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Visual adjustability and position of play in a group of university football (soccer) players

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Background: Visual adjustability is the ability of the visual system to be flexible enough to rapidly adjust and guide the body's motor responses quickly and accurately, while the surroundings change. The time it takes the visual system to adjust to the changes in the sporting environment will determine the efficiency of the motor response.

Aim: The aim of this study was to assess visual adjustability in a group of university football players in different positions of play. Visual adjustability was then trained using a cluster ball, and the skill was measured again to check for any improvement. The results were then compared with the control group and the norms by Buys and Ferreira.

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

Methods: Ninety-seven footballers took part in the current study. The participants were divided into control and experimental groups. Visual adjustability was assessed in both groups before and after the training and compared with the norms by Buys and Ferreira.

Results: Visual adjustability improved in the different positions of play after training. Comparing the results with the norms, footballers started training with visual adjustability at 'ineffective' and 'average', and improved to 'above average' when compared with the norms by Buys and Ferreira.

Conclusion: Visual adjustability improved after training when compared to the control group and the suggested norms. Control group improvements were statistically not significant.

Contribution: The current study aims to contribute more information on the subject of visual adjustability and recommend more research on the topic and draw attention to the significance of visual adjustability to sports performance. The study recommends that visual adjustability be made sport-specific.

Keywords: visual adjustability; norms; prism; experimental; control; sport; football.

Introduction

Visual adjustability is the ability of the visual system to be flexible enough to rapidly adjust and guide the body's motor responses quickly and accurately, while having the surroundings change.[1] When the sporting environment or the surrounding changes, the flexibility of the athlete's visual system is put to test in terms of its ability to respond and guide the body accordingly.[2,3] The environment during a football (soccer) match changes; with the football, the players and the match officials in constant movement; and the visual system must be flexible enough to adjust motor responses quickly and accurately.[4] The appropriateness of visual adjustability to sports performance and how it could be related to on-field performance has come into question,[2] but Ferreira[5] of Sports Information and Science Agency (SISA) maintains that visual adjustability, as well as other software visual skills such as central-peripheral awareness, eye-hand coordination, eye-body coordination, visual reaction time and visualisation (as opposed to hardware visual skills: ocular health, visual acuity [VA], contrast sensitivity, colour discrimination, eye movements, depth perception, accommodation and fusion flexibility) are highly important in a game of football. Campher[6] and Potgieter[7] argue that poor visual adjustability slows down the footballer's responses and results in inconsistent skill execution.

The time it takes the visual system to adjust to the changes on the field of play will determine the efficiency of the motor response.[5] Subsequently, the inability of a footballer to adjust to changes will result in his or her responses being unpredictable and inconsistent[3] which in turn is expected to affect on-field performance. According to Ferreira,[5] visual enhancement exercises can improve visual adjustability.

In a study by Bahdur,[8] visual adjustability (with base up yoked prisms) decreased after training, while visual adjustability (with base left, right or down yoked prisms) showed improvement, with the base down improvement being not significant. Despite the differences in skill requirement in the different positions of play, Bahdur et al.[4] found no differences in visual adjustability based on position of play (in elite football players). The current study involved the training of visual adjustability in a group of university football players in different positions of play, with the results also compared with the visual adjustability norms for elite athletes by Buys and Ferreira.[2] The norms for the visual skills form part of a general sports vision testing battery, which divides every skill into five different categories of competency, namely, 'superior' (> 'above average'), 'above average' (mean + 2 s.d.), 'average' (mean + 1 s.d.), 'ineffective' (mean – 1 s.d.) and 'needs immediate attention' (< 'ineffective'), where s.d. = standard deviation.

The norms by Buys and Ferreira[2] were developed with the participation of athletes from multiple sporting codes and were identified by SISA as extremely talented, being either athletes that had previously competed at international level or athletes that are up-and-coming stars of the future. The number of attempts an athlete needs to hit the target classifies the athlete as 'superior', 'above average', 'average', 'ineffective' or 'needs immediate attention' (see Table 1).

Research methods and design

An experimental research design was used, so the study involved both an experimental and a control group. The study received ethical clearance from both the Universities of KwaZulu-Natal (BFC225/16) and Limpopo (TREC/39/2017:IR). The University of Limpopo was the study site. All participants gave informed consent.

