Abstract

These case studies examined the effects of mindful sport performance enhancement (MSPE) programs on competitive swimming performance, flow experience and emotional Regulation. Sixteen national competitive adolescent swimmers were randomly allocated into MSPE (n=9) and RT (relaxation training); (n=7) groups for eight weeks. In the second phase of the intervention, the sixteen participants were evenly split into a MSPE-S (MSPE for swimming) and a control group for five weeks. The participants completed measures of trait and state flow, mindfulness and swimming races pre and post intervention. The data analysis revealed that mindfulness had significant effects on both action-awareness merging and clear goals subscales. Further analysis revealed that the MSPE-S group significantly improved in terms of presence relative to the control group. In conclusion, general and sport-specific mindfulness interventions can psychologically benefit adolescent competitive swimmers.

Case study context

This applied sport psychology training request arrived from a National Talent Swim England coach in the North-East of England who wanted to explore psychological training for his National Level competitors in the lead up to the National Championships 6 months later. The two sport psychology practitioners that designed, delivered and evaluated the intervention had different sporting backgrounds (one from Mixed Martial Arts and National competitive adult experience as an athlete) and a Swimmer (A GB Youth Finalist). They both had more than five years

of part-time practice in applied sport psychology (part-time) that they had delivered alongside academic roles that they have held for more than ten years. The applied sport psychology experience of the team included a variation from Elite competitive swimming and para-swimming, International level Mixed Martial Artists to FA referees or talent development pathways in partnership with National Governing Bodies. In terms of applied practice philosophy, both consultants draw from a humanistic and psychodynamic approach to formulation and intervention design and the practice approach is shaped by the Middle-Eastern Buddhism principles that underpin meditative practices. This was influenced by their immersion in these cultures when previously living in countries where that is more common practice. Therefore, the applied sport psychology practitioners had complimentary practice philosophies, perspectives and goals for the intervention and these aligned with the principles of mindfulness techniques in sport.

There has been growing interest in mindfulness interventions for sports performance enhancement as reflected in a recent meta-analysis (Buhlmayer, Birrrer, Rothlin, Faude & Donath, 2017) and systematic review (Corbally, Wilkinson, & Fothergill, 2020; Noetel, Ciarrochi, Van Zanden, & Lonsdale, 2019) that demonstrates the positive effects of mindfulness practices on facilitators of successful sport performance including the flow experience. Mindfulness can be defined as the act of deliberately attending to the present moment in a non-judgemental manner

(Kabat-Zinn, 1994; (Brown & Ryan 2003; Longshore & Sachs 2015). There are a number of mindfulness intervention approaches in sport including two more commonly practiced approaches; Mindful Sport Performance Enhancement (MSPE; Kaufman, Glass & Arnkoff, 2009) and Mindfulness-Acceptance-Commitment (MAC; Gardner & Moore, 2006). Through meditative and non-meditative practices these approaches aim to develop awareness and acceptance of both negative and positive emotions, cognitions and physical sensations thereby enhancing emotional and attentional regulation. Emotion regulation is the "internal and external processes responsible for experiencing, expressing and modulating one's emotions in the service of goal achievement" (Moore & Gardner, 2011, p.249). Mindfulness practitioners aim to facilitate athletic development by supporting an ability to (1) tolerate and accept cognitions and emotions in a non-judgemental way and (2) depersonalise cognitions and emotions and view them with a degree of adaptive detachment. The ability to engage with a present moment focus can lead to improvements in attention regulation and this can include both a) attention specificity (an ability to focus on selected and desired stimuli) and b) adaptive temporal attention, i.e., present-moment attentional focus rather than retrospective or prospective; (Jha, Krompinger & Baine, 2007; Jha, Stanley, Kiyonaga, Wong & Gelfand, 2010). Evidence has shown that these attention regulation abilities also underpin emotional regulation in that they allow an athlete to

tolerate and experience distressing emotions in a non-judgemental manner and thus assist goal-regulated behaviour (Marks, 2008; Davidson, 2002).

The MSPE applied intervention and the flow experience

Athletes who experience optimal athletic performance commonly refer to an experience of 'being in the zone' and experiencing an 'effortless flow'. The subjective features of this optimal flow performance states is characterised by deep concentration, emotional flexibility, enhanced self-confidence, present moment focus, low self-consciousness, ease of effort and self-transcendence. Researchers have suggested flow states share similar antecedents and consequences to those experienced in meditative states (Kaufman et al. 2009). Moreover, a growing body of literature shows that mindfulness can increase and facilitate flow states and athletic performance (Cathcart, McGregor & Groundwater, 2014; De Petrillo, Kaufman, Glass & Arnkoff, 2009).).

