for the k-means

Table 1
Descriptive statistics, internal consistency coefficients and zero-order correlations of the key variables

		α	Mean	SD	1	2	3	4	5	6	7	8	9	10
1	Novelty seeking	.73	5.31	.82	1.00									
2	Novelty producing	.75	4.24	.91	.42**	1.00								
3	Flexibility	.63	5.03	.94	.48**	.49**	1.00							
4	Engagement	.72	4.77	1.05	.21**	.20**	.23**	1.00						
5	Overall flow	–	3.53	.40	.26**	.39**	.30**	.15*	1.00					
6	Attentional control	.72	3.36	.58	.10	.25**	.18*	.22	.48**	1.00				
7	Emotional control	.69	3.03	.62	.10	.18*	.22**	.09	.23**	.44**	1.00			
8	Goal setting	.80	3.25	.69	.12	.28**	.30	.10	.45**	.32**	.05	1.00		
9	Imagery	.78	3.27	.73	.20**	.17*	.11	.13	.26**	.04	−.15*	.44**	1.00	
10	Self-talk	.88	3.37	.80	.17*	.11	.28	.18*	.20**	.21**	.02	.43**	.42**	1.00

*$p < .05$; **$p < .01$.

Table 2
Cluster means, standard deviations and z scores for the four clusters

		Cluster 1 ($N = 65$)			Cluster 2 ($N = 42$)			Cluster 3 ($N = 32$)			Cluster 4 ($N = 43$)		
		M	SD	z	M	SD	z	M	SD	z	M	SD	z
1	Novelty seeking	5.32	.62	.02	4.42	.67	−1.09	5.51	.59	.25	6.01	.56	.85
2	Novelty producing	4.01	.74	−.26	3.46	.63	−.85	4.52	.74	.31	5.15	.63	.99
3	Flexibility	4.92	.57	−.11	3.98	.73	−1.11	5.49	.63	.49	5.88	.63	.90
4	Engagement	5.20	.57	.41	4.19	.74	−.56	3.40	.65	−1.32	5.72	.61	.91

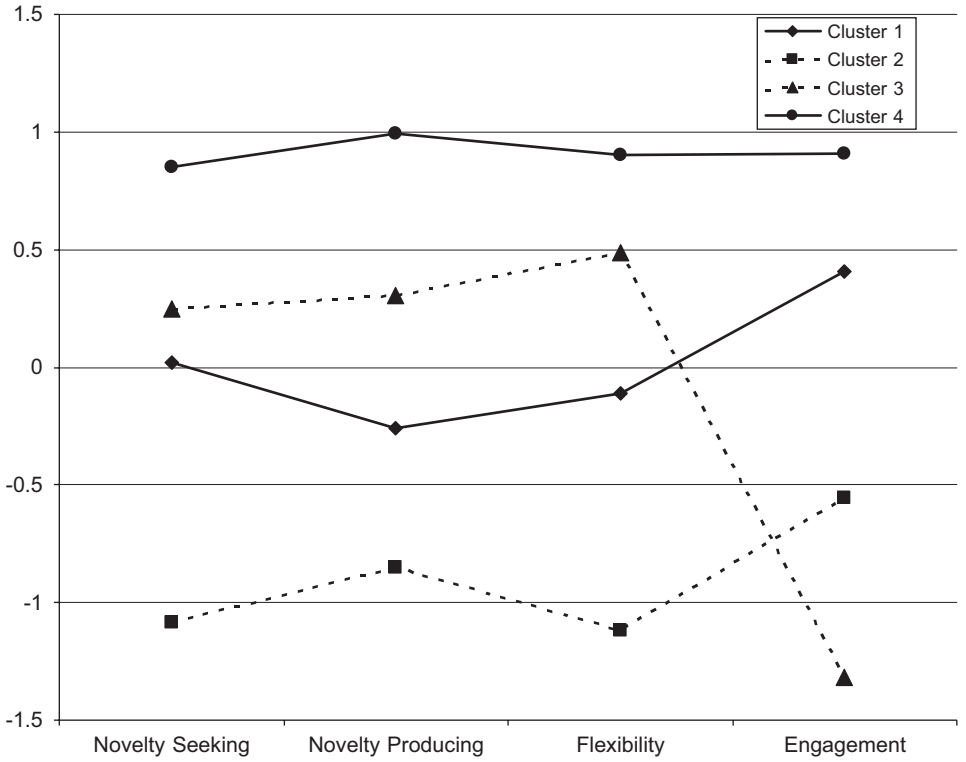

Fig. 1. Cluster profiles based on mindfulness characteristics.

cluster analysis. The final centroid values and the cluster sizes in the k-means cluster analysis was compared and found to be similar to those in the hierarchical analysis. A total of 85% of the athletes remained in the same cluster, supporting the stability of the clusters. The cluster means, standard deviations and z scores of the four clusters are shown in Table 2.