One hundred (N = 100) university football players were randomly selected to take part in a visual adjustability assessment, training and re-assessment. The football players selected form a pool of players taking part in the university football league and the team playing in the Varsity Cup, which is an intervarsity football competition; the footballers are classified as semi-elite. The participants were classified into four categories, namely goalkeepers, defenders, midfielders and strikers. The participants ranged in age between 17 and 28 years. Consent forms were signed by the participants who formed part of a bigger study. Fifty players were randomly assigned to the control group (keepers = 3, defenders = 21, midfielders = 14, strikers = 12) while the other 50 were part of the experimental group (keepers = 8, defenders = 12, midfielders = 22, strikers = 5) (Three participants assigned to the experimental group left the study). Each participant had to have unaided VA of at least 6/6 in each eye, when measured by the Snellen letter chart, and at least 20 s of arc of stereo acuity when measured by the Randot Stereo test. The VA and the stereo acuity levels were decided upon to exclude the effect of poor VA and reduced stereopsis on the study results.

TABLE 1: Visual adjustability norms by Buys and Ferreira.

Skill level	Base up number of attempts	Base down number of attempts	Base right number of attempts	Base left number of attempts
Superior	1	1 or 2	< 4	< 4
Above average	2–4	3–5	4–7	4–7
Average	5–6	6–8	8–9	8–9
Ineffective	7–8	9–12	10–12	10–14
Needs immediate attention	> 8	> 12	> 12	> 14

Source: Buys JHC, Ferreira JT. The development of protocols and norms for sports vision evaluations. S Afr Optom. 2008;67(3):106–117. https://doi.org/10.4102/aveh.v67i3.187

The visual adjustability response was stimulated by using ready-made yoked prisms spectacles (bases could be rotated up, down, left or right) to simulate a change in the visual environment, while attempting to perform a motor action. Therefore, each participant wore yoked prisms spectacles of 20 prism dioptres and then was required to throw a tennis ball at a target (an 'X' marked to full size with a black marker on a white A4 page) on a cream white wall with no posters, six metres away, and at eye level. The bases of the prisms in both lenses were oriented in the same direction (i.e. either to the left, right, up or down), resulting in the displacement of the target towards the apex of the prism. The number of attempts needed to hit the target and therefore compensate for the displacement was recorded.[2] The test stopped after each correct attempt. The results of this test gave an indication of how quickly an athlete can adjust to a change in the sporting environment as the number of attempts is inversely proportional to visual adjustability.[9]

Visual adjustability (VAT) was assessed in the first week using yoked prisms for all participants. Training was then undertaken by the experimental group, over a period of 6 weeks using a cluster (agility) ball[10] and not wearing the yoked prisms, while the control group underwent the normal football training; the experimental group joined the control group for normal football training after visual adjustability training. The participant had to bounce the cluster ball on the ground, which would then bounce randomly in any direction and the participant had to catch the ball as quickly as possible, before it bounced again. The participant had 60 s to bounce and catch the ball as many times as possible. The participant was asked to challenge himself or herself to improve his or her score at each session that followed. Each session lasted for 45 min to align with class attendance. After the training, the participants' visual adjustability was measured three times, the average number of throws taken, and the performance was compared with the norms by Buys and Ferreira.[2] The distribution of the collected data was tested for normality and found to be normal and subjected to t-test statistical analysis.

Ethical considerations

Ethical clearance to conduct this study was obtained from the University of KwaZulu-Natal Biomedical Research

Ethics Committee (BREC) and the University of Limpopo Turfloop Research Ethics Committee. (No. BFC225/16, TREC/39/2017:IR).

Results

The experimental group underwent the VAT while the control group only attended formal football training, with the experimental group joining them later on the field of play. Visual adjustability in the experimental group was compared before and after training, with the control group also compared before and after the training duration. The experimental and the control groups were also compared before and after the training duration. The experimental group lost three members and thus ended with 47 participants.

Visual adjustability following training

Table 2 shows visual adjustability (described as number of attempts to hit the target) and position of play of the experimental group before and after training, Table 3 shows visual adjustability and position of play between the experimental and control groups after training, Table 4 shows visual adjustability in the control group before and after the training duration; and Table 5 shows visual adjustability between the experimental and the control groups before the training of the experimental group.