The flow experience allows an athlete to enter a state of complete involvement in the task at hand for the sake of the absorbing experience itself (Jackson, 2016) and to perform fluid, autonomous movements with cognitive clarity and positive affect (Swann, et. al. 2012; Csikszentmihalyi, 2002). The current conceptual models of flow include nine dimensions of the flow experience including three facets (Csikszentmihalyi, 2002); challenge-skill balance, action-awareness merging, clear goals (Nakamura & Csikszentmihalyi, 2002). The remaining six dimensions are experiential aspects of flow state; unambiguous feedback, concentration on task, sense of control, loss of self-consciousness and time transformation. These aspects of flow are consistent with the aims and practices of mindfulness training (Jackson, 2016) and cluster analysis has revealed that those individuals who are higher in

mindfulness traits, self-report higher scores in challenge-skill balance, clarity of goals, loss of self-consciousness and concentration (Kee & Wang, 2008).

Research also suggests that mindfulness training creates psychological conditions that increase the likelihood of flow states in athletic populations (Chen, Tsai, Lin, Chen & Chen, 2018). Moreover, mindfulness facilitators can decrease negative rumination that has been shown to impede pre-performance concentration and focus. It has been established that flow is positively related to psychological factors that underpin successful sport performance, such as concentration and psychological flexibility. A relatively small number of experimental studies have used randomised-control trials to investigate the effect of mindfulness training on flow and other sport relevant psychological states (Scott-Hamilton, Schutte & Brown, 2016; Aherne, Moran & Lonsdale, 2011; John, Verma & Khanna, 2011; Moghadam, Sayadi, Sammimifar & Moharer, 2013; Quinones-Peredes, 2014). Scott-Hamilton, Schutte and Brown (2016) conducted a RCT and found that cyclists experienced a significant increase in mindfulness and flow and lowered concentration disruption after mindfulness training. Rooks, Morrison, Goolsarran, Rogers, & Jha (2017) found support for these conclusions by finding that mindfulness practices lowered the likelihood of loss of attention during intensive pre season football practices. Hill, Shucker, Wiese, Hagemann & Strauss (2019) examined the impact of an 8 week mindfulness training programme on flow experiences and running economy with 16 trained runners. The authors found that subjective flow and oxygen consumption improved at moderate intensity running pace, following the mindfulness programme which in turn led to better performance. They also found that these improvements occurred irrespective of attentional focus; i.e., on internal body signals, external video, the core component of the movement and on control of movement.

There are also applied intervention studies with athletic samples using the MSPE intervention protocol that have identified links between mindfulness and flow (Kaufmann, et. al. 2009; Swann, Keegan, Piggot & Crust, 2012; Kaufmann, Glass & Pineau, 2018). For example, Chen, Tsai, Lin, Chen & Chen (2018) implemented a 4 week MPSE training programme with amateur baseball players and examined pre/post intervention changes in flow, competitive anxiety, eating disorder risk factors and sleep disturbance. The authors found that the MPSE intervention increased flow state and self-confidence and decreased competitive anxiety, weight concern and sleep disturbances. The authors concluded that the MPSE intervention can have beneficial performance effects for amateur level athletes. In other sport-specific research, Chen and Meggs (2020) examined the effects of an 8 week MPSE intervention on flow subscales in national competitive swimmers and similarly found beneficial effects of the intervention on flow; specifically on clear goals and action awareness merging. Moreover, increases in flow-state and self awareness of pacing have been noted in sedentary populations following brief pre and during exercise mindfulness manipulations (Meggs & Chen, 2020). The finding that mindfulness (specifically bodily awareness in the moment) can benefit the process of pacing during sport or exercise appears to be evident in athletic populations; Cathcart, McGregor and Groundwater (2014) found that athletes in pacing sports may have a higher capacity to observe and notice present moment feelings and theorised that this finding was due to the mechanism of integrating kinaesthetic information with cognitive and emotional processes (Tucker, 2009). The performance benefits of mindful awareness of bodily sensations is further supported by Bernier, Thienot, Codron and Fournier (2009) who found that elite swimmers reported practices of

attending to bodily sensations prior to competition. In other research with athletes, Aherne, et. al. (2011) found that the flow dimensions of clear goals and a sense of control significantly improved following mindfulness training. Taken together, the existing research evidence suggests that mindfulness training can improve athletic sport performance by increasing aspects of flow such as action-awareness, present moment focus and goal clarity (Chen, Tsai, Lin, Chen & Chen, 2018). These aspects of flow are consistent with the aims and practices of mindfulness training (Jackson, 2016). As mindfulness training aims to facilitate, non judgemental experience of the present moment via focused attention, this overlaps with improving concentration, control and losing a sense of self preoccupation, all of which describe the experience of flow.