Based on the z scores of $\pm .5$ as criteria for classifying high or low scores, it was observed that cluster 1 had an "average" mindfulness profile because all four clustering variables were close to the means. This first cluster consists of 65 athletes (35.7%). The second cluster had a "low

mindfulness'' profile ($n = 42$), and consists of 23.1% of the sample. The third cluster consisted of 32 (17.6%) participants with a ''high novelty, high flexibility and low engagement'' profile and the last cluster had 43 athletes with a distinctly ''high mindfulness'' profile (23.6%) (see Fig. 1). The results of the ANOVA showed that the four clusters differed significantly in the global flow composite measure, $F(3, 178) = 9.10$, $p < .001$, partial $\eta^2 = .09$. Post hoc tests indicated that the ''high mindfulness'' cluster had significantly higher global flow disposition compared to clusters 1 and 2 (all $ps < .001$). Therefore, the predictive validity of the cluster solution was supported. No differences between clusters 3 and 4 were found, probability due to the high scores in merging of action and loss of self-consciousness of cluster 3.

Differences in flow dispositions across clusters groups

We examined the nine specific flow dispositions further using one-way MANOVA. The results showed significant differences between the clusters on the flow dispositions, Wilks's $\lambda = .754$, $F(27, 479) = 1.87$, $p < .01$, partial $\eta^2 = .09$. Table 3 show the means, standard deviations and z scores of the dependent variables for the four clusters among the athletes. The results of the follow-up tests showed that significant differences were found between the four clusters on six out of the nine dependent variables (i.e., challenge–skill balance, clear goals, concentration, sense of control, loss of self-consciousness and autotelic).

Post hoc Tukey tests revealed that those in clusters 1 and 2 had significantly lower challenge–skill balance, clear goals, concentration and sense of control compared to cluster 4 ($ps < .01$). For loss of self-consciousness, cluster 2 had significantly lower scores compared to cluster 4 ($p < .05$) (see Fig. 2). These results further validated the cluster solution.

Table 3
Cluster means, standard deviations, and z scores for the four clusters

	Cluster 1 ($N = 65$)			Cluster 2 ($N = 42$)			Cluster 3 ($N = 32$)			Cluster 4 ($N = 43$)		
	M	SD	*z*	*M*	SD	*z*	*M*	SD	*z*	*M*	SD	*z*
Challenge–skill balance	3.37	.66	−.21	3.31	.62	−.29	3.52	.62	.02	3.89	.60	.58
Merging of action and awareness	3.13	.52	−.11	3.05	.45	−.26	3.39	.59	.35	3.29	.66	.17
Clear goals	3.71	.55	−.13	3.55	.57	−.40	3.83	.55	.08	4.09	.56	.53
Unambiguous feedback	3.72	.53	.04	3.62	.51	−.14	3.59	.58	−.20	3.84	.71	.23
Concentration	3.40	.53	−.16	3.31	.47	−.32	3.50	.50	.02	3.78	.57	.54
Sense of control	3.39	.57	−.20	3.35	.54	−.26	3.50	.55	−.02	3.85	.63	.57
Loss of self-consciousness	2.95	.81	−.09	2.74	.69	−.34	3.23	.82	.24	3.27	.96	.29
Time	3.32	.63	−.11	3.34	.76	−.08	3.38	.74	−.02	3.57	.73	.25
Autotelic	4.15	.55	−.05	4.08	.54	−.18	4.10	.51	−.14	4.38	.52	.37
Attentional control	3.37	.56	.01	3.15	.60	−.36	3.26	.55	−.18	3.64	.52	.47
Emotional control	2.95	.63	−.12	2.89	.55	−.23	3.09	.62	.10	3.23	.64	.32
Goal setting	3.09	.68	−.23	3.13	.68	−.17	3.21	.67	−.06	3.64	.57	.57
Imagery	3.14	.73	−.18	3.27	.63	−.00	3.17	.82	−.14	3.56	.72	.39
Self-talk	3.32	.77	−.06	3.17	.64	−.25	3.31	.92	−.07	3.67	.81	.38

