Eye & Contact Lens

The effect of sporting experience on an eye-hand coordination task using the Sport Vision Trainer (SVT™)

--Manuscript Draft--

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Abstract:	Objectives: The purpose of this study was to determine if sporting background and expertise has an impact on rate of improvement on a previously validated familiarisation strategy. If the training of eye-hand coordination can be enhanced, there exists a potential to benefit the games player or athletes' sports performance. Methods: Sixty two sports participants (male n=50, female n=12) of varying sport experience and abilities volunteered for the study. Participants attended one session of approximately twenty minutes in length consisting of four trials using the SVT™. Each trial consisted of six measurement runs. In each trial, stimulus presentation consisted of a centrally programmed sequence of 20 consecutively illuminated lights (the centre 16 lights, 4 by 4 array). The time to hit the sequence of 20 lights was recorded in milliseconds. Results: Pearson's r revealed no significant relationship between years of sporting experience and difference in means between Trial 1(T1) and Trial 4(T4) (r (62) =-0.134, p=0.300), nor between training hours per week and difference in means between T1 and T4 (r=0.023, p=0.859). Limits of Agreement analysis shows that absolute reliability is increased between T4-T3 compared to T2-T1. The LoA indicates that the error decreased between the three respective trials: ±0.92 (95% CI, -1.21, +2.39 sec), ±0.91 (95% CI, -1.47, +2.09 sec), ±0.72 (95% CI, -1.00, +1.82 sec). Conclusion: These findings suggest that the SVT™ can be used as a familiarisation strategy for testing eye-hand co-ordination independently of the sporting background, expertise or experience of the participant.

The effect of sporting experience on an eye-hand coordination task using the Sport Vision Trainer (SVT™)

Abstract

Objectives: The purpose of this study was to determine if sporting background and expertise has an impact on rate of improvement on a previously validated familiarisation strategy. If the training of eye-hand coordination can be enhanced, there exists a potential to benefit the games player or athletes' sports performance. *Methods:* Sixty two sports participants (male n=50, female n=12) of varying sport experience and abilities volunteered for the study. Participants attended one session of approximately twenty minutes in length consisting of four trials using the SVT™. Each trial consisted of six measurement runs. In each trial, stimulus presentation consisted of a centrally programmed sequence of 20 consecutively illuminated lights (the centre 16 lights, 4 by 4 array). The time to hit the sequence of 20 lights was recorded in milliseconds. *Results:* Pearson's *r* revealed no significant relationship between years of sporting experience and difference in means between Trial 1(T1) and Trial 4(T4) (r (62) =-0.134, p=0.300), nor between training hours per week and difference in means between T1 and T4 (r=0.023, p=0.859). Limits of Agreement analysis shows that absolute reliability is increased between T4-T3 compared to T2-T1. The LoA indicates that the error decreased between the three respective trials: ±0.92 (95% CI, -1.21, +2.39 sec), ±0.91 (95% CI, -1.47, +2.09 sec), ±0.72 (95% CI, -1.00, +1.82 sec). *Conclusion:* These findings suggest that the SVT™ can be used as a familiarisation strategy for testing eye-hand co-ordination independently of the sporting background, expertise or experience of the participant.

Keywords: Psycho-motor Performance; Visual Motor Coordination; Reliability

Reaction Time; Test-Retest Reliability

Introduction

Eye hand co-ordination is a critical aspect of sport vision as it affects both body and timing control[1]. Simple reaction times in the retinal periphery have recently been shown to be improved with training, and this training effect is retained following cessation[2]. If the training of eye-hand coordination can be enhanced, there exists a potential to benefit the games player or athletes sports performance. Research has also identified differences of eye-hand co-ordination within sport for different ages[3-4] and within elite sport[5]. Early reviews of the literature identified that athletes have consistently exhibited better visual abilities than non-athletes[6-7], and that reaction time is a discriminator between expertise levels[8,3,9].Contemporary research corroborates this trend[10] indicating similar findings within a sporting context. Gender appears to have no effect on eye-hand visual reaction times[10-11].Measurement devices vary and sports vision practitioners have access to numerous visual-motor devices that claim to measure and train eye-hand coordination, for example: The Wayne Saccadic Fixator (Wayne Engineering, Illinois, USA); Dynavision 2000 (Dynavision International LLC, Ohio, USA); Vision Coach™ (Perceptual testing INC, San Diego, USA); Sanet Vision Integrator (HTS Inc, Arizona, USA); Batak (Quotronics Ltd, Horley, UK) and the Sport Vision Trainer (SVT™) (Sports Vision Pty Ltd, Sidney, Australia). However there is little[12] or in some cases no standardisation of protocols or assessment techniques. Reliability studies are therefore limited and research would benefit from understanding the effect of familiarisation and learning effects on such devices to enable separation of improvement and allowing validity of future research. Typically, some amount of biological error is always present with continuous measurements[13], it is therefore important to identify and assess technical error. The SVT™ has been shown to exhibit such test-retest reliability in a recently conducted study[14]. The purpose of this study was to determine if sporting background and expertise has an impact on rate of improvement on a previously validated familiarisation strategy.