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It is also important to consider the potential beneficial effects of mindfulness training over above more traditional relaxation training (RT) programmes. This experimental approach (comparing RT and mindfulness training) has been used in previous randomised control trials outside of sport (Lancaster, Klein & Knightly, 2016; Jain, Harpio & Swanick Set al., 2007) in order to isolate the unique effects of these interventions. This is important as noted by a recent review by Luberto, Hall, Park, Haramati and Cotton (2020). These authors highlighted the similarities and differences between RT and mindfulness practices in terms of their theoretical foundation, intentions and evidence-based psychophysiological outcomes. One of the primary differences between the intentions of the mindfulness vs RT approaches is that mindfulness encourages acceptance and tolerance of psychological and physiological states, whereas RT attempts to elicit parasympathetic dominance via

deliberate effort. In terms of the efficacy of these approaches; Sedlmeier, Ebert & Schwarz (2012) sought to explore this by conducting a systematic review of mindfulness vs RT clinical trials and found that mindfulness interventions represented larger effect size changes in psychological outcomes such as anxiety in comparison with RT. Luberto, Hall, Park, Harmati and Cotton (2020) suggest that greater tolerance of distress and negative emotions may allow for greater choice over emotion regulation and ability to be present. We theorise that although relaxation training may improve emotional regulation, the cognitive demands/load increase associated with deliberate effort may detract from more fluid and present performances that are typical of optimal flow states in athletic performances. Given that the extant literature supports the efficacy of both mindfulness and RT, and they appear to effect different and distinct neural and psychological mechanisms, it is therefore important to examine the unique effects of these interventions on psychological outcomes with athletic performers. These case studies take a novel approach to applied sport psychology mindfulness research by examining the unique and isolated effects of RT and mindfulness training on relevant psychological variables. The case studies further contribute to original knowledge development in applied sport psychology in that they address the need to develop evidence-base for applied mindfulness training, following traditional classroom based training. This is particularly important with youth athletes who may benefit from more concrete applications of mindfulness skills. To address this, we aimed to develop an applied, sport specific tailored mindfulness intervention and a process for the application of this approach in different sports. The approach taken is genuinely multi-disciplinary in terms of the intervention design, implementation and evaluation aspects. There is sound theoretical, empirical under-pinning in the selection of the intervention approach (swimming specific interoceptive

cues are integrated into the mindfulness intervention scripts), the design of the tools and the evaluation of the impact of the techniques. In summary, the applied mindfulness design phase using the expertise and knowledge of the coach and sport psychologist provides a framework for multi-disciplinary model of practice that could be adapted to other sports.

A multi-athlete case study with a RCT design was conducted to examine the effects of a (sequential & two phased) MPSE (phase 1) and applied mindfulness training (phase 2) programme on flow state, trait and state mindfulness and emotional regulation. The active control condition athletes received a traditional relaxation training programme. The inclusion of a relaxation training (RT) comparison group enabled the examination of the unique effects of mindfulness training over and above traditional RT interventions. The second phase of this intervention involved the implementation of a swimming specific MSPE-S mindfulness training program. This was important as research has emphasised that the contextual, technical and psychological demands and requirements of the sport should be considered when designing sport psychology interventions (Koehn, Morris & Watt, 2013). It was hypothesised that a) swimmers who received MPSE mindfulness training would self-report significant increases in flow and mindfulness skills in comparison with the relaxation training control group and b) swimmers who received an applied mindfulness intervention would self-report significant increases in mindfulness and emotion regulation skills in comparison to a control group.

Method

Participants

The 16 participants (male $n = 9$) were National Level competitive swimmers (M_{age}:13.06; SD=1.57) and their Mean sport experience = 4.53 years; SD: 1.59. The

MSPE group (n=9) participants were (M_{age}:13.78; SD=1.56) and their Mean sport experience = 5.33 years; SD: 1.41, while the RT (n=7) were (M_{age}:12.14; SD=1.07) and their Mean sport experience = 3.36 years; SD: 1.06.

Design

The intervention involved two sequential stages with a small group of specifically selected swimmers who were all competing at the upcoming British and English Nationals. A randomised experimental control design was used. In phase one the swimmers were randomly allocated to an experimental group; Mindful Sports Performance Enhancement training programme for adolescents (MSPE) and the control group received the relaxation training programme (RT). There was subject attrition in the RT group in that *n*=2 participants did not continue until the end of the intervention. In phase two, the experimental group received MSPE-S intervention (mindfulness training for swimmers) and the RT continued for the control group.

