The effect of sport specific exercises on the visual skills of rugby players

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Abstract— **Introduction:** Visual performance is an important factor in sport excellence. Visual involvement in a sport varies according to environmental demands associated with that sport. These environmental demands are matched by a task specific motor response. The purpose of this study was to determine if sport specific exercises will improve the visual performance of male rugby players, in order to achieve maximal results on the sports field. **Materials & Methods:** Twenty six adult male rugby players, aged 16-22, were chosen as subjects. In order to evaluate the effect of sport specific exercises on visual skills, a pre-test - post-test experimental group design was adopted for the study. **Results:** Significant differences ($p \leq 0.05$) were seen in the focussing, tracking, vergence, sequencing, eye-hand coordination and visualisation components **Discussion & Conclusions:** Sport specific exercises improved visual skills in rugby players which may provide them with an advantage over their opponents. This study suggests that these training programs and participation in regular on-line EyeDrills sports vision exercises (www.eyedrills.co.za) aimed at improving the athlete's visual co-ordination, concentration, focus, hand-eye co-ordination, anticipation and motor response should be incorpotated in the rugby players exercise regime.

Keywords— Rugby players, sport specific exercises, visual skills

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I. Introduction

Sport has become an increasingly competitive field of expertise, making it is imperative that an athlete is able to perform at the highest level possible at all times [1]. As a result, coaches and athletes alike are constantly searching for new and innovative ways to enhance the sporting performance of the athlete, in the ultimate quest for sporting excellence [2]. However, the unanswered question still stands, "How do exceptional athletes arise? How do we explain the full range of human athletic ability, from forgettable to incredible?" [3]. Variation in athletic/sporting performance can often be viewed as a complex interaction between psychological, physiological and socio-cultural factors which interact over the long term to have a resultant effect on the phenotype of the athlete [3]. The importance of a fortuitous genetic predisposition cannot be downplayed [3], however, this genetic component is non-modifiable. Some of the broad spectrum modifiable factors which may influence performance can include: home life [4]; work [3],[4]; friends [4]; sport training (load) [1]-[8]; fitness levels [3],[1]; climate [2],[4]; sleeping patterns [4],[9]; recreation [11], overall general health [11], dietary habits [2],[10]; stress [2],[4]; central nervous system functioning [2]; energy production [2] and visual skills [6],[7],[11]-[14].

Visual skills is a factor which has received much attention in recent years and Revien and Gabor [15] have even alleged that visual training in an athlete might well make the difference between winning and losing. However, evidence is still conflicting in terms of what level of visual skills is required

for success [5]. The visual system is regarded as such a fundamental role player in performance because it serves to acquire all the information from one's surrounding environment and then acts as the basis for the execution of the appropriate motor tasks [16].

Visual processing involves an amalgamation of the central nervous system, skeletal-muscular system and the visual system [5],[16]. Ferreira[17] claimed that many psychologists choose to separate the skills of the visual system into two distinctive components i.e. hardware and software systems. The software (cognitive aspects) often include visual concentration and perception, visual reaction time, visualisation and central peripheral awareness, whereas the hardware components are seen to include the non-task specific abilities, such as accommodation, fusion, depth perception, ocular health and visual acuity [17]. It must be noted that the visual skills required will vary according to the sport in question and subsequently demand the use of different aspects of visual processing, but the basic steps in the pathway will remain unchanged. In terms of rugby and most sports, it is the cognitive aspects which ultimately distinguish the novices from the experts [17]. In rugby, many of the visual skills which form the software component become especially important i.e. eye-hand coordination, central peripheral awareness, visual concentration and reaction time [17]. At present, little is known regarding the effects of exhaustion on the visual system – especially in terms of athletes.

Much research has been conducted to prove that exercise is associated with reductions in various physiological measures of stress as well as psychological parameters such as depression and anxiety [18]. However, the effects of physical activity/exercise on cognitive function is less widely substantiated by empirical research [18]. The belief that performance is associated with arousal levels has been a long standing topic of psychological research. Earlier critiques of literature reviews by Tomporowski and Ellis [19] failed to find any empirical evidence to support the notion that exercise does in fact have a significant positive influence on performance [19]. However, much research has been conducted since then and in a more recent literature review conducted by Tomporowski [19], it was found that results of empirical studies suggest that acute bouts of exercise can selectively facilitate multiple cognitive processes i.e. under certain conditions, exercise can enhance response accuracy and response speed as well as facilitate the cognitive processes which are central to goal orientated actions and problem-solving [19]. However, the effects are dependent on the type and duration of exercise being performed. Cognitive function will not be significantly impaired under intense anaerobic exercise conditions; however, submaximal aerobic exercise which results in dehydration will compromise memory as well as information processing function [19]. Although exercise does not directly influence the operations which are involved in the initial stages of the processing of information, moderate levels of steady state aerobic activity can facilitate particular stages of information processing - especially the decision making stage [19]. Studies show that faster choice responses have been observed in both simple [20]-[26] and complex tasks [27]-[30] during and after exercise/physical activity [19]. From this it is suggested that acute bout of physical activity/exercise improves an individual's ability to block information which they perceive to be irrelevant and respond only to task relevant information [31],[32]. Thus, acute bouts of exercise/physical activity are hypothesised to function in a manner which is similar to that of psycostimulant drugs – they do not directly manipulate the computational processes required for information processing, but rather they "produce changes in state processes that are responsible for the allocation of attentional resources" [19]. The duration of exercise also becomes significant in that exercise/physical activity produces increased plasma levels of neurohormonal substances (such as epinephrine and norepinephrine) which have been associated with cognitive functioning [23]. The length of time these remain circulating in the blood stream and rate of production differs from short bouts of exercise and steady state bouts of exercise [33],[34]. Thus, duration and intensity are two important factors which can influence cognitive function – especially in athletes. The purpose of this study was to determine the effect of sport specific exercises on the visual skills of rugby players**.**

II. METHODS AND MATERIALS

A. Subjects

Subjects were recruited from an International Rugby Academy to participate in this study. Testing was requested by the Academy and permission was granted for the use of the data. The study consisted of 26 participants . Pre- and Post exercise visual skill testing was performed on the group. Participants were aged between 16-22 years of age and differed with regards to ethnicity.