Materials and Methods

Prior to familiarisation and testing sessions, all procedures were explained and demonstrated. Participants were asked to attend one testing session lasting approximately twenty minutes using the SVT™ (32 Light, Sports Vision Pty Ltd, Sidney, Australia).

Participants

Sixty two sports participants (male n=50, female n=12) volunteered for the study. Abilities ranged from collegiate to national standard in a variety of team and individual sports (Mean experience: 7.58±4.72yrs; mean weekly training hours (4.87±2.65hrs) (Table 1). Vision health questionnaires[1] assessed suitability for inclusion in the study, and any suspected visual impairments or difficulties were referred to an optometrist. Participants were excluded if presenting with recent shoulder, wrist or finger injury (within last six months). All included participants reported normal visual acuity either unaided or while wearing their own corrective lenses. All experimental procedures were approved by the Institutional Ethics committee prior to testing. All participants were informed of the risks and procedures of the investigation prior to giving written informed consent. Principles of the Helsinki Convention were adhered to at all times.

Testing Procedures

During the task, participants stood centrally in front of a panel of 32 touch-sensitive red light emitting diodes (LED's) of the SVT™ (135 cm in length, 18 cm in width, 60cms in height) positioned in a landscape format (Fig. 1) with height standardised for male (at 1.77cm) and female (164.4cm) participants[15]. The ambient light in the room set at 420 Lux (Sport Vision, 2012) using a Lux light meter (CEM DT-1300, Shenzhen, China). Participants attended one session of approximately twenty minutes in length consisting of four trials using the SVT™. Each trial consisted of six measurement runs. The four trials were separated by a ten second break and each measurement run was separated by a five second break. The first two measurement runs were practice runs, means of the last four measurement runs were displayed at the end of the each trial. Participants were required to touch each randomly

illuminated light to extinguish it. Participants were instructed that the aim was to extinguish the sequence of lights as quickly and as accurately as possible. In each trial, stimulus presentation consisted of a centrally programmed sequence of 20 consecutively illuminated lights (the centre 16 lights, 4 by 4 array), and the time to hit the sequence of 20 lights was recorded in milliseconds. A light is not illuminated until the previous light is extinguished, and each light stays illuminated until hit. The SVT™ programme waits until it has measured the response before switching on the next light.

Statistical Analysis

A Kolmogorov-Smirnov test was conducted to test normality of data. Comparisons were conducted on mean task completion time over the last four measurement runs, in seconds, for trial 1 (T1) versus trial 2 (T2), trial 2 versus trial 3 (T3), trial 3 versus trial 4 (T4), and trial 1 versus trial 4 using the software for the Hopkins (2012) reliability spreadsheet[16] .This generated coefficients of variation (CV), intra-class correlation coefficients (ICC), and standard errors of measurements (SEM) for each comparison as recommended for these types of investigations[17-18] (Table 2). To derive the within-subject variation expressed as a coefficient of variation (CV) all data was log-transformed, differences between trials were then calculated for each participant. Probability values for Pearson coefficients were evaluated against a Bonferroni adjusted alpha level of $P \leq 0.017$. Bland-Altman plots[19] were used to describe the Limits of agreement (LoA) for each comparison within each trial, following the method described by Atkinson and Nevill (1998)[17]. This generates 95% confidence intervals for differences in the performance of individuals across sessions in each comparison. Differences falling outside these confidence intervals may be regarded as random.

Potential gender differences in performance were tested using a mixed 2 (gender) X 4 (trial) ANOVA, with gender as a between-participants variable and trial a within-participants variable. Effects of playing level (Recreational, Club, and Expert) were explored using a mixed 3 (playing level) X 4 (trial) ANOVA, with playing level as a between-participants variable and trial a within-participants variable. The difference in

participants' task completion time from T1 to T4 was calculated, and its relationship with years of sporting experience and training hours per week were explored using Perarons's *r*. There was no evidence to suggest that heteroscedasticity was present. All values presented are displayed as mean±standard deviation (SD), and a level of $p < 0.05$ was used to define statistical significance. All statistical procedures were conducted using SPSS17 statistical software (IBM, Chicago, USA).

