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NEUROPHYSIOLOGICAL, PSYCHOLOGICAL, SPORT AND HEALTH DIMENSIONS OF THREE MEDITATION TECHNIQUES

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ABSTRACT

The aim of this study was to record experiences of three meditation conditions: Ratio Breathing, Transcendental Meditation and Zazen, with special reference to sport, health, neuro-physiology and sense of coherence. The participants (N=9), seven males and two females were all British, actively competing across a range of individual and team sports, with no experience of using meditation techniques or practices in their sporting or daily lives. Their mean age was 31.56 years with an age range of 22 to 44 years. The study employed a within-subjects, repeated measures design, with each participant practising each meditation condition in a randomly counterbalanced order. Integrative findings support the value of all three meditation conditions for health and to a lesser extent for sport, especially with regard to their effect on focus. All three meditation conditions were associated with a decrease in respiration. The differential effect of the meditations was apparent. Participants valued Ratio breathing for its effect on concentration, Transcendental Meditation for its depth of meditation and Zazen for its effect on self and removal of external distractions. These qualitative findings were associated with differentially significant quantitative effects on lowered respiration rate in the Ratio Breathing group, increased physical relaxation and alpha activity in the Transcendental Meditation group, and increases in both alpha and theta activity in the Zazen group.

Key words: Ratio Breathing; Transcendental Meditation; Zazen; Consciousness; Phenomenological.

INTRODUCTION

The word „meditation“ derives from the same Greek and Roman roots as the word medicine: in Latin *meditari* means to contemplate or reflect (Hussain & Bhussan, 2010). Most wisdom, spiritual and/or healing traditions value some form of meditation and/or contemplation for transforming consciousness (Wilber, 2000, 2007). For example, in Christian contemplative prayer, Godhead becomes realised through silence and repetition of a meaningful word or phrase (Keating, 1997). In Buddhism, meditative practice is an end in itself with the journey to enlightenment viewed as a noble pursuit. Although many meditative practitioners may not

experience enlightenment, retrospective phenomenological accounts indicate that feelings of relaxation, stillness, emptiness and tranquillity characterise an individual's experience during meditation (Travis & Pearson, 2000). These hedonic qualities have in turn been associated with positive neurological, physiological, psychological, health and sport outcomes (Murphy, 1992; Murphy & White 1995; Benson, 1997, 2000; Travis & Pearson, 2000; Wilber, 2001a, 2001b; Ivey *et al.*, 2002; Watson & Nesti, 2005; Schreiner & Malcolm, 2008; Albrecht, 2011; Edwards, 2012, 2013a).

There exists an established literature extolling the benefits associated with employing breath based meditation techniques (Rama *et al.*, 1979; Cysarz & Bussing, 2005; Edwards, 2012). These approaches typically require participants to engage in a period of controlled breathing whilst directing awareness to bodily sensations (movement of the diaphragm, air flow in and out of lungs) and/or employing an associative or dissociative attentional focus (Wilber, 2000; Edwards, 2012). Such techniques have been routinely employed by communities in Africa, India, China and elsewhere for centuries. The writings of eminent yogis, monks and spiritual leaders has provided a wealth of ideographic data testifying to the efficacy of employing such meditation interventions (Reid, 1998; Mutwa, 2003; Iyengar, 2005). In Patanjali's yoga sutras, breathing exercises (*pranayama*) constitute the fourth limb of yoga, which provides a base for advanced meditation practices, such as withdrawal of external sense awareness (*pratyahara*), control of attention and intention (*dharana*), sustained concentration and witnessing awareness (*dhyana*), and absorption into unity consciousness (*samadhi*) (Iyengar, 2001, 2005; Chopra & Simon, 2004; Horan, 2009). Breath control has become established practice in health and sport psychology, particularly in relation to arousal control, anxiety reduction and, in Western countries, cognitive behavioural techniques, such as mindfulness, many of which have older African and Asian roots (Edwards & Edwards, 2007; Edwards & Sherwood, 2008; Marks, 2008; De Perillio *et al.*, 2011; Edwards & Beale, 2011; Weinberg & Gould, 2011). Such practice has been supported by modern scientific evidence that a decreased breath ratio of five to seven breaths per minute is associated with enhanced autonomic nervous system balance and heart-brain concordance (Yasuma & Hayano, 2004; Cysarz & Bussing, 2005; Breslin & Lewis 2008; Stanley, 2009).