Measures

Dispositional Flow Scale-2 (DFS-2) and Flow State Scale (FSS-2)

The DFS-2 and FSS-2 (Jackson & Eklund, 2002) are 36-item measures of the tendency to experience flow and past tense state experiences respectively, each scored on a Likert scale from 1 (never) to 5 (always). The scales are theoretically grounded in the concept of flow and contain nine dimensions with three core principles of the flow experience: challenge-skill balance, clear goals, unambiguous feedback and six flow characteristics: action-awareness merging, concentration on the task at hand, sense of control, loss of self-consciousness, time transformation and autotelic experience. There is evidence to suggest that the DFS-2 and FSS-2 have acceptable reliability and validity in athlete populations (Jackson & Eklund, 2004).

Mindful attention awareness scale for adolescents (MAAS-A)

The MAAS-A (Brown, West, Loverich, & Biegel, 2011) is a 14-item inventory examines trait mindfulness with items such as 'I find myself doing things without paying attention' that are measured on a 6-point Likert scale from 1 (almost always) to 6 (almost never). The instrument has been found to have acceptable test-retest-reliability coefficients (Brown, et. al., 2011).

Toronto mindfulness scale (TMS)

The TMS (Lau, Bishop, Segal, Buis, Anderson, Carlson & Cormody, 2006) assesses state levels of mindfulness immediately following the practice of a mindfulness exercise or workshop (Bishop, et. al., 2004). Each of the 13-items are rated on a Likert scale ranging from 0 (not at all) to 4 (very much). Analyses by Lau, et. al. (2006) showed that this instrument is a reliable and valid measure of state mindfulness that contains the two subscales, curiosity and de-centring. The composite reliability calculation in the current study (Cronbach's omega = 0.73) is within the acceptable range.

Phase two measures

Mindfulness inventory for sport (MIS)

The MIS (Thienot, Jackson, Dimmock, Grove, Bernier & Fournier, 2014) measures state mindfulness for sport with items such as "I am aware of the thoughts that are passing through my mind" and "When I become aware that I am thinking about a past performance, I criticise myself for not being focused on my current performance". It is a 15-item inventory measured on a 6-point scale of responses, ranging from 1 (not at all) to 6 (very much); higher scores reflected higher state-mindfulness for sport. The MIS has the three subscales, awareness, non-judgement and refocusing. The

composite reliability calculation in the current study (Cronbach's omega = 0.73) is within the acceptable range.

Freiburg mindfulness Inventory (FMI)

The FMI (Walach, Buchheld, Buttenmuller & Schmidt, 2006) is a 14-item self-report measure of mindfulness skills that can be analysed as either a single or double factor inventory. Each item including '*I am open to the present moment*' is measured on a 4-point Likert scale ranging from rarely (1) to almost always (4). The double factor inventory includes the subscales acceptance and presence. Both single and double factor solutions have been found to have acceptable model fit (Kohls, Sauer & Walach, 2009). The composite reliability calculation in the current study (Cronbach's omega = 0.81) is within the acceptable range.

***Emotion regulation questionnaire (ERQ;* Gross & John, 2003)**

The ERQ is an 8-item self-report measure of emotional regulation with two subscales: reappraisal and suppression. Each item (including 'when I wanted to feel more positive emotion, I changed what I was thinking about') is measured on a 7-point Likert scale ranging from strongly disagree (1) to strongly agree (7). The internal consistency of the measure has been shown to be satisfactory (Spaapen, Waters, Brummer, Stopa & Bucks, 2014). The composite reliability calculation in the current study (Cronbach's Omega = 0.85) is within the acceptable range.

Protocol

The study Ethical Clearance was provided by the University committee prior to data collection. In phase 1 and 2 the rationale of the program was explained at the first introduction workshop, and participants completed the baseline psychometric

questionnaires; phase 1 (DFS-2; FSS-2; MAAS-A and TMS in weeks 2, 4, 6 & 8) and phase 2 (FMI; MIS; ERQ). The two intervention groups attended a 30-minute weekly training workshop for 8 weeks (phase 1) and 5 weeks (phase 2) with associated home activities and practice logbooks. The MSPE workshops and exercises were based on the MSPE protocol (Kaufman, Glass, & Arnkoff, 2009; Kaufmann, Glass & Pineau (2018) including the raisin/polo mint exercise, diaphragmatic breathing, sitting meditation, the STOP acronym, the body scan, mindful yoga and walking meditation. In week 8, a final mindfulness skills session applied in swimming training was delivered.

