The impact of physiological stress on performance effectiveness and processing efficiency in a video-based badminton-anticipation task: From testing to training

David B. Alder[1], David P. Broadbent[2], Jamie Poolton[1]

[1]Leeds Beckett University; [2]Brunel University London

Introduction

Expert performance in badminton requires athletes to consistently produce superior motor and perceptual-cognitive performance (e.g., anticipation, decision making) over an extended period. During the final stages of a match, players are subjected to heightened physiological stress. Success may be, in part, determined by an athlete's ability to maintain performance under such conditions. The current project comprises two experiments. Firstly, we examined the impact of badminton-specific physiological stress on perceptual-cognitive anticipation in badminton, and key underlying mechanisms, such as gaze behaviour (Casanova et al., 2013). The second experiment investigated the effects of combining anticipation training in badminton with high physiological stress to see if there are any benefits of training under stressors that are common to the performance environment (Alder et al., 2016).

Method

Experiment 1: Elite level badminton players (N = 13) responded to life sized video clips of elite level badminton players performing overhead smash shots, which occluded at racket-shuttle contact point. Players were required to physically (via a shadow shot) and verbally respond to 48 trials (6 blocks of 8 trials). Immediately prior to each trial, a badminton-specific exercise protocol was completed, which replicated the physiological stress demands of an in-competition rally (Bottoms et al., 2012). As a result, the physiological stress placed on the players progressively increased through testing. Response accuracy (RA), gaze behaviour, heart rate (HR), rated of perceived exertion (RPE), and mental effort was collected.

Experiment 2: 10 players from Experiment 1 were randomly assigned to one of two training groups. Players assigned to the *combined* training group (n = 5) completed a video-based anticipation training intervention (similar to Experiment 1) whilst experiencing heightened physiological stress induced by the badminton-specific exercise protocol. Players assigned to the *independent* training group (n = 5) also completed the anticipation training intervention and the badminton-specific exercise protocol, but not together. A post-test, which was identical to Experiment 1, was used to evaluate the effectiveness of the training interventions.

Results

Experiment 1: HR and RPE significantly increased across the six test blocks, p = .002 and p < .001 respectively, suggesting that the badminton-specific exercise protocol had effectively increased players experience of physiological stress. Heightened physiological stress was accompanied by a significant increase in perceived mental effort, p = .001. With regards to RA, only in the final block of testing, when physiological

stress was highest, was the groups average performance at no better than chance levels, $p = .20$. Interestingly, the gaze behaviour underpinning performance also changed significantly across test blocks, $p < .001$. Specifically, a relatively greater number of fixations of shorter duration were observed towards the end of testing when physiological stress was highest.

Experiment 2: Players in the combined training group showed a greater positive change in RA in the final block of the post-test than players in the independent training group, $p = .03$. The performance change was accompanied by a change in gaze behaviour. Players in the combined training group showed a reduced number of fixations of longer duration in the post-test, which was similar to their gaze behaviour when the physiological stress was lower. In contrast, the training intervention appeared to have had no effect on the gaze behaviour shown by players in the independent training group under heighted levels of physiological stress. 1

Discussion

Experiment 1 showed that physiological stress reduces processing efficiency as athletes increase mental effort, possibly in an attempt to maintain efficient visual search strategies. However, there is a level of physiological stress at which athletes appear unable to sustain neither efficient nor effective perceptual-cognitive performance (Casanova et al., 2013). Experiment 2 provided evidence that training perceptual-cognitive anticipation skill under heightened physiological stress can negate the debilitating effects of physiological stress. The findings support the notion that purposeful exposure to the stressors that commonly accompany performance, in this case heightened physiological stress, may have a positive adaptive effect on visual attentional processes (Alder et al., 2016); although any performance gains were limited to the specific level of physiological stress experienced in training. From an applied perspective, this project highlights the negative impact physiological stress can have on perceptual-cognitive skills in badminton and suggests that coaches should carefully design training environments that replicate the physiological demands of competition.

References

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