Meditation traditions have often been categorised into broad overlapping categories, such as concentration and mindfulness meditation (Dunn *et al.*, 1999; Horan, 2009). Analysis of four traditional Electro-encephalography (EEG) frequency bandwidth data, delta, theta, alpha and beta, have empirically demonstrated strong mean amplitude frequency differences between concentration and mindfulness forms of meditation. These correspond to unique forms of consciousness, with mindfulness meditation producing more EEG activity, including relatively slower delta and theta activity, as well as relatively more fast, alpha and beta activity (Dunn *et al.*, 1999). At the level of technique, a good case can be made for concentration and mindfulness as dimensions existing along orthogonal axes (Ivanovski & Malhi, 2007). Concentrative meditation has a convergent focus through use of some form of mental device, such as a mantra, body sensation, breath, or specific image. Mindfulness meditation, especially the pioneering work of Kabat-Zinn (1994, 2003), has increasingly become the focus of research over the past two decades (Shapiro *et al.*, 2005), and typically involves divergent, objective witnessing of consciousness and experience that is typical of Vipassana and Zen. To some extent, these categories represent early and later patterns of

Hindu and Buddhist traditions, early and later phases of meditation practice, as well as methods employed by beginner and experienced meditation practitioners respectively.

Clearly there is considerable overlap. Some typically concentrative types of meditation, such as Transcendental Meditation, which uses a mantra, and Soto Zen, which uses breath, may also involve objective witnessing mindfulness and higher or deeper meditation stages, such as cosmic and unity consciousness (Wilber, 2000; Alexander, 2005; Cysarz & Bussing, 2005). In addition, both yogic and Zen traditions may include practices, which begin with some form of conscious breath work. In the present study, three relatively distinct meditation techniques are postulated. Transcendental Meditation is viewed as a concentrative technique and Zen Buddhism as a mindfulness technique. The third technique is Ratio Breathing, around six breaths per minute, as popularly employed by prominent sports coaches to promote health, team unity and optimum performance (Dunn *et al.*, 1999; Watson & Nesti, 2005; Albrecht, 2011).

Although a wealth of phenomenological, social constructionist reports have been published examining outcomes associated with Zazen, Transcendental Meditation and Ratio Breathing based interventions, relatively less is known about the neurological and physiological correlates of different meditation practices in sport and health contexts. In keeping with the Vedanta view that meditation involves fourth (*turiya*) and non-dual (*turiyatita*) states of consciousness (Wilber, 2007), research indicates that mindfulness and concentration meditations are associated with EEG signature patterns that reflect qualitatively different states of consciousness (Badawi *et al.*, 1984; Benson, 2000), that are distinct from eye closure relaxation conditions (Dunn *et al.*, 1999). However, there is a relative dearth of research indicating the consistent evidence based effectiveness of such meditations under controlled, experimental conditions (Ivanovski & Malhi, 2007; Horan, 2009; Hussain & Bhussan, 2010). This relative dearth of knowledge and some inconsistent findings provided the motivation for the present research.

RESEARCH PROBLEM

The aim of this study was to compare the effectiveness of three meditation conditions, Ratio Breathing, Transcendental Meditation and Zazen, with special reference to their influence on selected neuro-physiologic and psychological variables in the context of sport and health. In view of the relatively inconsistent research findings, and the essentially exploratory nature of this study, the null hypothesis was set for all comparisons.

METHODOLOGY

Approach

Integral philosophy (Wilber, 1997, 2000, 2007) provides the overarching theoretical framework for this study. Wilber's AQAL model, which is shorthand for all quadrants, all levels, refers to a comprehensive approach that integrates quadrants and levels, as well as lines, states and types of consciousness (Wilber, 1997, 2000, 2007). The AQAL model postulates an essentially non-dual, spiritual-material universe, with 4 quadrants, reflecting interior and exterior aspects of the individual and collective. The fundamental linkages in this

universe are called holons, which are always both wholes and parts of other wholes, at various levels of consciousness experienced as matter, body, mind, soul and spirit. Wilber's (2007) integral methodological pluralism (IMP) transcends and includes theoretical, paradigmatic perspectives, such as positivism, interpretivism and social constructionism, and their related research methods (Terre Blanche *et al.*, 2006). It may be argued that when studying human phenomena one needs to adhere to the principles that define rigorous scientific method, as for example, established by Popper (1959). Objectifying any human, wholly personal or unique experience provides insight that can then be evaluated by peers offering opportunities for future work to build on, and extend understanding in a given area. Qualitative approaches provide a rich source of data that enables a researcher to access the „lived experience“ of the participant (Giorgi, 1970; Moustakas, 1994; Munroe-Chandler, 2005).

Participants and ethics

The participants (n=9), 7 males and 2 females with a mean age of 31.56 years, and age range from 22 to 44 years, all competed on an amateur basis across a range of individual and team sports. The participant group represented a convenience sample recruited via responses to posters displayed in the psychology department at the first author's institution. The participant group were all British and indicated that they had no experience of using meditation techniques or meditative practices in their sporting or daily lives. The participants signed consent forms and the study was granted ethical clearance by the institution referred to previously.

Apparatus

An Infiniti Thought Technology bio-feedback and neuro-feedback apparatus (Thought Technology, Ltd., Montreal Canada), was used to monitor and record the neuro-physiologic data. This apparatus distinguishes and records numerous physiological and electroencephalographic variables. It was particularly suitable for recording baseline and meditation data for the dependent physiological variables of blood volume pulse (BVP), muscle tension/relaxation as recorded on electromyography (EMG), respiration rate (RES) in-breaths per minute, as well as EEG data bands of delta (0-3 hertz or cycles per second), theta (4-7 hertz), alpha (8-12 hertz), beta (13-30 hertz) and gamma activity (above 30 hertz).