In phase 2, the MSPE-S protocol implemented the applied mindful swimming scripts which focused on different aspects of race preparation and performance. The content for each MSPE-S workshop used different applied swimming training scripts that built on the Mindful sports performance enhancement (MSPE) protocol. Each swimming specific mindful script focused on a different aspect of preparation and performance. Present moment anchors were related to the demands of the specific swimming event, e.g., distance = pacing, speed = power and explosive action and the associated physiological cues such as muscle tension and breathing rate. The scripts were developed after considering the training cycle stage and session characteristics, physiological and performance demands that were outlined by the national performance club coach. The weekly applied mindfulness swimming specific scripts were (1) Psychological warm up and preparation, (2) the dive start, (3) Pacing (endurance), (4) Pacing (sprinting), and (5) Marshalling (all swimmers trained in the pool 5-6 times per week using these scripts). Participants were provided with log-books to reflect upon their challenges and successes when applying the mindfulness scripts. The CG received no intervention but continued to attend their typical S&C

and swimming training sessions. One week following the final workshop (allowing for any post-intervention learning to stabilise) the post-intervention psychological measures were completed again. The swimmers completed a daily mindfulness log detailing their practices and reporting specific techniques, environments for practice and present moment anchors that worked best for them.

Relaxation Training

The RT program used was a body awareness-based relaxation intervention. The RT program adapted techniques from autogenic relaxation training using the instructions from Bernstein, Borkovec and Hazlett-Stevens (2000) and integrated these instructions into the same body exercises as the MSPE group. Instructions were given to alternate between tension and relaxation of specific muscles of the body in order to train awareness of different physical states and simple breathing techniques. The first three sessions included exercises specific to systematically teaching relaxation and tension of different muscle groups throughout the whole body (e.g., Bernstein, et. al., 2000, p.35). These instructions were then applied to the same exercises used in the MSPE group (i.e., body scan, yoga and walking) so that participants would learn to appreciate different states of relaxation and tension in those activities.

Data analysis

Data satisfied all parametric assumptions. Analysis of Covariance (ANCOVA) was performed with the dependent variable as the post minus pre change scores on all variables. Analysing change scores from baseline is a common method for examining mean differences between independent groups in RCT designs (Fu & Haley, 2016). The significant differences in outcome measures between the experimental and control groups were examined with pre-measurement scores entered as a covariate. Tabachnick and Fidell (2013) recommend using ANCOVA to examine the results of a

between-groups design with pre- and post-test measures as this approach takes into account ceiling and floor effects. Means (SD) of the change scores were reported for each of the significant subscales. (Cohen, 1988). To correct for upward bias estimation, due to the small sample size, the Hedges *D* correction was applied to provide an unbiased estimate (Hedges & Olkin, 1985) of the effect sizes. Hence the corrected Hedges *D* statistic was interpreted using the following guidelines (Rosner, 2010) with a small, medium and large effect sizes of .2, .5 and .8 respectively. They were also reported along with the 95% CI. (Cohen, 1988). IBM SPSS Statistics (Version 26) was used for all statistical test with $\alpha = .05$ for all inferential tests. Statistical power (1-β) was calculated with the G*Power software v. 3.1 (Faul et al, 2007). A value of <0.8 statistical power was deemed acceptable (Cohen, 1988). Lastly the reliable change index (RCI; Jacobson & Traux, 1991) was calculated (Zahra & Hedge, 2010) for each global measure, as this can provide change pattern data. The Reliable Change Index (RCI) was computed using the equation provided by Jacobson and Traux (1991). The RCI provides a measure of the change in standardised units, the direction of the change and whether it is reliable for each individual participant.

Results

Table 1 presents the descriptive statistics including pre and post scores of each measurement subscale. ANCOVA findings revealed that Global Flow, F (1,13) = 19.38, $p < .005$, partial n^2 =.60, and merging of action and awareness subscale, F (1,13) =19.80, $p < .005$, partial n^2 = .60 showed a significant difference in pre and post intervention change scores between the MSPE and RT group. The MSPE group showed an increase in Global Flow (M = 10.22, SD = 6.65) whereas the RT participants reported a smaller increase (M = 2.57, SD = 14.21, Hedges D = 0.68 [-0.33,1.70], 1-B = 0.24). This represented a medium effect size. The MSPE group

showed an increase in merging of action and awareness (M = 1.22, SD = 3.31) whereas the RT participants reported a decrease in this subscale (M = -2.0, SD = 3.61, Hedges D = 0.89 [-0.15,1.92], 1-B = 0.38); This represents a large effect size. There were no other significant differences between the MSPE and RT groups. ANCOVA revealed that Clear Goals showed a significant difference between groups, F (1,13) = 5.24, p < .05, partial n^2 =.29, with the MSPE group showing an increase (M = 2.11, SD = 2.89) and the RT participants reporting decreases in clear goals (M = -1.14, SD = 2.67, Hedges D = 1.10 [0.04,2.16], 1-B = 0.53); large effect size.

