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Visualisation assessment and training in a group of university football players

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Background: Visualisation is the ability to generate a mental image of a situation before it occurs, and it is important in sports such as football. The footballer mentally imagines and rehearses situations that can occur in football; they are also able to mentally modify patterns of play to be more efficient and correct.

Aim: The study aims to assess and train visualisation in footballers. The trained visualisation is compared with the control data and the norms.

Setting: The study was conducted at the University of Limpopo Optometry Department and the offices of the University of Limpopo Soccer League.

Methods: A total of 97 footballers took part in the study. They were divided into experimental and control groups. Visualisation was initially assessed using the Getman Manipulation Tester in both groups before training the experimental group using the Ace-to-Seven method over a period of 6 weeks. The control group did not do any visualisation training. After training, the experimental group of both groups was assessed with the Getman Manipulation Tester.

Results: Pre- and post-training results in the experimental group showed improvement in visualisation, which was statistically significant ($p = 0.012$).

Conclusion: Visualisation in the experimental group improved after training, and the improvement was statistically significant. Literature suggests that visualisation is trainable and the training transfers to improvements on the field of play.

Contribution: Visualisation improves after training, which demonstrates that visualisation should not be assumed as a natural attribute; it should be assessed and be trained according to need.

Keywords: visualisation; visual skills; Getman Manipulation Tester; Ace-to-Seven training technique; sports performance.

Introduction

Visualisation, or mental imagery, is the act of constructing mental images of an object or event that resemble the actual appearance of the object or event.[1] This is the ability to generate a mental image of a situation before it occurs, involving actions and responses, and this ability is vital in sports such as football.[2] Visualisation shares similar neural processes as for visual perception, which has significant implications in sport. Visualisation of motor skill performance shares cognitive processes with the actual performance of motor tasks.[1] The player mentally imagines and rehearses situations, actions and responses that can and do occur during a game of football; the athlete can also mentally modify patterns of play to become more efficient and accurate and then be able to use this information in actual play situations now and in the future.[3]

Athletes with lower skill levels require more time to execute visualisation of a physical performance than the actual time required to perform the physical act. Elite athletes have been shown to use visualisation strategies in preparation for performance.[1] Visualisation is an important skill that allows a footballer to retrieve previously stored movement patterns and responses as required for specific play situations.[4] The football player with good visualisation has the luxury of increased time to react to stimuli before they occur[2] in real life. Deficits in this ability can hinder the player's correct responses to various game situations that occur. The deficits can also make it difficult for players to learn from mistakes they and/or others

might make during competition.[5] Task difficulty and expertise level have been shown to affect the time required for visualisation more than that for physical performance.[1] Enhancement exercises can be used to train visualisation.[3]

Studies[6,7] have shown that football players underperform in visualisation. Coopoo et al. (2012) pointed out that visual skills and visual capabilities of South African football players are below average,[8] and they argued that visual skills, including visualisation, cannot be assumed to be natural attributes, but must be tested and be subjected to training according to need. In a study involving university students, Du Toit et al.,[9] concluded that visualisation improves after training, and that the improvements suggest that the training had a positive effect on the trained visual skill; their study involved the use of the *Ace-to-Seven* training technique where playing cards are used. The current study was therefore an attempt to assess and train visualisation in football players and compare the skill with existing values (see Table 1) from Buys and Ferreira (2008).[4]

Methods

An experimental research design was used. The study received ethical clearance from the University of KwaZulu-Natal (BFC225/16) and the University of Limpopo (TREC/39/2017:IR), which was the study site. The participants signed the necessary consent forms before participating in the study.

One hundred (N = 100) university football players were randomly selected using simple random sampling to take part in visualisation assessment, training and re-assessment. The sample size was calculated using the Slovin's formula ($n = N / (1 + Ne^2)$, where N = population size, n = sample size and e = margin of error. The participants were split into goalkeepers, defenders, mid-fielders and strikers. They (the participants) ranged in age between 17 and 28 years. Fifty players were randomly assigned to the control group while the other 50 were part of the experimental group. Unfortunately, the experimental group lost 3 participants, leaving 97 participants in the study. Each participant had to have unaided visual acuity (VA) of at least 6/6 in each eye and 20 s of arc of stereo acuity. Participants who refused to sign the consent form, had disease or were using any form of medication that could affect their thinking and visual perceptual skills, were excluded from the study. The football players underwent pre-training assessment; the experimental group attended visualisation training using the Ace to Seven method, and the control group received no additional training relating to visualisation or placebo training. After the visualisation training of the experimental group, both groups were re-assessed for any changes in visualisation using the Getman Manipulation Tester. The collected data was analysed using the Statistical Package for the Social Sciences (SPSS), version 28.

TABLE 1: Norms for visualisation by Buys and Ferreira[4] using the Getman Visual Manipulation Tester.