Measures

Physiological, neurological, psychological and phenomenological data recorded in this study were measured in the following way.

Physiological variables

BVP was taken from the index finger of the non-dominant hand. The participant's RES was recorded using a belt with strain gauge placed around the lower abdominal region in order to record diaphragmatic breathing. EMG electrodes were placed on the participant's trapezius muscle on the dominant side of the body.

Neurological variables

Electro-encephalography (EEG) was used to record neural activity across delta, theta, alpha, beta and gamma frequencies. Clasp electrodes were placed on each ear lobe with one open cup electrode being located in the area between the somato-sensory and motor cortex (CZ). This region was selected as it has been implicated in the experience of „flow“ (Csikszentmihalyi, 1990), and sense of coherence (Antonovsky, 1987; Bischoff, 2008).

Psychological variables

Sense of Coherence (SOC) was reported using a shortened 9-item version of Antonovsky's (1987) scale, with a Cronbach alpha reliability coefficient of 0.79. This abridged version has been shown to demonstrate high internal reliability and concurrent validity when assessed against Antonovsky's original 29 item measure (Klepp *et al.*, 2007). Participants reported their feelings in relation to items, such as “Do you have the feeling that you don't really care about what goes on around you?” (one of 9 items), employing a 7-point Likert scale anchored by *very often* and *very seldom*.

Phenomenological variables

After completion of each experimental condition, the participants were required to respond in writing to 4 open-ended questions using a maximum of 6 lines for each question: 1) Describe your experience of the (*enter experimental condition*); 2) What value do you feel (*enter experimental condition*) may have for your sporting performance?; 3) What value do you feel (*enter experimental condition*) may have for your health?; and 4) What was your favourite condition and why? (The latter question was completed after the last trial condition only.) The participants were also invited to attend a focus group session scheduled for after the study had been completed that sought to explore the group's experiences of the 3 meditation conditions. The focus group took place in a classroom on university premises and was facilitated by the lead author.

Design and procedure

The study employed a within subjects, repeated measures design with 3 levels of the independent variable: Ratio Breathing (RB), Transcendental Meditation (TM) and Zazen Meditation (ZM). Each participant visited the laboratory to receive an initial briefing detailing the requirements for their involvement in the study. At this time the participants were attached to the Infiniti Thought Technology equipment so that they would become familiar with the experimental set-up prior to the first testing session. The lead author, who has experience in the delivery of meditative practice, then provided the participants with a description of the 3 meditation techniques and the main principles underpinning the use of each condition. The participants were provided with a description of the 3 meditation techniques and the main principles underpinning the use of each condition. The participants were then lead through a period of application whereby each technique was trialled. The meditation techniques were delivered by a member of the research team who has expertise in the area and has extensive experience in the use of such approaches with a range of sportspersons. After each meditation technique had been trialled, the participants were invited to ask any questions that they may have regarding the use of the technique. At the end of the familiarisation period, the participants received a hand-out confirming the elements comprising each meditation technique. The participants was then instructed to practise each

meditation technique for 20 minutes on a daily basis over the course of the following week. All of the meditation conditions were practised and trialled with the participants seated and with their eyes open. The following are descriptions of the meditation techniques.

Ratio Breathing (RB)

The participants were required to regulate their breathing such that an in-breath lasted for 3 heart beats and an out breath for 7 beats. Following this sequence, the participants were required to establish a cyclic breathing pattern that equated to roughly 6 breaths a minute. The participants were instructed that they should direct their attention to the flow of breath, become attuned to the rhythm of their heart beat and synchronise these 2 activities. This approach has been used extensively in psycho-therapeutic interventions and has been shown to promote feelings of balance, control and access to higher states of consciousness (Yasuma & Hayano, 2004; Cysarz & Bussing, 2005; Breslin & Lewis, 2008; Stanley, 2009; Edwards, 2012, 2013a).

Transcendental Meditation (TM)

The TM condition required participants to witness their experience while slowly repeating the mantra “aum”. The participants were informed that the duration of each cycle of the mantra should last for roughly 5 seconds and that the mantra should be repeated silently and in continuous cycles for the 20-minute experimental period. There was no stipulated time period between the end of completion of the mantra and the start of the next cycle with the only instruction being that the period should remain consistent, be comfortable and be limited to a few seconds. The construction of the TM condition was based on guidelines established by Iyengar (2001, 2005).