RCI analysis

The individual RCI scores showed that two MSPE participants demonstrated a reliable improvement in their trait and state flow scores and one of these showed a reliable improvement in trait mindfulness. Two participants also showed reliable decreases in mindfulness despite showing reliable increases in flow. No participants in the RT group showed any reliable changes in either three measures (See Table 2).

Phase 2 Post-intervention changes between groups

Mindfulness skills, F (1,13) = 5.18, p < .05, partial n^2 = .29, improved significantly more in the MSPE-S group (M = 4.00, SD = 5.13) compared to RT participants reporting decreases in clear goals (M = -2.11, SD = 4.81, Hedges D = 1.17 [0.10,2.23], 1-B = 0.58). This represented a large effect size. Also, in terms of presence, F (1,13) = 7.11, p< .05, partial n^2 =.35, the MSPE-S group showed a significantly higher improvement post-intervention (M = 2.00, SD = 2.38) compared to control group participants who reported decreases in presence (M = -1.11, SD = 1.45, Hedges D = 1.54 [0.42,2.67], 1-B = 0.81). This represented a large effect size. State emotion regulation pre and post change almost reached significance, F (1,13) =4.41, p = .06, partial n^2 =.25, in that the MSPE-S group reported increases in their

scores (M = 8.41, SD = 5.40) compared to control group who reported a decrease in clear goals (M = -4.22, SD = 10.35, Hedges D = 1.36 [0.27,2.46],1-B = 0.71. This represented a large effect size.

RCI analysis

The individual RCI scores showed that only one MSPE-S participant demonstrated a reliable improvement in their Sport Mindfulness score. One MSPE-S participant also showed a reliable increase in emotional regulation, compared to three control group participants who showed a decrease. No control group participants showed any reliable improvements in any of the three measures (See Table 3).

Discussion

This paper outlines two separate but related studies on the effect of mindful sport performance enhancement (MSPE) programs on dispositional and state flow state, mindfulness and competitive swimming performance in a group of adolescent swimmers. Overall, the results were promising, with some medium to large effects of the mindfulness practices and applications can bring about improvements in flow, emotional regulation and aspects of trait mindfulness.

The aim of phase one was to examine pre and post differences in trait/state mindfulness and trait/state flow after MSPE training in comparison to a relaxation intervention as a comparison group. The prediction that the MSPE group would show improved mindfulness and trait and state flow over the course of the programme showed partial support as there were differences over the course of the 8-week programme in selected flow variables. The most noted differences were large effect size improvements in the subscales 'loss of self-consciousness' (d=.90) and 'challenge-skill balance' (d=.84) followed by medium effect size differences in in 'global dispositional flow score' (D =.68) and flow characteristics (d =.74). These

results are partly consistent with research by Kee and Wang (2008) who found that athletes that scored highly in mindfulness, reported increased scores in the flow dimension of loss of self-consciousness. The RCI analysis revealed that two MSPE participants reliably improved in loss of self-consciousness relative to the RT group (no participants reported an increase in the subscale).

In terms of state flow ratings (the participants completed the flow measure immediately after a training session), there was also a large effect of the MSPE group significantly improving action and awareness merging ($D = 0.89$) compared to the RT group. This subscale involves a feeling of one and absorption with the activity of swimming. The RCI analysis showed that two MSPE participants significantly improved their action and awareness relative to two RT participants showing a decrease in this subscale. There was also a large effect of MSPE training on the *state* flow clear goals subscale ($D = 1.10$). This measurement of change implies that the swimmers in the MSPE group became more connected to task-relevant cues for performance, which is one of the three conditions thought necessary for flow to occur.

Of interest, the curiosity sub-scale decreased from week 4 to 8 for the MPSE group. From a mindfulness perspective, curiosity is the cognitive ability to be attentive to external stimuli by being sensitive to the environment, alert to new information and to create new categories to organise observations (Langer & Moldoveanu, 2000). This decrease during weeks 4 and 8 may reveal participant's initial engagement and interest in a novel program and the nature of meditative practices in encouraging open-minded curiosity and self-awareness in the early stages of mindfulness practices which then decreased. This could suggest that 4 weeks may

be an optimal period of practice for mindfulness in youth athletes which should then be followed by application of these techniques in practice.