While visual adjustability (base up) was noted to improve in the experimental group for all positions of play after training; however, only strikers had a statistically significant improvement ($p = 0.008$). In the control group the base-up improvements were only noted among keepers ($p = 0.305$) and strikers ($p = 0.055$) but were not statistically significant (Table 4). Strikers in the experimental group achieved a statistically significant 'superior' result on base-up visual adjustability (Table 2).

With base down yoked prisms, while statistically not significant, improvements in visual adjustability were noted among keepers ($p = 0.221$) and midfielders ($p = 0.130$) in the experimental group, but also among defenders ($p = 0.333$) and strikers ($p = 0.122$) after the training duration in the control group.

TABLE 2: Mean visual adjustability pre- and post-training (experimental group) for the different orientations of the yoked prisms according to position of play where $p \leq 0.05$ is significant.

Orientation of yoked prisms for assessment of visual adjustability: Statistic	Position of play											
	Keeper			Defender			Midfielder			Striker		
	VAT Pre-training	VAT Post-training	*p*	VAT Pre-training	VAT Post-training	*p*	VAT Pre-training	VAT Post-training	*p*	VAT Pre-training	VAT Post-training	*p*
Base up	-	-	0.175	-	-	0.228	-	-	0.124	-	-	0.008
Mean	3.500	3.000	-	3.750	3.420	-	3.180	2.860	-	3.000	2.200	-
s.d.	0.926	0.756	-	0.866	1.240	-	1.053	1.006	-	0.707	0.447	-
Base down	-	-	0.221	-	-	0.231	-	-	0.130	-	-	0.352
Mean	3.880	3.500	-	3.670	3.920	-	3.550	3.230	-	3.000	3.200	-
s.d.	0.641	0.926	-	0.888	1.084	-	0.963	0.813	-	1.000	0.837	-
Base to participant's left	-	-	0.313	-	-	0.361	-	-	< 0.001	-	-	0.115
Mean	5.380	5.130	-	5.330	5.500	-	5.950	4.050	-	5.600	4.600	-
s.d.	1.768	1.553	-	1.723	1.382	-	1.527	1.527	-	1.517	0.548	-
Base to participant's right	-	-	0.221	-	-	0.147	-	-	< 0.001	-	-	0.104
Mean	5.880	5.500	-	5.500	5.080	-	5.860	4.000	-	5.00	4.40	-
s.d.	0.991	1.195	-	1.784	1.165	-	1.859	1.447	-	1.225	0.548	-

VAT, visual adjustability training; s.d., standard deviation; *p*, *p*-value.

TABLE 3: Mean visual adjustability according to position of play between experimental and control groups post training.

Orientation of yoked prisms for assessment of visual adjustability: Statistics	Position of play											
	Keeper			Defender			Midfielder			Striker		
	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*
Base up	-	-	0.226	-	-	0.466	-	-	0.007	-	-	0.039
Mean	3.00	3.33	-	3.42	3.38	-	2.82	3.79	-	2.20	3.11	-
s.d.	0.756	0.816	-	1.240	0.921	-	1.006	1.122	-	0.447	1.269	-
Base down	-	-	0.267	-	-	0.032	-	-	0.160	-	-	0.398
Mean	3.50	3.83	-	3.92	3.24	-	3.23	3.57	-	3.20	3.33	-
s.d.	0.926	0.983	-	1.084	0.625	-	0.813	1.089	-	0.837	1.000	-
Base to participant's left	-	-	0.177	-	-	0.63	-	-	0.003	-	-	0.334
Mean	5.13	4.50	-	5.50	4.76	-	4.05	5.57	-	4.60	4.33	-
s.d.	1.553	0.837	-	1.382	1.044	-	1.527	1.505	-	0.548	1.658	-
Base to participant's right	-	-	0.268	-	-	0.422	-	-	0.003	-	-	0.180
Mean	5.50	5.83	-	5.08	5.00	-	4.00	5.43	-	4.40	5.00	-
s.d.	1.195	0.753	-	1.165	1.140	-	1.447	1.342	-	0.548	1.732	-

VAT, visual adjustability training; s.d., standard deviation; *p*, *p*-value.

TABLE 4: Mean visual adjustability pre and post training duration according to position of play (control group).