Zazen Meditation (ZM)

The participants were requested to sit in a chair with an erect posture with their hands placed in front of them on their laps, forming the “cosmic mudra” (grasp the thumb of the non-dominant hand with the fingers of the non-dominant hand and to wrap the fingers of the dominant hand around the outside of the non-dominant hand). With their arms at a comfortable position away from the torso the participants fixed their gaze on a spot on the ground roughly 2 metres in front of the chair. In Zazen there is no established or forced breathing pattern but participants were instructed to breathe using their lower abdomen whilst specifically directing their awareness to the sensations and movements of the belly during breathing. The participants were instructed that they should seek to transpose their consciousness allowing for a sinking effect such that their awareness moves from their head to the navel area. Guidelines for establishing the correct breathing, posture and hand positions were taken from Suzuki (1956).

The participants returned to the laboratory a week later and indicated on a 9-point Likert scale (9=*totally adhered*, 1=*not adhered*), the extent to which they had adhered to the practice requirements over the course of the previous week. This indicated that the participants had engaged in the process (M=8.2; SD=0.5), and that the time spent practising had been equal across the 3 conditions. Each participant then assumed a seated position. The Infiniti© Thought Technology equipment was applied. At this stage the participants completed the SOC scale based on how they were feeling at that specific point in time. Having completed the questionnaire, a rest period of 4 minutes followed in which the participants were

instructed to remain motionless. Recordings taken during this time served as a baseline measure for each experimental condition. Each participant then commenced the meditation condition to which they had been assigned for that trial and remain in this condition for 20 minutes, an optimal time period for meditation (Edwards, 2012, 2013a). All meditation conditions were performed seated in a comfortable position, with the participant's back to the experimenters and with the eyes open. After completion of the period of meditation the participant was requested to return his/her consciousness to the present and complete the SOC scale in addition to the 4 questions outlined in the phenomenological measures. The participants returned to the same room at the same time on 2 further occasions to repeat the procedure with the other 2 meditation conditions. The order of the experimental conditions was randomised across participants. A focus group was conducted with all participants the week immediately following the completion of the experimental data collection from the meditation conditions.

Data analysis

Integrated qualitative and quantitative, subjective and objective analysis of the individual and collective data was performed via the following steps:

1. Phenomenological analysis based on the participants' written descriptions, focus group discussions and researcher notes (Giorgi, 1970; Moustakas, 1994);
2. Individual written accounts and verbatim focus group transcripts were analysed into the smallest naturally occurring units of experience (nmu's);
3. Each individual's description of the meditation experience was summarised;
4. Nmu's in relation to each meditation condition that emerged spontaneously across individual and group accounts were clustered together;
5. Participants' quantitative, individual neuro-physiologic recordings were analysed;
6. Group neuro-physiological recordings were analysed. All quantitative measures (EEG, EMG, BVP, respiratory rate and sense of coherence) were analysed via a 2 (time: pre vs. post) x 3 (condition: RB vs. ZM vs. TM), within subjects multivariate analysis of variance. Follow-up univariate analyses with a Bonferroni corrected significance level were completed where appropriate. All preliminary analyses were conducted with significance set at $p < 0.05$;
7. Individual and group, qualitative and quantitative data were integrated, analysed and discussed; and
8. The completed research paper was given to each participant for critical reading and feedback. This also served as an ethics, validity and integrity audit.

RESULTS AND DISCUSSION

Qualitative findings

Qualitative findings follow in the form of question driven, phenomenological analysis of the participants' individual descriptive, smallest, naturally occurring units of experience (nmu's), which are numbered for each participant. Individual profiles are followed by synthesis into collective profile themes for each treatment condition and question with an audit trail of

natural meaning units. The 9 participants are coded from A to I with regard to individual experience.

Ratio Breathing

Description of experience:

- Felt relaxed and very sleepy! It's an easy technique to do. (B:1)
- Comfortable and relaxing. Quite difficult to get the breathing timing right. (K:1)
- Calming and peaceful. (I:1)
- It was very relaxing but hard to focus on technique. I was tired, felt like I wanted to fall asleep. (J:1)
- Conscious breathing rhythm and timing feel relaxed and calm and slightly disorientated. (C:1)
- Strange for 20 minutes, struggled to remain „present“ as I was constantly evaluating whether I was falling asleep or not. (D:1)
- Relaxing, approaching „sleepy“, calm. (H:1)
- It was extremely calming and relaxing. Around half way through I went to a deeper level in that everything turned black – this sounds weird but I saw myself as a child and I had a big smile on my face. I felt very happy at this point. Session went very quickly. (E:1)
- I found the experience difficult to maintain. I felt my breathing pattern was varying throughout the 20 minutes of meditation. I did feel that I could not concentrate on the thoughts in my head as I had to concentrate on my breathing pattern. (A:1)
- Relaxed, sleepy. (B:1)

Participants experienced Ratio Breathing as very relaxing and calming. Some struggled with the breathing pattern, others transcended this.