The loss of self-consciousness flow subscale is theoretically related to attention regulation which is one of the two key components of mindfulness (Bishop et al, 2004). This component reflects a lack of concern about what others are thinking, reducing the possible negative influence of social evaluation and thus enhancing concentration. As both the trait flow characteristics and total flow variables both showed medium effect size improvements, these findings are broadly consistent with flow theory relating to the ability to sustain attention and remain in the flow state (Csikszentmihalyi, 2002). Brown and Ryan (2003) suggested that mindful individuals are less effected by introjections and experience a loss of self-consciousness more readily (Kee and Wang, 2008). However, the effect of the meditative practices did not appear to have a significant effect on trait-mindfulness (Kaufmann et al, 2009). However, it is important to note that the swimmers in this case study reported relatively high trait mindfulness at baseline which could be as a consequence of their sport specific training given that swimming is rhythmic and requires long periods of prolonged solitary training. In our sample it appeared that the intervention assisted participants in bringing about the characteristics necessary for optimal flow experiences as a result of their existing mindfulness ability and the further refinement of these skills developed in training sessions.

In phase two of the mindfulness training, it was expected that we would find that the MSPE-S would significantly improve general and sport-specific mindfulness skills, relative to the control group. There was some support for this prediction as there were medium effects of MSPE-S on general mindfulness and presence relative to the control group. The presence subscale items focus on openness to experience

and feeling connected to the here-and-now. This is conceptually similar to the merging of action and awareness subscale in the DFS-2 that was found to significantly improve as a result of mindfulness training in phase two of the intervention. Openness and presence (attuning to the present moment experience regardless of positivity or negativity) are likely distinct constructs from acceptance (allowing the situation to 'be' without attempting to control or change it). Other related research by Bernier, et. al. (2009) found that elite swimmers reported acceptance of bodily sensations before competition. However, the swimmers in the current sample were pre-elite youth national swimmers who are likely to initially begin to be open to the present moments of experiences in training and competition before learning acceptance of positive and negative states. This case study implies that the ability to be present and thereby focus on interoceptive pacing cues and motor skill patterns is important for developing youth swimmers, as they are in a period of relative rapid growth. The applied importance of this skill is therefore twofold; a) to attend to changes and refinement in motor skill learning and support them in retaining their 'feel' of the water and ability to attend to the fluidity of one's swimming stroke in a time when physical growth makes this more challenging. This ability is deemed a key component in developing excellence and ability; b) to promote pacing awareness through presence with pacing cues. In summary, mindfulness is likely to be helpful for athletes to maintain presence and awareness of subtle changes when coaching practices are implemented or when they experience development in physique and growth.

It is important to note that in phase one, where the traditional Kaufmann, et. al., (2009) 8-week classroom-based mindfulness training protocol was used, mindfulness skills did not significantly improve in the intervention group and in some

cases they significantly decreased. It could be that with our adolescent sample, they were unaware of their skill ability to begin with, and the mindful activities brought about increased awareness which may have then changed their perceptions of how skilful they really were with this strategy. The Dunning-Kruger Effect (Johnson, Kerri, Joyce & Kruger, 2003) asserts that as people increase their knowledge, they become less certain of their competence as their minds are opened to a body of new knowledge and experience in essence, how little they know of that area. It is possible that by swimmers increasing awareness of thought content through mindful observation in the workshop practices, they experienced an increase in mindful skill knowledge and therefore an associated initial self-reported decrease in their perceptions of mindfulness skills. This has important applied implications in that mindfulness skill tools may be less helpful to monitor change in youth athlete mindfulness training programmes than psychometrics that examine theoretically relevant sport specific constructs such as Flow. Our case study found that the phase one 8-week mindfulness for sport training programme, did bring about significant improvements in trait and state flow. The swimmers reported a significant increase in curiosity and this specifically increased and developed between weeks 4 and 8. They also reported an increase in merging of action and awareness and clear goals. The reported increase in optimal psychological states associated with flow would suggest that the swimmers did experience a benefit from the mindfulness skills training protocol. It would be useful to utilise fMRI or EEG tools to identify brain activity changes post-mindfulness training and correlations with self-reported changes in skills.

In phase two, an applied mindfulness training protocol was used, whereby mindfulness training scripts were developed and tailored according to the

psychological, technical and physical demands of swimming races. The phase two intervention was focused on the mindfulness principles of non-judgemental acceptance, present-moment awareness and balance, and primary anchors that were co-developed by the sport psychology practitioners, swimmers and coach.

