Psychophysiological Interventions in Biathlon

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Introduction

Biathlon has been described as a complex sport that places huge demand on psychophysiological processes (Josefsson et al., 2021). Many psychophysiological factors have been explored in shooting sports (such as gaze behaviour and breathing patterns), however training these factors and determining their influence on shooting performance has been somewhat neglected. Therefore, the current project aimed to assess the influence of quiet eye (QE) and slow-paced breathing (SPB) educational interventions on shooting performance in biathletes.

Slow paced breathing

SPB is an accessible relaxation technique where athletes slow their breathing rate to six cycles per minute (Laborde et al., 2022). This has an increasing effect on the parasympathetic system (the output of which can be measured by heart rate variability, a measure indicating self regulation). Athletes using SPB have experienced positive influences on performance in the short term (Mosley et al., 2023) and long term (Gross et al., 2017).

Quiet eye

QE was defined by Vickers (1997) as the final fixation that is located on a specific location or object within 3° of visual angle for a minimum of 100ms. Research has shown that skilled performers can be taught to develop more effective QE periods, with subsequent improvements in performance (Adolphe et al, 1997; Harle & Vickers, 2001), although QE in biathletes shooting performance has so far produced mixed results (Heinrich at al., 2020; Vickers and Williams, 2007).

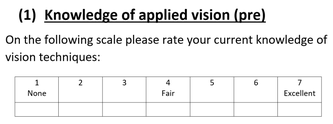
Methodology

- 9 biathletes from the development squad for British Biathlon (mean age=18.11, SD=3.01, 6 male). All fit and well, no known variables that could influence the intervention e.g. heart conditions, visual impairment. All gave consent to participate.
- Measures:

eMotion Faro
Heart rate variability measurement

Tobii 2 Pro
Eye tracking measurement

Laser gun (Kiwi Precision Evolution LV1L)
Shooting performance measurement



(1) **Knowledge of applied vision (pre)**

On the following scale please rate your current knowledge of vision techniques:

1 None	2	3	4 Fair	5	6	7 Excellent

Likert scales
Knowledge pre and post educational workshops

- The study took place over six consecutive days during a snow-based training camp. For a full overview of the procedure please see Figure 1.
- Following the intervention and shooting performance screening, participants took part in a focus group which aimed to assess their perceptions of the interventions and how they felt they had influenced their shooting performance.

Results

The results of the shooting data show that there was a significant improvement in performance from baseline to final shooting assessment which took place after both intervention workshops ($Z = 2.34$, $p=0.02$). There was no significant difference found between the improvements bought about by each intervention ($U = 3$, $p=0.08$). Means and standard deviations can be seen in Table 1.

Eye-tracking data was limited but did show that QE duration increased following both interventions, but most following the QE intervention.

Contrary to expectations, a decrease in RMSSD was seen post the SPB workshop.

Perhaps the results of most interest are those from the focus group and the changes in knowledge reported following the workshops. Figure 2 shows large increases in knowledge relating to all aspects of the interventions following the workshops.

Results from focus groups indicated that SPB and QE enhanced performance. Mechanisms were suggested relate to using relaxation, enhancing gaze control, and managing distracting thoughts. Barriers to integrating interventions related to old habits, role models, and practice.

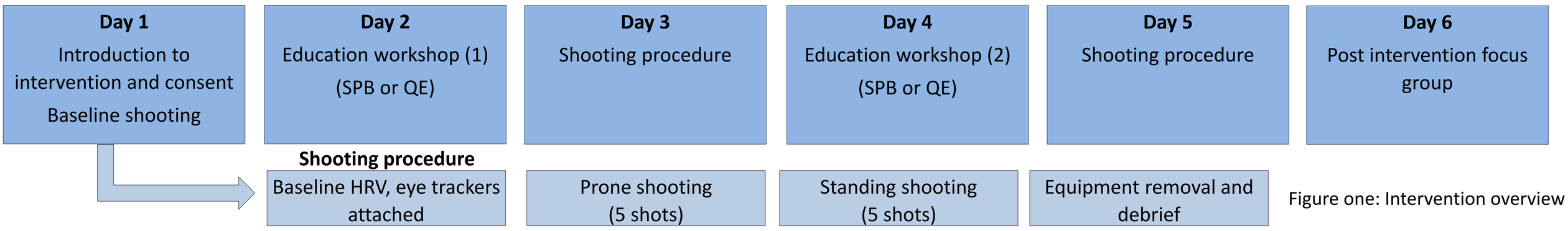


Figure one: Intervention overview

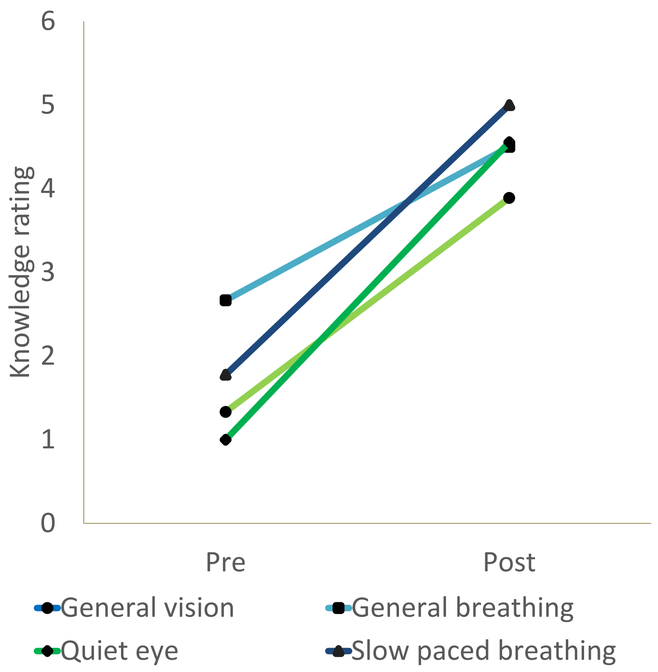


Figure two: Knowledge differences pre vs post intervention (all relationships $p < 0.05$)

"With the shooting aspect, a lot of us were going in with rapid breathing which stimulates you and realistically I wanna be relaxed. So in shooting when I wanna be relaxed it's (SPB) really useful"

"I had no idea about how detailed it could be and I thought you just look through the scope and you fire, but now (with) quiet eye and holding it onto the gaze for that extra millisecond I have noticed a difference in my success rate on the range"

Athlete quotes from focus groups

Table 1:
Means and standard deviations of shooting scores (out of a maximum of 10).

Baseline	Post-QE intervention	Post-SPB intervention	Final test
7.22 (1.2)	8.56 (1.13)	8.45 (1.42)	8.78 (1.09)

Concluding Remarks

The results of this intervention-based study found that workshops in both SPB and QE bring about improvements in shooting ability in Biathlon athletes. Due to limited numbers, it was not possible to statistically determine which of the two workshops bought about greater improvements in performance and this should be investigated further.

Athletes also showed increases in knowledge relating to both vision and breathing as well as reporting how they plan on using the skills learned during competitions.

It is possible that each of the workshops influenced the other, with athletes potentially holding their gaze for longer, in time with their SPB and vice versa.

Future research should investigate the broader effects of each intervention on other psychophysiological outcomes.

Based on the findings of this study we would recommend educational workshops on SPB and QE be implemented, initially for Biathlon coaches, and then for athletes in order to improve shooting performance.

SCAN FOR REFERENCES

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