Orientation of yoked prisms for assessment of visual adjustability: Statistic	Position of play											
	Keeper			Defender			Midfielder			Striker		
	VAT Pre-training duration	VAT Post-training duration	*p*	VAT Pre-training duration	VAT Post-training duration	*p*	VAT Pre-training duration	VAT Post-training duration	*p*	VAT Pre-training duration	VAT Post-training duration	*p*
Base up	-	-	0.305	-	-	0.113	-	-	0.186	-	-	0.055
Mean	3.670	3.330	-	3.000	3.380	-	3.430	3.790	-	3.890	3.110	-
s.d.	1.033	0.816	-	0.949	0.921	-	0.938	1.122	-	0.928	1.269	-
Base down	-	-	0.148	-	-	0.333	-	-	0.403	-	-	0.122
Mean	4.330	3.830	-	3.330	3.240	-	3.500	3.570	-	4.110	3.330	-
s.d.	1.211	0.983	-	0.913	0.625	-	0.855	1.089	-	1.054	1.000	-
Base to participant's left	-	-	0.127	-	-	0.016	-	-	0.220	-	-	< 0.006
Mean	5.500	4.500	-	5.570	4.760	-	6.070	5.570	-	6.220	4.330	-
s.d.	1.871	0.837	-	1.207	1.044	-	1.542	1.505	-	1.986	1.658	-
Base to participant's right	-	-	0.164	-	-	0.211	-	-	0.111	-	-	0.452
Mean	6.500	5.830	-	5.380	5.000	-	6.210	5.430	-	5.110	5.00	-
s.d.	2.074	0.753	-	1.658	1.140	-	1.718	1.342	-	2.421	1.732	-

VAT, visual adjustability training; s.d., standard deviation; *p*, *p*-value.

TABLE 5: Mean visual adjustability according to position of play between experimental and control groups pre-training.

Orientation of yoked prisms for assessment of visual adjustability: Statistic	Position of play											
	Keeper			Defender			Midfielder			Striker		
	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*	VAT Experi-mental	VAT Control	*p*
Base up	-	-	0.381	-	-	0.040	-	-	0.223	-	-	0.016
Mean	3.50	3.67	-	3.62	3.00	-	3.17	3.43	-	2.83	3.89	-
s.d.	0.926	1.033	-	0.961	0.949	-	1.029	0.938	-	0.753	0.928	-
Base down	-	-	0.213	-	-	0.188	-	-	0.472	-	-	0.017
Mean	3.88	4.33	-	3.62	3.33	-	3.52	3.50	-	2.83	4.11	-
s.d.	0.641	1.211	-	0.870	0.913	-	0.947	0.855	-	0.983	1.054	-
Base to participant's left	-	-	0.451	-	-	0.312	-	-	0.413	-	-	0.210
Mean	5.38	5.50	-	5.31	5.57	-	5.96	6.07	-	5.50	6.22	-
s.d.	1.768	1.871	-	1.653	1.207	-	1.492	1.542	-	1.378	1.986	-
Base to participant's right	-	-	0.259	-	-	0.351	-	-	0.309	-	-	0.477
Mean	5.88	6.50	-	5.62	5.38	-	5.91	6.21	-	5.17	5.11	-
s.d.	0.991	2.074	-	1.758	1.658	-	1.832	1.718	-	1.169	2.421	-

VAT, visual adjustability training; s.d., standard deviation; *p*, *p*-value.

Visual adjustability as assessed using yoked prisms with the bases to the participants' left showed statistically significant improvement in the experimental group only among midfielders ($p \leq 0.001$). In the control group, however, statistically significant improvements were observed among defenders ($p = 0.016$) and strikers ($p \leq 0.006$).

Visual adjustability (with yoked prism bases to the participants' right) improved in all positions of play in both the control and experimental groups, with a statistically significant ($p \leq 0.001$) change noted only among midfielders in the experimental group; all improvements in the control group were not statistically significant.

The experimental and control groups were compared before and after training of the experimental group. Visual adjustability in the two groups was compared according to position of play.