Level of competence	Number of correct responses
Superior	12
Above average	10 or 11
Average	9
Ineffective	7 or 8
Needs immediate attention	< 7

Source: Ferreira JT. Sports vision assessment manual. Sports Information and Science Agency, Johannesburg: University of Johannesburg, Sports Vision Department; 2000

The Getman Manipulation Tester (Figure 1) was used to assess visualisation. The Getman Manipulation Tester was adapted from the Sports Information and Science Agency.[3] The procedure consists of four different figures. Each figure is on a separate sheet and another sheet has the different possible answers. The participant looked at each figure (3 m away) and answered the following questions as suggested by Buys[10]:

- If you were to look at this figure from behind, what will it look like to you?
- If you were to flip this figure upside down, what will it look like to you?
- If you were to look at this figure from behind, and it was flipped upside down, what will it look like to you?

If all four figures were correctly identified, a maximum score of 12 was achieved. The manipulations must be done without hesitation.[3] If a score of less than 7 was achieved, the athlete's performance is classified as 'needs immediate attention', a score between 7 and 8 is classified as 'ineffective'; 9 is classified as 'average'; 10 to 11 as 'above average' and 12 as 'superior'.

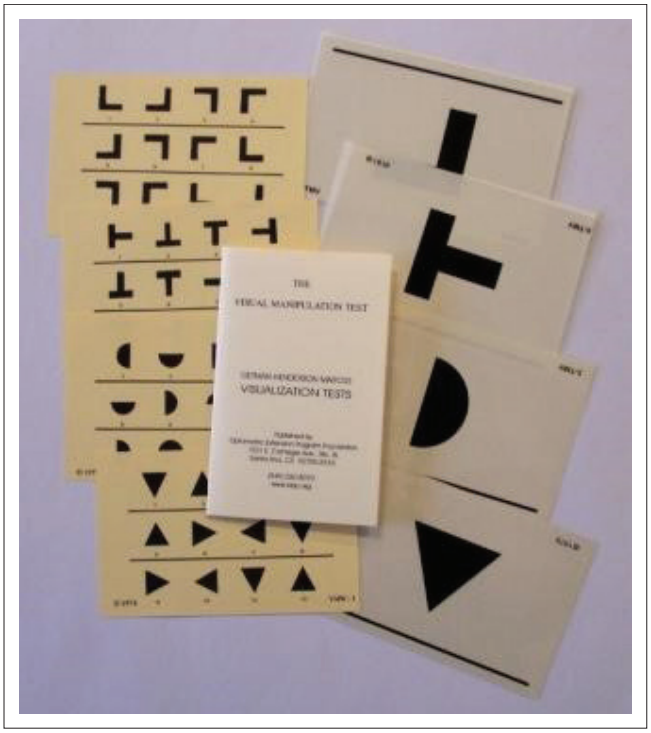

FIGURE 1: The Getman Visual Manipulation Tester.

The training of visualisation in the experimental group was done in-office using the Ace to Seven Test over a period of 6 weeks.[9] Training took place over 3 days per week. Seven playing cards from 'Ace' to 'Seven' were placed on the table in random order. The participant could look at the cards for as long as it takes to memorise the order and then turn the cards face down as soon as they were ready. The participant then needed to again turn the cards over in the correct order from 'Ace' to 'Seven'. The time started as soon as the participant looked at the cards and ended once the cards were turned over in the correct order. If a card is turned over in the incorrect sequence all cards must be turned face down and the participant needed to start again. The control group did not attend any training, except the usual training at their football team practices.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of KwaZulu-Natal, Biomedical Research Ethics Committee (No. BFC225/16) and the University of Limpopo, Turfloop Research Ethics Committee Clearance Certificate (No. TREC/39/2017:IR).

Results

Visualisation in the control group was measured around the same time with the experimental group. The scores of the control and experimental groups players in different positions of play were subjected to the paired sample *t*-test. The mean difference of the defenders (pre-training duration 7.19; post-training duration 8.33) and midfielders in the control group yielded statistically significant result (Table 2), while the experimental group defenders (pre-training 7.42; post-training 9.58) had a statistically significant ($p \leq 0.05$) mean difference (Table 3). The other positions had statistically non-significant mean *differences* ($p > 0.05$) (Table 2 and Table 3).

When compared with results for Buys and Ferreira,[4] visualisation in the control group remained 'needs immediate attention'. Only strikers could achieve 'average' mean visualisation (Table 2). Strikers started the assessment with 'above average' visualisation (Table 3), and after training, the performances remained 'above average'.

TABLE 2: Mean visualisation differences (with Getman Visual Manipulation Tester) *versus* position of play (Controls) with *p*-values, standard deviations (s.d.) and standard errors (s.e.) for the means.

Position of play	*N*	Training duration measurements	Means	Mean differences	s.d.	s.e.	*p*
Keeper	6	Pre	6.67	-0.333	1.155	0.667	0.333
		Post	6.33				
Defender	21	Pre	7.19	1.143	1.740	0.380	0.003
		Post	8.33				
Midfielder	14	Pre	6.64	1.000	1.881	0.503	0.034
		Post	7.64				
Striker	9	Pre	7.42	1.417	3.476	1.003	0.093
		Post	8.83				

s.d., standard deviation; s.e., standard error; *p*, *p*-value.