Results

No significant main effect for gender was identified ($F_{(1,60)}$=1.282, p=0.262, CI (males-females)= -1.632- 0.452). All trials demonstrated a reduction in the CV, SEM and ICC across the trial comparisons from T1-2 to T3-4 (Table 2). Mauchly's test of Sphericity was significant for trial and Greenhoise-Geisser corrections were utilised to identify a significant main effect of trial ($F_{(2,515,150.928)}$ = 13.901, p=0.001, ηp^2=0.188). There was no significant interaction between playing level and trial ($F_{(4.940,\ 145.743)}$ = 0.695, p=0.626), and no main effect of playing level (F (2,59)= 0.791, p=0.458). Pearson's *r* revealed no significant relationship between years of sporting experience and difference in means between T1 and T4 (r (62) =-0.134, p=0.300), nor between training hours per week and difference in means between T1 and T4 (r=0.023, p=0.859). The LoA analysis (Fig. 2) shows that absolute reliability is increased from T1-T2 to T3-T4. The LoA indicates that the error decreased between the three respective trials: ±0.92 (CI, -2.09, +1.47 sec), ±0.91 (CI, -1.47, +2.09 sec), ±0.72 (CI, -1.82, +1.00 sec).

Discussion

The purpose of this study was to determine if sporting background or expertise has an impact on rate of improvement on a previously validated familiarisation strategy[14]. Previous research using the SVT™ used a familiarisation strategy of testing participants who completed four sessions of six trials over a four week period, at the same time of day to take into account circadian variations[20-21]. The present study conducted all the sessions in one shorter, more practical strategy taking approximately 20 minutes. The findings of the test-retest reliability of the eye-hand

co-ordination measures assessed using the SVT™ corresponds with this previous research[14] and is reflective of the equivalent scale as would characteristically be expected for the current population[22]. Performance data can therefore be assumed to have reliable measurement reliability.

The findings show that there is no influence of experience on rate of improvement between T1 and T4, which may be due to lack of familiarisation strategies being employed prior to testing taking place. Prior sporting expertise also did not transfer to performance on this novel hand-eye coordination task using the SVT™. Emerging findings are therefore suggesting common patterns in data when novices are introduced to the SVT™. The previous strategy identified no relationship between current training hours and performance and this was also the case with the participants in the present study. This indicates that current sport specific training exposure does not transfer to performance on the SVT™. This is important as the implication is that future research using the SVT™ as a familiarisation strategy can be used independent of the experience of the individual. Minimizing any training effects will allow practitioners to interpret Interventions without compromising the data. It would be useful for future research to identify if there is any retention of skill of this familiarisation[23]. This would allow practioners to identify optimum times to familiarise and plan training programmes.

No gender differences emerged from our labs assessing performance on the SVT™ suggesting a common pattern of familiarisation with the recent study. One limitation of the study is a relatively small sample size for experienced and recreational populations. The use of novel technological approaches to improve on visual performance is an emerging issue within sport-vision; the present study assesses one such technology proposed to improve upon visual components of sporting performance. Medical or surgical intervention is not always required for athletes, but it has been proposed that improvement in visual performance can be obtained through the use of specific training approaches. These approaches would therefore require validated tools and techniques to assist in the testing of components of visual attributes. This type of research into familiarisation strategies would therefore assist in this process. In conclusion, these findings suggest that the SVT™ can be used as a familiarisation strategy for testing eye-hand co-ordination independently of the

sporting background, expertise or experience of the participant. Future research should focus on the use of such technology in the training of visual performance, and its subsequent transfer to sports performance.

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Figure (TIF or EPS only. 300 ppi Images or 1200 ppi Line-Art)