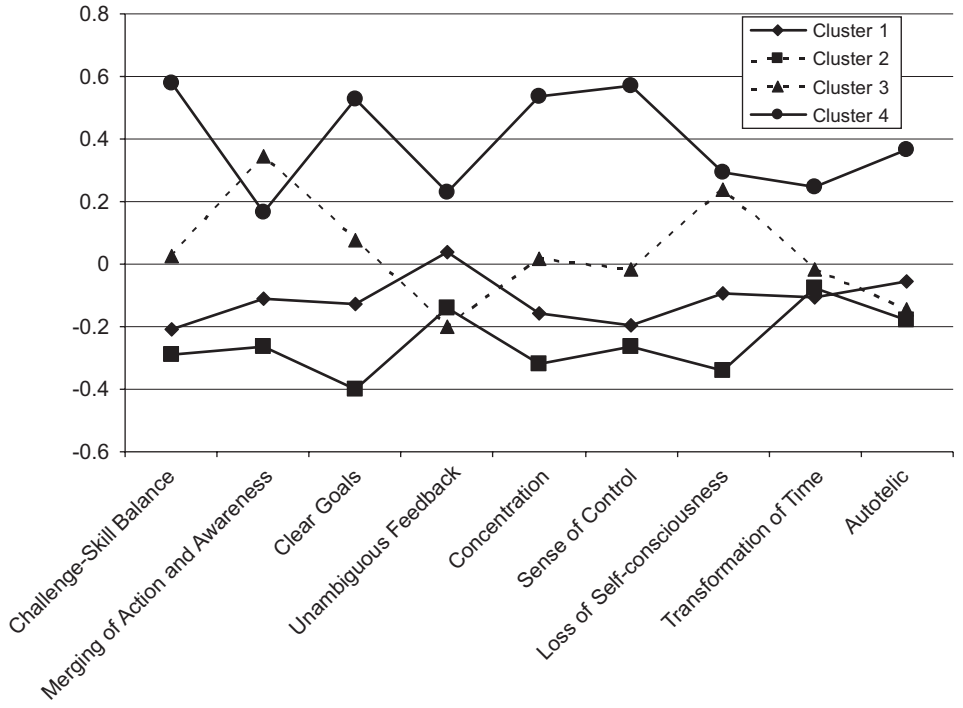

Fig. 2. Cluster differences based on flow dispositions.

Differences in mental skills adoption across clusters groups

The results of the second MANOVA using mental skills qualities as dependent variables also showed significant differences between the clusters, Wilks's $\lambda = .747$, $F(15, 480) = 3.57$, $p < .01$, partial $\eta^2 = .09$. Table 3 displays the means, standard deviations and z scores of the dependent variables for the four clusters and Fig. 3 presents the clusters profiles in mental skills adoption. The results of the follow-up ANOVAs showed that significant differences were found between the four clusters on all the five dependent variables ($ps < .01$).

Post hoc tests showed that those in cluster 4 had significantly higher goal setting than all the other three clusters (all $ps < .01$). Cluster 4 also reported higher positive self-talk skills compared to cluster 2 and higher imagery when compared to cluster 1 (all $ps < .01$). No significant differences were found between the clusters in each pairwise comparison.

Gender and nature of sports differences in cluster composition

The results of the chi-square tests indicated that there were no gender differences among the clusters [$\chi^2 = (3,\ N = 182) = 3.44$, *ns*]. However, there were differences in the sport groups, $\chi^2 = (3,\ N = 182) = 11.78$, $p = .01$. Specifically, cluster 1 had more athletes from team sports ($N = 41$) compared to individual sports ($N = 24$) and cluster 3 had more athletes from individual sports ($N = 23$). In clusters 2 and 4, there was even distribution of athletes from team and individual sports.