A paired *t*-test of visualisation shows an improvement in mean visualisation post-training score (pre-training, 8.16 ± 2.12; post-training, 9.28 ± 2.15). The improvement is statistically significant ($p \leq 0.05$) (Table 4). Before training, the mean visualisation was 'ineffective' and became 'average' after training when compared to norms by Buys and Ferreira.[4]

A two-sample *t*-test between the experimental and control groups (Table 5) shows an improvement in performance in mean visualisation in the experimental group (Controls 8.34 ± 2.65; Experimental 9.28 ± 2.15). The improvement is not statistically significant ($p > 0.05$). Comparing the experimental group after training with the control group, the experimental group is 'average', whereas the control group is 'ineffective'.

Discussion and conclusions

Elite athletes use visualisation strategies when preparing for competitions. Athletes with lower skill levels require more time to execute visualisation of a physical performance than the actual time required to perform the physical act.[1] Football players in the different positions on the field of play in the current study demonstrated statistically non-significant mean differences in visualisation in both the experimental and the control groups; in both instances, only the defenders had a statistically significant visualisation mean difference. Control and experimental group goalkeepers in the current study did not show any improved mean visualisation after the training of the experimental group. In studies by Bahdur et al.[5] and Du Toit et al.,[11] they found no differences in visual skills based on positions of play. They concluded that the visual foundation should

TABLE 3: Mean visualisation differences pre- and post-training *versus* position of play (Experimental group).

Position of play	*N*	Type of training	Means	Mean differences	s.d.	s.e.	*p*
Keepers	8	Pre	9.75	-0.125	0.991	0.350	0.366
		Post	9.63				
Defenders	12	Pre	7.42	2.167	2.290	0.661	0.004
		Post	9.58				
Midfielders	22	Pre	8.59	0.455	2.262	0.482	0.178
		Post	9.05				
Strikers	5	Pre	7.40	1.600	2.881	1.288	0.141
		Post	9.00				

s.d., standard deviation; s.e., standard error; *p*, *p*-value.

TABLE 4: Paired *t*-test visualisation pre- and post-training (Experimental group).

Groups	Observations	Means	s.d.	s.e.	*p*
Pre-training	50	8.16	2.122	0.300	0.012
Post-training	47	9.277	2.154	0.314	-
Combined	97	8.701	2.199	0.223	-
Differences	-	1.117	-	0.434	-

s.d., standard deviation; s.e., standard error; *p*, *p*-value.

TABLE 5: Two-sample *t*-test post-training (Controls vs Experimental group) for scores using the Getman Visual Manipulation Tester.

Visualisation	Observations	Means	s.d.	s.e.	*p*
Controls	50	8.34	2.647	0.374	0.060
Experimental	47	9.277	2.154	0.314	-
Combined	97	8.794	2.453	0.249	-
Differences	-	-0.937	-	0.492	-

s.d., standard deviation; s.e., standard error; *p*, *p*-value.

be formed at a younger age when the visual system is still developing, ensuring that when players reach levels of competitive sport, the basic visual skills are already at an advanced stage. This will allow for the implementation of training programmes aimed at improving advanced visual skills and making the training match-specific. Du Toit et al.[12] found a significant improvement in mean visualisation after training. In their study, Du Toit et al.,[13] using laboratory and internet-based visual skills training methods, found no improvement in visualisation trained on the internet.

In another study by Du Toit et al.,[9] a paired *t*-test was used to compare the pre-test and the post-test mean values for the control and experimental groups. Visualisation in the experimental group showed improvement, even though the improvement was statistically not significant.

In the current study, the paired *t*-test showed a statistically significant improvement in visualisation after visual skills training. The mean visualisation in the experimental group improved from 'ineffective' to 'average' after training. The improvement is statistically significant. Comparing the control group and the experimental group after training, the two-sample *t*-test results show an improvement in mean visualisation in the experimental group from 'ineffective to 'average'. The improvement is statistically non-significant and may have occurred by chance. The above results agree with several studies[9,12,13,14] that suggested visual skills are trainable. Where the exercises are sports specific, the training can transfer to improved performance on the field of play. Studies have also shown that visual skills training translates to improved performance on the field of play.[15,16,17,18] The improved performances included dribbling, passing, shooting and overall playing abilities.[15,17,18] Further, the football player with good visualisation has the luxury of increased time to react to the visual stimulus before it has occurred. Deficits in visualisation can hinder a player's correct responses to various game situations.

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Competing interests

The authors, J.R.R. and R.H., declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

J.R.R. and R.H. planned and carried out the study. J.R.R. and R.H. were involved in the data collection and analysis of the findings. The article was co-written by J.R.R. and R.H.

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Data availability

The authors confirm that the data supporting the findings of this study are available within the article and/or its supplementary materials.

Disclaimer

The views and opinions expressed in this article are those of the authors and do not necessarily reflect the official policy or position of any affiliated agency of the authors.

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