Figure Legends

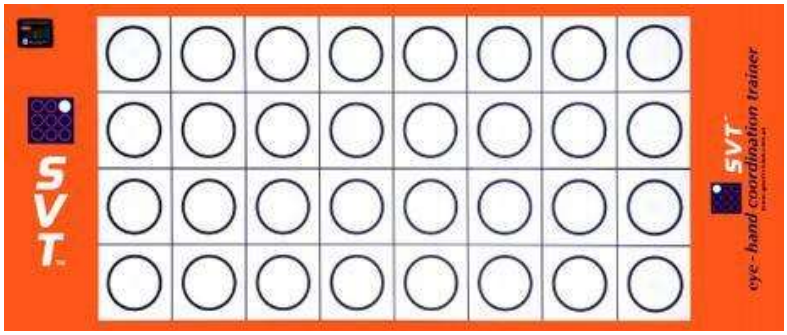

Fig. 1: The Sport Vision Trainer (SVT™) 32 Light Board

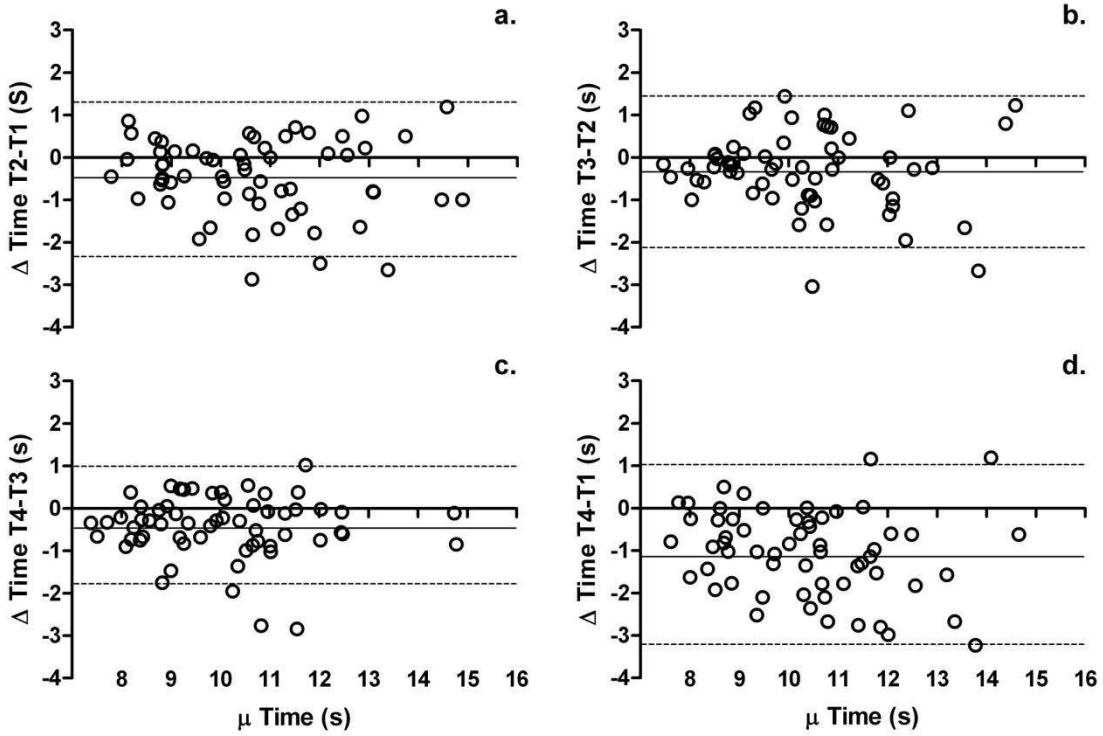

Fig. 2: Bland Altman plots showing differences between tests against each individual mean for tests (a) *trial 2-trial 1,(b) trial 3-2 and (c) trial 4- trial 3,* (4) *trial 4-1*. Solid lines represent mean bias; dashed lines represent 95% limits of agreement.

Tables

Table 1. Descriptive statistics of participants and mean scores achieved (mean ± SD)

Participants	T1 Mean* (s)	T2 Mean (s)	T3 Mean (s)	T4 Mean (s)
Recreational (n=10)	10.97±1.65	10.40±1.58	10.10±1.41	9.95±1.29
Club (n=43)	10.80±1.75	10.42±1.71	10.00±1.60	9.65±1.58
Expert (n=9)	11.53±2.53	10.80±2.29	10.97±2.14	10.58±1.92
Total	10.93±1.84	10.47±1.76	10.16±1.66	9.83±1.60

* Mean (±) SD proactive time to hit twenty light measurement runs

Table 2. Reliability (Coefficient of variation, CV), Intraclass correlation coefficient (ICC), Standard error measurement (SEM) and Bonferroni post hoc comparisons between trials.

TRIALS	*Typical Error CV	ICC	Bonferroni Adjustment	SEM
2-1	6.10	0.87	*P*=0.082	6.8
3-2	6.00	0.86	*P*=0.406	6.4
4-3	4.90	0.90	*P*=0.088	5.4

*95% confidence interval) for all trials