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The BASES Expert Statement on the Effectiveness of Vision Training Programmes

Produced on behalf of the British Association of Sport and Exercise Sciences by Dr Nicholas Smeeton, Dr Jenny Page, Dr Joe Causer, Dr Mark Wilson, Dr Rob Gray and Prof Mark Williams.

Introduction

Two types of vision training programmes exist, namely, generalised vision training (GVT) and sport-specific vision training (SVT). GVT programmes are designed to improve basic visual function (e.g., depth perception, motion perception and peripheral vision). A range of exercises is typically used by vision specialists such as optometrists and ophthalmologists. Although these specialists usually work to assist individuals with visual deficiencies, more recently the same methods have been used with athletes in an effort to improve sports performance. Whilst there is anecdotal support for the use of GVT programmes, there remains a paucity of empirical evidence to suggest that such training improves sports performance. Conversely, research on SVT has been shown to lead to task-specific improvements in sports performance (Smeeton *et al.*, 2005; Williams *et al.*, 2002). Here, we summarise scientific research that examines the utility of both types of training programmes for performance enhancement in sport.

Vision training

The rationale for using GVT is that improving basic aspects of visual function will lead to improvements in the performance of perceptual-motor skills that use the functions being trained. For example, exercises that improve an individual's general ability to detect objects in peripheral vision will improve skills such as playing basketball. In GVT it is not necessary to include/represent the specific sport context as part of the training intervention (i.e., sport-specific images are typically not employed).

In contrast, SVT aims to improve the ability to detect, discriminate, and/or identify the specific sources of visual information involved in a particular athlete's sport. For example, rather than using abstract stimuli to train an individual's ability to detect the direction of a moving object, sport-specific stimuli are employed to improve a goalkeeper's ability to detect the direction of motion of a shooter's hip during a football penalty kick.

The first stage in the development of SVT programmes typically involves using experts from within the sport to identify the specific sources of information used during successful performance on the task (i.e., the expert-model approach). Next, interventions are developed that use sport- and task-specific video simulations to ensure that these specific information sources are captured. *In situ* instructions are given to highlight the most useful places to extract information from the visual display and link this information to actions and outcomes. The effectiveness of these training interventions relies on the development of a comparable knowledge base and visual strategy to that employed by the expert model(s).

Support for generalised vision training

The evidence used to support GVT is limited due to the fact that very few researchers have demonstrated a causal link between improvements in visual function and subsequent changes in sports

performance. Indeed, the majority of researchers have employed correlational designs. In the USA, Clark *et al.* (2012) examined whether GVT exercises improved the batting performance of baseball players over two consecutive seasons in the National College Athletic Association. The GVT programme included exercises designed to improve depth perception, saccadic eye movements, accommodation and vergence. Significant increases were reported for several performance metrics following training. While such findings suggest a possible link between GVT and improvements in sports performance, the absence of adequate control and placebo groups precludes definitive conclusions from being drawn.

The majority of intervention studies using GVT programmes in the sports domain do not support the utility of GVT (see Abernethy, 1996; Williams & Grant, 1999 for reviews). Schwab and Memmert (2012) reported that a group of young field hockey players who participated in a 6-week intervention that included practice using a Dynavision D2® Trainer, Eyeport, Vision Performance Enhancement Program, Hart Charts and P-Rotator improved performance on the same visual test on which they trained. However, there was no improvement on a functional field of view task or an additional measure of transfer (multiple object tracking). Using a randomised, placebo-controlled design, Abernethy and Wood (2001) reported that while participants who underwent one of two GVT programmes did improve performance in a stationary sport-specific transfer test (by 7.25 %) participants in a control group who received no vision training also improved (by 3.3 %). To provide stronger support for the efficacy of GVT programmes, researchers need to ensure that appropriate control and experimental groups are employed so that a cause and effect relationship between GVT and performance can be ascertained.

While there is a lack of evidence for the efficacy of GVT programmes in improving sports performance, such interventions may be useful to redress imbalances (e.g., eye dominance) or deficits in normal visual functioning. The tests used in many GVT programmes could be valuable for screening/testing vision in sport. There may be instances when the visual system of an athlete is not functioning properly and, as a result, sports performance (and general health) might suffer (e.g., Goodrich *et al.*, 2013). GVT for screening and health purposes must not be ignored.

Support for sport-specific vision training

When sport-specific visual stimuli are used there is some evidence that training does improve sports performance (see Causer *et al.*, 2012 for a review). Williams *et al.* (2002) trained anticipation of tennis groundstrokes using film-based sport-specific vision (perceptual) training. They demonstrated that anticipation could be trained through video feedback of key visual stimuli from the opponent's action. Not only did anticipation performance improve above that seen in a matched-ability intervention group, but these improvements transferred to an on-court test of anticipation

(the training group's mean responses were 0.187 s quicker than reported for the control and placebo groups). Hopwood *et al.* (2011) demonstrated that highly skilled cricket players who received visual-perceptual training in conjunction with on-field training, demonstrated greater improvements in *in situ* fielding tests (catching success improved by 21.7 % from pre- to post-test) compared to those who received on-field training alone (catching success improved by 16.2 % from pre- to post-test).

Additionally, studies examining eye-gaze behaviour in sports requiring accurate aiming have shown that skilled performance is linked to having a longer and earlier 'quiet eye' (final fixation prior to the critical movement) on the relevant target location. Training interventions designed to increase this quiet eye dwell time not only successfully enhance task performance (above technically-focused interventions) in laboratory settings, but also transfer to competitive sports settings (see Causer *et al.*, 2012; Vine *et al.*, 2012 for reviews). An important advantage of quiet eye training is that the eye movements are trained *in situ*. However, as with other SVT programmes, the performance improvements routinely do not generalise to other tasks (Smeeton *et al.*, 2005; Williams *et al.*, 2002). In conjunction with the lack of support for GVT, these findings suggest that benefits arise due to specific ('software') rather than generalised ('hardware') improvements (Abernethy & Wood, 2001). Without task-specific knowledge about the salient visual information, the benefits of having more effective general visual functioning in individuals with already healthy visual function are unlikely to be realised.

Conclusions and recommendations

- Generalised vision testing is useful in screening for deficits in visual functioning. Such tests should be conducted by qualified practitioners (e.g., optometrists, ophthalmologists).
- While GVT may improve an athlete's performance on a general test of visual function, there is no peer-reviewed evidence to support the transfer of this improvement to sports performance.
- SVT has been shown to have performance advantages when compared to control and placebo groups across a range of sports. These advantages appear to be task-specific.
- When considering evidence for any vision training intervention, it is important to gauge whether good practice has been followed. Have placebo and control groups been used and has transfer of performance to the competitive situation been measured? Correlational and anecdotal accounts should be interpreted with caution. ■



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