Value for sporting performance:

- It could take away some of the nerves prior to competing. (B:2)
- Increase focus and meditation. (I:2)
- Reduce anxiety before competition. (J:2)
- Reduce anxiety – help positive sleep and recuperation by reducing the factors that may affect these. (C:2)
- Useful, though 20 minutes would feel too long. Being able to zone in quickly and finding the techniques rhythm would be useful. (D:2)
- I felt I was able to block external stimuli with this method and was able to concentrate on the task. This would probably transfer over to sporting activity. (E:2)
- Potentially providing calm period to focus more during performance. (H:2)
- It may enable me to control my breathing pattern to a better extent as this is something I have never focussed on or thought to keep at a certain rate. (A:2)
- Refocus during a competition. (B:2)

Participants valued Ratio Breathing for sport to reduce or prevent anxiety, increase focus and concentration, block external stimuli, assist sleep, control and calm.

Value for health:

- It could be beneficial as I am a stressful person. (B:3)
- Decrease stress and decrease anxiety. (K:3)
- Stress relief. (I:3)
- It was positive on health. I very rarely sit and just relax. Normally busy doing something. (J:3)
- Reducing anxiety and improving health through better sleep. (C:3)

It was very good. Focussed time to relax and free my mind, undisturbed for a period of time, is a rare treat. (D:3)

Potentially reduce resting blood pressure (systolic/diastolic) and reduce resting heart rate. (H:3)

I felt extremely relaxed and calm after. Regular sessions like this would probably enhance resting heart rates and blood pressure so being good for cardiovascular health. Felt much calmer mentally – didn't have the grumpiness that I started out with so that's good too. (E:3)

I have never felt the need to perform a specific meditation technique and I am not convinced of any benefits it may have for my health. (A:3)

Could have a positive impact. (B:3)

Participants valued Ratio Breathing for health to decrease stress, anxiety, heart rate, blood pressure and negative mood, increase focus and concentration, assist with meditation and calm.

Transcendental Meditation

Description of experience:

Hard to concentrate on mantra. I feel very relaxed and slightly tired. (J:1)

I zoned in and out of being able to focus on the chant. Little distracted by external sounds though not a big problem when practising. (D:1)

Calmness, peace, restful. (I:1)

Despite my best efforts this session irritated me for some reason. I didn't feel particularly relaxed and was very aware that I was part of the environment – I felt very much on the surface of it all. I found it a distraction to focus on the mantra. (E:1)

Comfortable, relaxing. (K:1)

I found this condition to be the most relaxing of the sessions yet completed as it helped focus my meditation in my head rather than my body (breathing). (C:1)

I found the meditation method difficult to maintain. I found myself losing concentration as time progressed and found that a longer period passed between performing the „mantra“. However, when I remembered I continued in the mantra but not that they were performed at regular intervals as planned. (A:1)

Calm, somewhat sleepy, refreshed none the less. (H:1)

Participants experienced Transcendental Meditation as relaxing. Some found it very relaxing, but most struggled with the mantra, distraction, zone, focus and concentration.

Value for sporting performance:

Increasing focus, could use with imagery. (J:2)

As a runner, very useful before or after training runs. (D:2)

It may improve focus and relieve stress before a competition. (I:2)

I wouldn't use this type, it irritated me and I kept feeling distracted. (E:2)

Reduce anxiety, help clear the mind of the small matters involved in daily living. (C:2)

As I found myself losing concentration I am not sure this type of meditation would help. Saying that, however, when I did perform the mantra it stopped me from thinking about other things and ideas in my head which was a comforting break from my normal state of mind. (A:2)

Potential value in busy times to take breaks and relax the mind. (H:2)

Participants valued Transcendental Meditation for sport to relax, clear and focus the mind, reduce anxiety and stress. Some found it distracting and irritating, others valued its use as distraction, and combined with imagery in competition.

Value for health:

High value to health. (J:3)
 High value for stress relief. (I:3)
 I don't think this would benefit me much. (E:3)
 Decrease stress and decrease anxiousness. (K:3)
 Reduce anxiety and include time in the week for peaceful thought and reflection. (C:3)
 As I found it difficult to maintain I am not sure of any potential health benefits. However, as it forced me to stop thinking about current concerns, issues and workload it may help me to put things in perspective upon completion. (A:3)
 Potential decrease stress hormones, resting heart rate, systolic blood pressure, gain greater meditation. (H:3)

Participants highly valued Transcendental Meditation for health, stress relief, anxiety, heart rate, blood pressure, as well as assist with peaceful thought and awareness control.

Zazen Meditation*Description of experience:*

Very tired and sleepy post intervention. (H:1)
 Stress relieving, calm. (I:1)
 Comfortable and relaxing. (K:1)
 A lot of external distractions but was relatively easy to keep focus on breathing technique. (D:1)
 Relaxing, 20 minutes feels very long. (B:1)
 Difficult at first to focus and I periodically was aware of my mind wandering. When focussed on breathing I felt quite tired and yawned quite a bit. Was aware that my heart rate felt faster than usual. (E:1)
 Was able to maintain focus for at least three prolonged periods and sensed that I was moving into a meditative state at these points. Following the condition I feel slightly floaty-peaceful. (C:1)
 I found it hard to focus on purely abdominal breathing as this is my „norm“ – deep, quiet, strong. I, therefore, tended to have numerous thoughts, ideas and planned activities running through my head so I did not feel as relaxed as in the other techniques. (A:1)

Participants experienced Zazen as stress relief, calming and relaxing. Some found it hard to focus, while others became involved and meditative and peaceful.