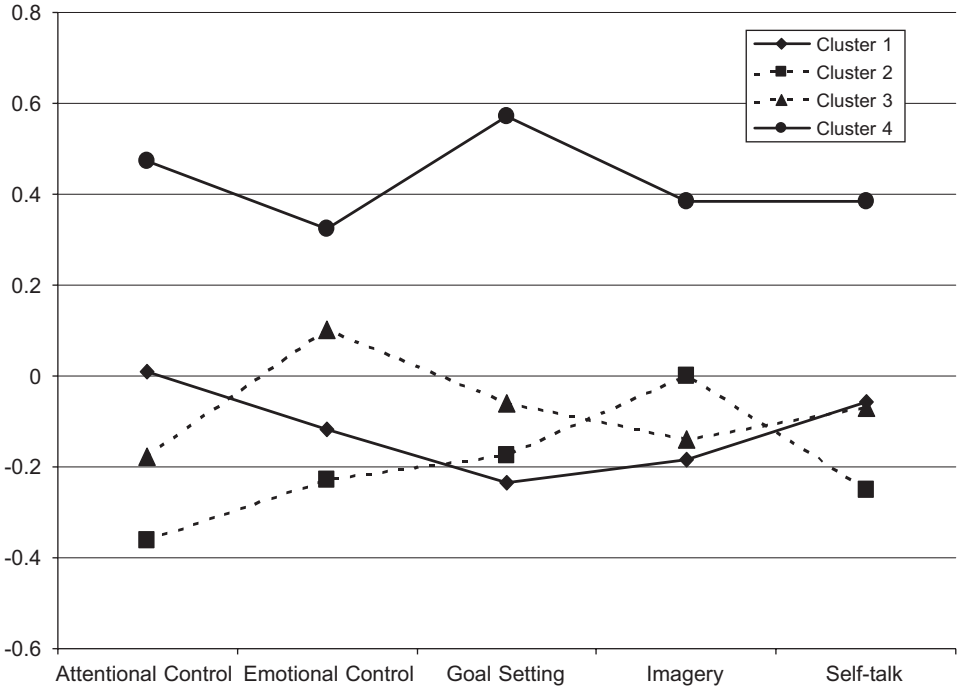

Fig. 3. Cluster differences based on mental skills adoption.

Discussion

The relationships between mindfulness, flow dispositions and mental skills adoption are examined in the present study. Given the popular belief that adopting a present moment focus is conducive for achieving peak performance, it is hypothesized that those who display mindfulness characteristics are more likely to score higher in flow dispositions and mental skills adoption measures.

Four unique clusters of individuals with varying mindfulness characteristics were found in the present group of participants. These groups were clustered based on relative differences in the members' MMS scores. The two extreme clusters are the high mindfulness cluster (cluster 4) and the low mindfulness cluster (cluster 2). The former has the highest mean scores in novelty seeking, novelty producing, flexibility and engagement, while the latter has the lowest mean scores in these mindfulness characteristics. There is also an average mindfulness cluster (cluster 1), with moderate scores for all the four mindfulness characteristics. Lastly, there is another cluster (cluster 3) which is high in novelty seeking, novelty producing and flexibility, but has the lowest scores in engagement compared to the rest. It appears that cluster 3 is an interesting cluster, and its characteristics shall be elaborated later.

To answer the two research questions posed, flow dispositions and mental skills adoption habits scores were compared across clusters. The differences observed between the most mindful (cluster 4) and the least mindful cluster (cluster 2) were the most evident. The high mindfulness cluster

scored significantly higher in flow dispositions of challenge–skill balance, clear goals, concentration, sense of control and loss of self-consciousness scores compared to the low mindfulness cluster. In terms of mental skills adoption, scores of attentional control, emotional control, goal setting and self-talk were significantly higher in the high mindfulness clusters compared to the low mindfulness cluster.

The findings suggest that those with the propensity to be more mindful are also more likely to experience the flow states. Since mental skills adoption is related to more frequent flow experience (Jackson, Thomas, Marsh, & Smethurst, 2001), the observed link between mindfulness and mental skill adoption is of interest. Five out of nine flow dispositions were found to be significantly higher in the high mindfulness cluster (cluster 4) when they were compared to the low mindfulness cluster (cluster 2). At the same time, those who were most mindful also tend to adopt attentional control, emotional control, goal setting and self-talk strategies during their sport practices. These are the two main findings in relation to the research questions. However, in such a cross-sectional study, it would be impossible to infer causality between mindfulness and flow. Nevertheless, the differences between the high and low mindfulness clusters suggest that one's tendency to be mindful of the present moment might be related to flow disposition and mental skills adoption.

It is observed that the high mindfulness cluster had significantly higher overall flow disposition score compared to clusters 1 and 2. As challenge–skill balance has been touted as a key flow disposition (Jackson & Csikszentmihalyi, 1999), the observed difference in challenge–skill balance deserves special mention. From the current findings, it is evident that those in the high mindfulness group are more inclined towards novel challenges compared to clusters 1 and 2. A more flexible attitude could be one reason why the high mindfulness group scored better at challenge–skill balance. In order to experience flow, how one perceives challenge is more important than the actual challenge presented (Jackson & Eklund, 2004). Being flexible in attitude allows one to be less restrictive about one's perception of ability and challenges. This could lead to more favorable perception of balance between challenge and ability, making it conducive for flow to occur.