Visual adjustability base up did not improve among defenders when comparing the experimental and the control groups (experimental 3.620 ± 0.961 and control 3.000 ± 0.949) before training (Table 5) and after training of the experimental group (experimental 3.420 ± 1.240 and 3.380 ± 0.921) (Table 3). Only midfielders ($p = 0.007$) and strikers ($p = 0.039$) had statistically significant improvement after training of experimental group, while defenders ($p = 0.040$) and strikers ($p = 0.016$) are statistically significant before training of experimental group.

When the prism base was oriented down, defenders in the experimental and control groups (Table 3, $p = 0.032$) did not have improved visual adjustability. Before training, midfielders VAT in the experimental group did not improve (Table 3).

With the prism orientation to the left, VAT in only midfielders improved after training of experimental group (experimental 4.05 ± 1.527, control 5.57 ± 1.505) (Table 3). Before training the experimental group scored better than the control group in all positions of play (Table 5).

When the prism base was oriented to the right of the participant, there was no improvement in visual adjustability among defenders before and after training of the experimental group (Table 3 and Table 5).

When comparing the results of the experimental and the control groups after training, the defenders in the control group scored better than the experimental group, although the results were statistically not significant. Before training, the defenders in the control group outperformed the experimental group in all base directions except when the base was to the participant's left. Midfielders in the experimental and control groups had statistically significant results after training, except where the base direction was down (Table 3).

Visual adjustability following training in comparison to established norms

Table 1 represents the number of attempts an athlete needs to make when hitting the target (an 'X' on an A-4 paper) for them to be categorised as either 'needs immediate attention', 'ineffective', 'average', 'above average' or 'superior'.

The visual adjustability scores achieved by the study participants were compared to visual adjustability norms by Buys and Ferreira[2] (Table 1). Thirty-four per cent of the participating footballers in the experimental group started training with VAT of 'ineffective' and 'average'. In the control group there were 23% of footballers with 'ineffective' and 'average' VAT. After the training duration there were 15% of footballers in the experimental group and 22% of footballers in the control group with 'average' and 'ineffective' VAT. The experimental group improved by 19% whereas the control group improved by 1%. As shown in Table 2, Table 3, Table 4 and Table 5, the VAT group scores were 'above average' before and after the training duration when compared to the norms by Buys and Ferreira[2] (Table 1).

Discussion

Studies[11,12,13] have shown that visual skills are trainable, and that the improved visual skills can translate into improved performance on the field of play. Coopoo et al.[14] argue that visual skills should not be assumed as natural attributes but should be trained according to need. The VAT scores of the study athletes improved after training and were 'above average' when compared to the available norms.[2] In a similar study by Bahdur[8] involving senior elite male football players, the scores ranged between 'needs immediate attention' and 'superior' before training. In the current study, individual scores ranged from 'ineffective' to 'above average' before training. The study athletes improved to 'above average'.

The current research participants adapted quicker to the research target when it was displaced vertically compared to when it was displaced horizontally, as was found by Bahdur[8] and Buys and Ferreira[2] in their sample of elite athletes when they (Buys and Ferreira) were developing protocols and norms for sports vision evaluation. Ramaja and Ferreira[15] reported that only 10% of their participants performed poorly when the target was displaced vertically, as opposed to 40% when the target was displaced horizontally. In a study by Langout,[16] vertical displacements produced similar performance in a group of male and female participants. However, horizontal displacements produced varied performances, with the groups more spread out over larger values for the horizontal displacements compared to vertical displacements.

Bahdur et al.[4] found an improved VAT (base left and base right) after visual skills training; their sample had similar results when compared with junior rugby players in a study by Venter.[17] Bahdur et al.[4] concluded that VAT is a dynamic and important skill in sport, such that footballers need to be able to adjust their aim, make passes to moving players and shoot past the goalkeeper.

In the current study, the strikers in the experimental group (Table 3) have shown better improvement than the other positions of play, including the control group. Defenders in the control groups have shown better improvement in visual adjustability than the experimental group defenders before and after the training duration. The scores in the control group have shown improvement after the training duration even though the footballers only undertook normal football training.

It has also been reported previously[4,18,19] that despite differences in football positional requirements, there were no differences in performance based on position of play, unlike in the current study where the strikers showed better improvement; the improvement in VAT among strikers may explain the demand on the position in terms of accuracy when shooting for goal and positional play. Furthermore the visual foundation should 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 to allow for the implementation of training programmes aimed at improving advanced visual skills and making the training match-specific.[4,19] A limitation of the study is that VAT of football players was not compared to that of athletes from different sporting codes. Further research on VAT training and VAT norms need to be made sports-specific.