Value for sporting performance:

Immediately - I do not feel ready for vigorous activity; Long term - potentially relaxing effect. (H:2)
 Helps focus. (I:2)
 Good for pre-performance routines though not useful during performance. (D:2)
 Could be useful between rounds at a competition. (B:2)
 With practice it would calm and focus the mind on the task at hand. (E:2)
 To block out unnecessary worry of everyday (trivial) matters – to aid in restful sleep. (C:2)
 As I found it difficult to truly relax I am not sure what effect this meditation session would have on my sporting performance if any. (A:2)

Participants valued Zazen for sport in terms of pre-performance routines, between rounds at competition, for meditation, focus and sleep.

Value for health:

- Lower resting heart rate/blood pressure. (H:3)
- Decreases stress. (I:3)
- Decrease stress, decrease anxiety and increase happiness. (K:3)
- Good for relaxing, reduced tension. (D:3)
- Could be beneficial. (B:3)
- Again, a calming experience that takes you away from manic external stimuli. (E:3)
- Anything that can reduce anxiety/stress should be good in reducing risk factors for CVD, etc. (C:3)
- Again, as it was difficult for me to maintain and to feel my self-consciousness I doubt it will have any value or positive health benefits. (A:3)

Participants valued Zazen for health, to reduce stress, anxiety, heart rate, blood pressure and cardiovascular risk.

What was your favourite condition and why?*Ratio Breathing (RB):*

- Harder to do but very relaxing. (K:4)
- I felt like I had disappeared for a while and although I was aware of the environment I didn't feel part of it. I felt extremely relaxed and calm. (E:4)
- Found it easier to focus on it. (B:4)
- Felt more relaxed from this method than the others but also felt alert at which the others I felt rather tired. (H:4)
- Easier to stay focussed and the meditation and less likely for mind to wander. (I:4)
- I found concentrating on heart rate and mantra difficult. I would say that all conditions were effective though. (J:4)

Six of the 9 participants preferred Ratio Breathing for its effect on meditation, focus and concentration.

Transcendental Meditation:

- Transcendental was my favourite condition as I found it easiest to reach a deeper state of meditation when focussing on a sound in my head. This seemed to correspond to my breathing pattern which also seemed more smooth and rhythmic. (C:4)
- Due to my inability to maintain a relaxed state I felt the third state (transcendental) to be my favourite as it gave me something to focus on and stopped me from having any normal, alternative thoughts. (A:4)

Two participants preferred Transcendental Meditation for its effect on depth of meditation and focus.

Zazen Meditation:

- Having the mind focussed on myself and my breathing removed a lot of external distraction. (D:4)

One participant preferred Zazen for its effect on self, focus and removal of external distraction.

Focus group summary

There was consensus regarding the potential usefulness of the 3 meditation techniques with words such as "tranquil", "immersed" and "vacant" typically describing the experiences of the participants. A number of participants agreed with respect to the difficulties experienced

in establishing a relaxed state and then maintaining this for the full 20 minutes. There was a split in terms of the technique that was deemed the easiest to maintain with a roughly even spread of participants reporting a preference for each approach. The benefits for health were deemed to be more prevalent than for sport with the group questioning the usefulness of the techniques for sport performers. It was felt that significant refinement would be needed before the techniques could be used in an applied setting. The participants felt that all 3 approaches might be useful for performers when trying to relax at night or the day before a competition.

Quantitative findings

Multivariate analysis of variance with pair wise t-test comparisons were employed to analyse both the neuro-physiological data and responses to the sense of coherence scale across the 3 meditation conditions. Parametric analyses were computed based on 3 considerations:

1. Inspection of the Kolmogorov-Smirnov statistic indicated that the null hypothesis be accepted ($p > 0.05$) for all measures;
2. The level of measurement that the data represented; and
3. The acceptance that analysis of variance is considered to be robust enough to withstand violations of normality (Vincent, 1999).

Neuro-physiologic and sense of coherence findings

Neuro-physiological data were coded for blood volume pulse in mean number of beats per minute (BVP), muscle tension or meditation as measured on the electro-myograph (EMG), respiration in terms of mean number of breaths per minute and electro-encephalographic (EEG) activity in terms of percentage delta activity (0-3 hertz or cycles per second), theta (4-7 hertz), alpha (8-12 hertz), sensory-motor activity (SMR) (13-15 hertz), beta (16-30 hertz) and gamma (above 30 hertz).

Sense of Coherence data were scored for the total scale (SOC), as well as for the subscales, Meaningfulness (ME), Manageability (MA) and Comprehensibility (CO). Pre- and post-test means and standard deviations (SD) for the 3 treatment conditions, Ratio Breathing (RB), Transcendental Meditation (TM) and Zazen (ZM) appear in Table 1.