The results also suggest that mindfulness tendency is linked to the flow dispositions of clear goals, concentration, sense of control and loss of self-consciousness. These four dispositions are related to the self-regulation of attention, which according to Bishop et al. (2004) is one of the two components of mindfulness. With a heightened self-regulation of attention, those who are mindful are more likely to be conscious of their goals when executing moves. Higher flow disposition of clear goals suggests this. The relation between concentration and mindfulness is not surprising as flow disposition of concentration pertains to the focus on the task at hand (Jackson & Eklund, 2004). Likewise the heightened sense of control in the mindful athletes is anticipated as mindfulness is directly related to the self-regulation of attention (Bishop et al., 2004). Finally, according to Ryan and Brown (2003), those who are more mindful are likely to have a positive self-esteem and are less affected by introjections. This could be a reason why there is a stronger likelihood for loss of self-consciousness for the more mindful athletes. The tendency to experience the loss of self-consciousness may have something to do with the purposelessness of mindfulness (Brown & Ryan, 2003) mentioned earlier, whereby the inhibition of cognition (Bishop et al., 2004) and a sense of unselfconsciousness towards the task at hand could bring about flow more readily (Jackson & Eklund, 2004).

Individuals' mental skills adoption habits also differ in the two extreme groups clustered based on mindfulness characteristics. There is more frequent use of attentional control, emotional control, goal setting, imagery and self-talk strategies in those who have a stronger disposition towards mindfulness. In other words, novelty seeking, novelty producing, flexibility and engagement tendencies are related to mental skills adoption in the current sample.

Why should that be so? It might have something to do with the heightened sense of self-awareness accompanied by mindfulness. There is previous suggestion that mindfulness training can promote the use of various coping strategies through improvements in self-observation (Baer, 2003). Those who are mindful are better at detecting threats and emotional events. Such early detection encourages the application of the previously acquired coping strategies. The current findings suggest that mental skills of attentional control, emotional control, goal setting, imagery and self-talk strategies are more readily adopted by those who have the propensity to be mindful.

This present findings could have some implications for applied sport psychology. Firstly, an appreciation of individual differences in mindfulness may help sport psychologists make better decisions when they deliver mental skills programs. Previous research suggests that factors such as motivation and goal orientations can influence mental skills adoption (Harwood et al., 2004). The present study documents that individual propensity towards novelty seeking, novelty producing, engagement and flexibility is also associated with mental skill adoption habits. As mental skills adoption is an important issue in sport psychology, acquiring new understanding of other personality characteristics that may influence mental skills adoption tendencies is important. Mindfulness characteristics could be one class of personality characteristics that deserve further attention.

Secondly, as progression towards the development of mindfulness tendencies may be an indication of increasing flow dispositions, changes in the mindfulness characteristics can offer some insights into the personal growth or the complexity process of the athletes' psyche. Although personal growth through flow has been suggested (Jackson & Csikszentmihalyi, 1999), the idea of flow-related psychic complexity initially proposed by Csikszentmihalyi (1990) has not been well examined within sport psychology. The lack of a suitable measure of complexity could be the reason why there is a dearth of research here. Since flow disposition is found to differ across groups of athletes with varying mindfulness characteristics, tracking changes in terms of mindfulness characteristics offers an alternative for examining the personal growth.

Csikszentmihalyi (1990) suggests that experience of flow, which is linked to enjoyment, can bring about further personal growth. He termed this the complexity process which comprises of differentiation and integration. Differentiation pertains to the active seeking of new challenges following flow experience (Jackson & Eklund, 2004). This is an area where novelty seeking and novelty producing aspects of mindfulness might mirror. Integration, which is related to increase in skills for meeting those challenges (Jackson & Eklund, 2004), can be understood in terms of improved engagement and flexibility since being engaged and flexible indirectly increases one's resources for dealing with the task at hand. As these four mindfulness characteristics are related to some of the flow dispositions, sport psychologists can perhaps track athletes' personal growth based on mindfulness.