Conclusion

Visual adjustability improves after training. The unpredictability of the direction of the football can create an environment similar to that created by the cluster ball used in the training of the study football players. Visual adjustability in the sampled footballers improved after training. The control group participants also showed improvement after the training duration. The experimental group trained with the cluster ball, while the control group was using the normal size 5 football. The environment created by the cluster ball can also be created by the normal football because of its unpredictability, contributing to improvement in visual adjustability in the control group. On the other hand, participants were exposed to the yoked prisms before and after the training duration, creating an element of familiarity; this contributed to the greater improvement in VAT in the experimental group. Further studies are recommended to investigate the link between VAT training and improvement and performance on the field of play.

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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

Both authors, J.R.R. and R.H., declare co-authorship of the article.

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Data availability

The authors confirm that the supporting findings of this study are available within the article. The data are available from the corresponding author, J.R.R., on request.

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.

References

1. Williams AM, Davids K, Williams JG. Visual perception and action in sports. New York, NY: Spon Press (Taylor & Francis); 1999.
2. Buys JHC, Ferreira JT. The development of protocols and norms for sports vision evaluations. S Afr Optom. 2008;67(3):106–117. https://doi.org/10.4102/aveh.v67i3.187
3. Planer PM. Sports vision manual. Harrisburg: International Academy of Sports Vision; 1994.
4. Bahdur K, Ferreira JT, Lategan L, Ludeke A. The effects of a visual intervention programme on the visual skills of professional football players. Afr J Phys Act Health Sci. 2016;22(3:2):920–931.
5. Ferreira J. Sports vision assessment manual. Johannesburg: Sports Information and Science Agency; 2000.
6. Campher J. The role of visual skills and its impact on skills performance of cricket players [masters dissertation]. University of Pretoria, 2008; p. 1–205.
7. Potgieter K. The role of vision and visual skills in rhythmic gymnastics [maters dissertation]. University of Johannesburg. 2007; p. 1–244.
8. Bahdur K. The effect of a physical, psychological and visual intervention on decision-making in football players. D Phil thesis (Sports Science) [unpublished]. University of Johannesburg, 2014; p. 1–273.
9. Buys JHC. The development of norms and protocols in sports vision evaluations. Masters thesis (Optometry) [unpublished]. University of Johannesburg, 2002; p. 1–179.
10. Van Dyk AP. The effects of a sports vision training programme on a selected visual-motor skills in non-fatigued and fatigued cardiovascular condition. PhD (Sports, Recreation and Exercise Science) [unpublished]. University of the Western Cape, 2014; p. 1–151.
11. Shivaji G, Jeyavelmurugan G. Effect of visual skill fitness training programme on selected psychomotor variables of male cricket players. Int J Sci Res. 2013;2(3):270–273.
12. Binu A. Effect of vision training among skill ability of football players. Ind J Appl Res. 2020;10(1):2021. https://doi.org/10.36106/ijar/0912538
13. Kumar V, Arumugam S. Effect of visual perceptual training on selected performance variables of football players. World Acad Inform Manag Sci. 2020;9(4):9401–9405.
14. Coopoo Y, Moss H, Fortuin C, Freese H, Cameron M. The art, philosophy and science of football in South Africa. Johannesburg: Mapungubwe Institute for Strategic Reflection; 2012.
15. Ramaja JR, Ferreira JT. Evaluation of visual skills in a group of elite and sub-elite football players. African Journal for Physical, Health Education, Recreation and Dance, Supplement 2. 2012; 210–228.
16. Langhout W. A comparison of the visual skills in male and female students. M Phil (Optometry) [unpublished]. University of Johannesburg. 2012; p. 1–190.
17. Venter SC, Ferreira JT. A comparison of visual skills of high school rugby players from two different age groups. S Afr Optom. 2004;63(1):19–29.
18. Ramaja J. The role and importance of visual skills in football performance [Masters thesis], UJ; 2015, p. 1–177.
19. Ramaja JR, Hansraj R. Visualisation assessment and training in a group of university football players. Afr Vision Eye Health. 2024;83(1), a819. https://doi.org/10.4102/aveh.v83i1.819