Multivariate analysis revealed a significant within group effect ($N=9$) for respiration decreases ($F=33.61$, $p=0.000$, $\eta^2=0.58$), for alpha increases ($F=10.01$, $p=0.004$, $\eta^2=0.29$) and a weak effect for theta increases ($F=4.107$, $p=0.054$, $\eta^2=0.146$). However, between groups analysis only revealed one significant finding. Tukey LSD test indicated significant differences in respiration (RES) between Transcendental Meditation and Ratio Breathing at the post-test ($t=4.08$, $p=0.0270$). Inspection of Table 1 indicates that this significant finding is associated with the relatively greater mean decreases in the Ratio Breathing condition than in the Transcendental Meditation condition.

In order to examine significance within groups pre- and post-test effects further, pair wise t-tests were run on each of the 3 groups separately. This indicated that the Ratio Breathing was associated with significant decreases in respiration. The Ratio Breathing condition pre-test respiration (15.2 ± 3.7) was significantly higher than post-test respiration (9.6 ± 3.4), with $t(8)=4.13$, $p=0.003$. Secondly, the Transcendental Meditation condition was also associated with significant decreases in respiration, from pre- (15.4 ± 3.2) to post-test (13.7 ± 3.0), with

$t(8)=3.50$, $p=0.008$, as well as significant decreases in muscle tension EMG from pre- (6.1 ± 5.6) to post-test (3.12 ± 2.6), with $t(8)=2.6$, $p=0.032$, and significant increases in alpha activity from pre- (12.5 ± 7.4) to post-test (14.5 ± 8.6), with $t(8)=2.73$, $p=0.026$. Finally, the Zazen was also associated with significant decreases in respiration from pre- (14.9 ± 3.1) to post-test (12.8 ± 4.5), with $t(8)=2.81$, $p=0.023$, as well as increases in theta activity from pre- (13.1 ± 5.5), to post-test (15.5 ± 6.7), with $t(8)=23.0$, $p=0.017$. These significant differences are observable in Table 1. There were no significant differences pre to post across any of the 3 meditation conditions with respect to either total sense of coherence score or the 3 constituent subscales.

TABLE 1: RATIO BREATHING, TRANSCENDENTAL MEDITATION, ZAZEN: PRE- AND POST-TEST MEANS AND STANDARD DEVIATIONS (SD)

Variables	Ratio Breathing		Transcendental Meditation		Zazen	
	Pre-test Mean±SD	Post-test Mean±SD	Pre-test Mean±SD	Post-test Mean±SD	Pre-test Mean±SD	Post-test Mean±SD
BVP	67.5±11.4	66.3±9.1	68.6±10.6	66.3±9.0	71.8±14.0	70.8±12.2
EMG	2.5±1.4	3.2±1.7	6.1±5.6	3.15±2.6	4.3±4.5	3.1±2.8
RES	15.2±3.7	9.6±3.4	15.4±3.2	13.7±3.0	14.9±3.1	12.8±4.5
Delta	14.2±3.4	12.6±3.1	13.8±3.6	12.2±3.8	13.8±5.2	14.1±4.5
Theta	14.1±5.7	14.0±5.8	12.2±3.5	13.9±6.0	13.1±5.5	15.5±6.7
Alpha	12.2±6.3	14.4±9.2	12.5±7.4	14.5±8.6	12.2±7.0	14.6±8.7
Beta	12.9±9.9	10.2±7.0	8.4±2.4	8.9±2.7	10.8±8.1	11.1±8.1
Gamma	4.9±4.6	3.4±3.3	3.0±1.2	2.3±0.4	4.2±3.7	3.8±3.7
SOC	48.2±3.2	50.0±4.5	46.6±9.9	46.6±7.1	48.9±5.3	49.0±5.1
ME	15.8±1.8	15.8±2.3	14.9±3.4	14.7±2.4	16.0±2.3	15.8±2.9
MA	16.1±1.6	16.6±1.7	15.9±3.8	15.8±2.9	16.4±1.7	16.7±1.7
CO	16.3±1.5	17.1±2.3	15.8±3.3	16.1±2.5	16.4±1.9	16.6±1.7

BVP= Blood volume pulse; EMG= Electromyography; RES= Respiratory rate; Delta, Theta, Alpha, Beta, Gamma= Electroencephalography frequencies; SOC= Sense of coherence; ME= Meaningfulness; MA= Manageability; CO= Comprehensibility

Integrative findings

There was consensus regarding the potential usefulness of the 3 meditation techniques with words such as “tranquil”, “immersed” and “vacant” typically describing the experiences of the participants. Although the ideal of about 6 breaths per minute was not reached by any meditation condition, the integrated findings indicate the general value of breathing exercises in meditative, sport and health contexts. This finding supports related research on the

qualitative value of breath consciousness in health and sport settings (Edwards & Edwards, 2007; Edwards, 2012), the value, albeit limited, of quantitative relationships between breath-ratios, spirituality perceptions and health perceptions (Edwards, 2013b), as well as clinical observations by sport psychologists that sportspersons tend to favour breathing exercises as the most valuable form of psychological skill to be learned and practised (Edwards *et al.*, 2013). The integrative findings generally support the evidence that concentration and mindfulness meditations are distinct forms of consciousness (Dunn *et al.*, 1999). The findings also support the value of all 3 meditation conditions for health and to a lesser extent for sport, especially with regard to their effect on focus.