Although the discussion thus far focused mainly on the differences between the most mindful and the least mindful clusters, the existence of cluster 3 (which has the lowest engagement scores) deserves special mention. This cluster has the lowest engagement scores despite having above

average novelty seeking, novelty producing and flexibility scores. An inverse relationship between engagement and the rest of the mindfulness characteristics seems to be present in this cluster. Low engagement scores perhaps suggest that members of this cluster lack persistence. Since one important aspect of engagement is the extent of attention towards details (Bodner, 2000), and persistence is somewhat associated with attention abilities, the inverse relationship observed here can be explained by the inverse relationship between persistence and novelty seeking previously suggested (Ito, Fukuda, Suto, Uehara, & Mikuni, 2005; Kim, Cho, Kang, Hwang, & Kwon, 2002).

The role an increased engagement could play in influencing mental skills adoption and flow could be of great interest to future researchers. As shown in Fig. 1, the distinction between the high mindfulness cluster and cluster 3 is characterized by a significant difference in engagement scores. Individuals with low engagement (despite having moderate novelty seeking, novelty producing and flexibility) may be less likely to experience flow and to adopt mental skills compared to the highly mindful individual. Future studies could explore whether mindfulness training (e.g., Baer, 2003) is effective in developing better engagement in individuals with cluster 3 characteristics.

Despite the potential contribution of the present findings, there are several limitations to be noted. First, the sample size of the study is rather small for the type of analysis used. Therefore, the cluster characteristics reported in this study must be interpreted with care. The variations found in the four clusters are in no way perfect reflection of actual differences observed in the population. Other than the high and low mindfulness clusters, there could be other clusters with characteristics dissimilar to the present sample if the same procedure is applied to different samples. Secondly, the validity and reliability of MMS might be another weakness. The Cronbach alpha level for flexibility sub-scale is below the acceptable level of .70. Furthermore, as only 13 out of 21 original items were used in this study, the full spectrum of mindfulness characteristics originally conceptualized by Bodner and Langer (2001) may not be fully captured. Development of mindfulness instruments has been ongoing since the initial conceptualization of this study (e.g., Baer, Smith, Hopkins, Krietemeyer, & Toney, 2006). Future research could explore other questionnaires but should bear in mind that different authors may conceptualize mindfulness differently. Thirdly, as this is a cross-sectional study, links between the constructs examined are merely correlational.

Given the possible links between mindfulness and peak performance, future research could advance the line of mindfulness research in sport and exercise science in at least four areas. First, the suitability and effectiveness of mindfulness-based training should be further examined. It is not known if the majority of the athletes would approach mindfulness training favorably, given the individual differences observed in mindfulness tendencies. It might be useful to ascertain differences in mental skill acquisition abilities between athletes of varying mindfulness tendencies. Secondly, it is important to further understand the psychophysiology of mindfulness in performance settings (Ryback, 2006). For example, biofeedback modalities may be used for tracking athletes' mindfulness state during a movement task. In so doing, the processes of cognitive inhibition and flow can be further investigated (Collins, 2002). Thirdly, the effects of mindfulness during motor skills learning have not been investigated. It is not known if learning abilities can be moderated by mindfulness. Lastly, other potential correlates of mindfulness, such as creativity (Langer & Moldoveanu, 2000) and

compassion (Shapiro et al., 2006) should be subsequently investigated to ascertain if they are likewise related to athletes' flow experience.

In conclusion, the current preliminary cluster analytic evidence suggests that the strategy of present moment focus might indeed have relevance for performance enhancement in some ways as previously noted (e.g., Jackson & Delehanty, 1995; Jackson & Csikszentmihalyi, 1999; Orlick, 1990; Ravizza, 2002). There are some athletes who are more likely to pay attention to the "here and now" during their course of daily living, and it appears that these mindful individuals have a higher chance of mental skill adoption and also tend to experience elements of flow more often. There appears to be carryover effects of mindfulness in the direction of daily life onward to athletes' sports involvement. However, it is equally plausible that sports involvement with its opportunities for moment-to-moment attention and flow might also play a role in shaping one's mindfulness characteristics. After all, mindfulness of flow in itself is necessary for experiencing flow. As such, the link between mindfulness and flow appears to be symbiotic. However, given that the pursuit of flow is highly elusive (Jackson & Csikszentmihalyi, 1999), it is perhaps more appropriate to further develop mindfulness instead of striving for flow to happen. In the spirit of maintaining purposelessness during mindfulness practice, perhaps flow and performance enhancement should be indeed considered as by-products rather than outcome goals.

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