B. Inclusion criteria

Male subjects currently enrolled at the Academy; Subjects who accurately completed the relevant pre-test questionnaires; Subjects who were willing to take part in the various testing procedures; Subjects who accurately read, understood and signed the relevant informed consent documentation

C. Exclusion criteria

Any disorder which included: cardiovascular, muscular or respiratory; Subjects who were unwilling to complete the relevant pre-test questionnaires; Subjects who were unwilling to participate in the various testing procedures; Subjects with incomplete informed consent documentation; Subjects with any form of visual disorder

D. Procedures

Prior to testing procedures, participants were asked to complete and sign informed consent forms and complete general questionnaires regarding biographical and medical information. A further three pre-test questionnaires were

completed: sports competition anxiety test, a nutritional assessment and an exercise/fitness lifestyle evaluation. These served to give an overall indication of each subject's relative nutritional status, fitness, emotional health and overall wellness. The pre- and posttest visual skills testing included visual acuity, focusing, tracking, vergence, sequencing, visualization, eye-hand coordination and hand ball toss [1],[35],[36]. The sport specific exercises between the pre- and post-test visual skills evaluations comprised of sit-ups (amount per minute), push ups (amount per minute), turn and catch, push up to catch, step test (three minutes) and passing for accuracy [1]. The exercises (>6 METS) were performed for 60 min at an average of 82% of maximum heart rate [1]. Monitoring heart rate is an easy and reliable method for determining effort during exercise [1]. Using this specific aerobic training intensity, a good aerobic fitness base could be achieved without applying unnecessary stress on the body, thus decreasing risk of injuries as well as limiting the effects of fatigue which could have affected post-test results. The Housand telemetry heart rate system was used as a means of monitoring physical activity by enabling one to set clear, precise and observable limits on physical activity which are, to a degree, able to be self-controlled [1]. Pre-and post-test results were then pooled for analysis and comparison was carried out using the Paired Samples T-test ($p \leq 0.05$).

III. RESULTS

The results of pre- and post-test components/ tasks were assessed and the paired samples t-test analysis are shown in Table 1. Significant differences in pre- and post-test performances are denoted by an asterisk.

TABLE I
PRE- AND POSTTEST RESULTS FOR VISUAL SKILLS COMPONENTS

	Pre-test		Post-test	
	Mean	**SD**	**Mean**	**SD**
Focussing (letters/min)*	43.85	20.45	55.81	17.13
Tracking (letters/min)*	52.08	11.52	58.35	14.28
Vergence (cm)*	2.30	1.98	1.52	1.04
Sequencing *	1.88	0.82	2.31	0.93
Eye-hand coordination (s)*	18.18	7.49	15.05	6.32
Visualisation (s)*	18.64	7.92	12.17	3.36

***p≤0.05**

IV. DISCUSSION

The athletic ability of an athlete is also largely dependent on the hand-eye-coordination of the individual [1],[5],[7],[8],[14]. If the information fed from the eyes to the brain is incorrect, performance will be negatively affected due to an inability to focus clearly, inability to rapidly process visual information and an inability of the eyes to quickly change focus [13]. Consequently, this can be especially detrimental in the game of professional rugby. Reductions in the visual skills and coordination category can be attributed to overall poor vision, emotional/psychological stress, poor nutrition and hydration status, poor sleeping patterns and reduced exercise/fitness levels. However, following the vigorous sports specific exercises performed by the group, results showed improvements in post-tests which suggest improvements in visual skills (Table 1). Significant differences were seen in the focussing, tracking, vergence, sequencing, eye-hand coordination and visualisation components ($p \leq 0.05$). These results confirm the possibility that physical exercise can infact aid in improving mental performance [26]. This strengthens Tomporowski's [18] above mentioned suggestion that under certain conditions, acute bouts of exercise can selectively facilitate multiple cognitive processes such as response accuracy and speed and facilitate the cognitive processes central to goal orientated actions and problem solving [18]. Thus, even although some of the post-test results such as focussing (mean post = 55.81letters/min), tracking (mean post = 58.35letters/min) and sequencing (mean post = 2.31correct sequences) were well below average when compared to the International norm, there was a significant difference between pre- and post-test means ($p \leq 0.05$) which lends support to the study aim that vigorous sports specific exercises (>6 METs) will possibly have an effect on performance related parameters required for sporting excellence.

V. CONCLUSION

This study was carried out in order to determine the effect of vigorous sports specific exercises (>6 METs) on performance related parameters required for sporting excellence. Results showed that the visual skills tend to increase following vigorous sports, specific exercises (>6 METs). Thus athletes need to engage in correct training programmes which include sports specific exercises in order to achieve and maximise sporting excellence.

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