The differential effect of the meditations was apparent with regard to both qualitative and quantitative findings. Participants valued Ratio Breathing for its effect on concentration, Transcendental Meditation for its depth of meditation and Zazen for its effect on self and removal of external distraction. These qualitative findings correlate nicely with differentially significant quantitative effects on lowered respiration rate in the Ratio Breathing group, increased physical relaxation and alpha activity in the Transcendental Meditation group and increases in both alpha and theta activity in the Zazen group. Such findings provide some basis for the theory that the 3 meditation conditions reflect increasing meditation depth as implied in Patanjali's yoga sutras (Iyengar, 2001, 2005; Chopra & Simon, 2004), with associated differential neuro-plastic changes (Marks, 2008; Hallsband *et al.*, 2009). Patanjali's last 3 yogic limbs, collectively referred to as *sanyama*, may also provide a theoretical basis for the neuro-psychological connections between mindfulness and creativity (Horan, 2009). Such theoretical speculation could be tested in future studies, via appropriate research hypotheses generated from relevant operational definition, differentiation and manipulation of meditation conditions.

The integrated findings support the psychological value of meditation training with special reference to general experiences, sport and health (Benson, 2000; Wilber, 2001a, 2001b; Kabat-Zinn, 2003; Alexander, 2005; Schreiner, & Malcolm, 2008). To the extent to which the study satisfies qualitative research criteria of credibility and dependability, as well as quantitative research criteria of validity and reliability, integrated and/or triangulated validity claims apply with regard to research integrity, researcher reflexivity and quality assurance of the investigation as a whole. The fact that all findings are consensually validated by all participants also provides some reassurance towards the authenticity of the study as a whole. Integration of findings from qualitative and quantitative analyses facilitated understanding and interpretation of apparent similarities and obvious differences between individuals with regard to their experiential descriptions. As the number of participants was relatively small, as well as linguistically and ethnically biased, interpretation of findings should obviously be treated with much caution. Larger, randomised controlled studies, involving on-going meditation practice, with various participant samples, including advanced practitioners, as well as integrated and differentiated research methods are needed to generalise findings and strengthen validity claims.

A strength of the present study was the randomised, experimental design. The latter enabled operational definition of and differentiation between independent variables in the form of the three meditation treatment conditions, while keeping other conditions constant and observing change in dependent variables. While this may have satisfied some principles of experimental

design established by such classic luminaries as Popper (1959) and Kerlinger (1978), two limitations regarding maximal differentiation of meditation conditions, which possibly created confounding effects, need to be acknowledged. Firstly, all three groups separately were associated with decreases in respiration. The ideal breath-ratio of five to seven breaths a minute, which may have further differentiated the groups, was not achieved in the Ratio-Breathing group. An objective breath-ratio counter could have given the Ratio Breathing group an undue biofeedback advantage. However, more initial training could have been done to both achieve the ideal six breaths a minute breathing rate and differentiate the meditation conditions. Secondly, although delta and gamma activity did not increase in the TM group, the general increases in EEG alpha, theta and beta band activity in both TM and ZM groups, were more consistent with evidential patterns of mindfulness meditation, which produces relatively more slow delta and theta, as well as relatively more fast, alpha and beta activity than concentrative meditation (Dunn *et al.*, 1999).

These findings support the research of Horan (2009), who classifies TM as both a concentrative and mindfulness type of meditation. It also supports the findings of Tanner *et al.* (2009). These authors found that a three month TM program increased mindfulness skills significantly more than a waiting list control group. The neuro-physiological findings of meditation initially activating the middle bands of the EEG spectrum have also been reported in other studies (Edwards, 2012, 2013a, 2013b). As meditation deepens, Horan (2009) hypothesises that the transcendent observer, or witness, is associated with defocused, low alpha band activity. This integrates with the relative neural silence of delta activity in mirror-like, ground recognition and with gamma activity in binding integration of insights. Future research could control for this witnessing effect through the use of concentration or mindfulness measures, such as that of Wallach *et al.* (2006) and/or other standardised scales related to research hypotheses.

CONCLUSION

In conclusion, this study satisfied its main aim to record a small group of participants' experiences of three meditation conditions, Ratio Breathing, Transcendental Meditation and Zazen, with special reference to sport, health, neuro-physiology and sense of coherence. Integrative findings support the value of all three meditation conditions for health and to a lesser extent for sport. Larger, randomised controlled studies, involving on-going meditation practice, with various participant samples, including advanced practitioners, as well as integrated and differentiated research methods, are needed to generalise findings and to address the limitations of the present study.

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