It is important to note that the relatively small sample sizes in both phase 1 and phase 2, may detract from the power of the statistical findings and therefore caution should be applied when considering the generalisability of our statistical findings. Having said that, our findings tentatively suggest that there does appear to be merit in the success of mindfulness practices with adolescent high performance swimming populations. Moreover, flow-state is a theoretically and practically relevant construct in high-performance swimming. A further noteworthy limitation is that we included self-report measures and although their underpinning psychometric properties have received support in previous research, the use of these tools with adolescent populations requires further exploration. In order to mitigate for social desirability effects, we emphasised the need for honest reports and reflections from the athletes and the confidential nature of their individual responses.

Practitioner reflections

Our experiences were that competitive swimmers prefer tangible and concrete practices and goals and therefore struggle initially with the practice of accepting and refraining from attempting to strive to change them. This attempt to control thoughts was reported by swimmers in the early stages of mindfulness practices and appeared to coincide with their self-reported increases in meta-cognitive self-awareness (meta-cognitive ability). This change was also mirrored in the psychometric measures; some swimmers self reported increases in mindfulness subscales that examined their attempts to control thoughts. We therefore recommend two suggestions for

practitioners, a) to be aware and accepting that this initial change may occur, and is likely to subside with continued practice and b) they could counter this effect by providing another stimulus other than one's thoughts in mindfulness practices; i.e., active mindfulness practices where the goal is sensory experiences while moving. These more 'active' mindfulness exercises were reported to be more beneficial and increased the engagement of all swimmers in phase 1. In summary, we suggest that youth sports participants can benefit from active mindful practices that include anchors of neuromuscular or physiological/movement exercises. We also found that swimmers were keen to understand the end-goal and evidence-base for the use of mindfulness exercises. They reported finding that they were sitting still and struggling to achieve any progress and as such there was a sense of lost time reported. We addressed this barrier to engagement by outlining evidence-base practices and making comparisons with their physical training that were relatable e.g., when adopting or altering a new or existing technical skill such as the freestyle entry, a level of unfamiliarity and uncertainty can lead to the questioning of the validity of the training. We recommend that youth athletes respond well to tangible and comparable experiences that they have had within their sport.

A secondary recommendation comes from the finding that the applied swimming scripts used in the pool in the second phase of the intervention appeared to be preferred by the swimmers. We found that the collaborative nature of phase 2; i..e, the coach and practitioners contributed to and tailored the phase 2 mindfulness scripts. This process was predominantly led by the sport psychologist consultant with a competitive swimming background. We also recommend that applied sport mindfulness interventions are implemented after athletes have experienced some initial exposure to classroom-based mindfulness skills. This provides an opportunity

for athletes to become familiar with the mindfulness terminology, practices and decide upon their own preferred anchors and structures for practice (e.g., the breath or muscular interoceptive cues). This study provides a novel example of how applied sport psychology practitioners can develop a sport specific mindfulness intervention and combine mindful tools with coaching and training practices in rhythmic sports such as swimming. The sport specific mindful instructions included present moment awareness and acceptance scripts that allowed the athlete to understand pre-performance sources of stress prior to competition using mindful techniques. It provides a template for the design and application of mindfulness training with youth athletes and recommendations for sensitive and evidence based measures of psychological change.

Conclusion and summary

This innovative two phase mindfulness intervention approach provides an example of a skills based and applied practice in swimming that could provide a guide for mindfulness interventions in various sports. Some evidence suggests that interventions should be tailored according to the sporting demands and research supports that mindfulness is beneficial for rhythmic sports. This case study therefore could provide a basis for mindfulness application in other rhythmic sports with bilateral movements such as; gymnastics, running, cycling or rowing. Moreover, athletes may be more likely to engage with sport psychology application if they practice it alongside their physical and technical training which allows for contextual relevance and tangible methods and tools to apply in practice. We provided swimmers with detailed scripts that targeted each aspect of a swimming performance from marshalling, pre-race preparation and each stage of a race: detailed start scripts, main swim race phases and techniques to rehearse in training in preparation for the

National target meet. Given these practices were rehearsed alongside their typical swimming training, there was no additional time burden/commitment for the swimmers. This was particularly helpful at a high physical training volume period in their training cycle. The continuation of traditional mindfulness skills allowed for a progressive application of the mindfulness techniques. In summary, this case study provides support for the use of both general and sport specific MSPE interventions (in a progressive structured format) for swimmers as a strategy that may improve mindfulness skills and flow state experiences.

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