

## **Sport vision assessment in soccer players**

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### **Abstract**

Sport has become a very competitive business and focus has been placed on reaching ones full potential. Few aspects like hand-eye co-ordination and visual reaction time have been addressed in the past. Visual involvement in a sport varies according to environmental demands associated with that particular sport. These environmental demands are matched by a task of specific motor responses. This study was carried out in order to determine the relevance of sport vision testing and visual skills training in soccer players. This study also seeks to determine the visual skills of soccer players by assessing depth perception, accommodation flexibility, eye tracking, eye jumps, peripheral awareness and visual memory of soccer players. Forty-eight soccer players aged 12 to 20 were assessed. The results were compared according to age group and the four main positions in soccer, namely: striker, midfielder, defender and goalkeeper. The results indicated that visual skills tend to improve with age and that different positions do not necessarily require different levels of visual skills. This reinforces the suggestion that visual skills are not necessarily a function of the position one plays. Sportsmen will have a great advantage over their fellow rivals due to improvements in their exercise and sports vision training programs. These training programs can help improve and train the athlete's visual co-ordination, increase concentration and focus, hand-eye co-ordination, anticipation as well as gain knowledge about their motor response. These principles can also be implemented in a similar evaluation of other athletes and non-athletes.

**Key words:** *Sport vision, hand-eye co-ordination, visual concentration, peripheral awareness.*

### **Introduction**

A lot of interest has developed around the effect of vision on sports performance ever since researchers from Columbia University reported that the visual skills of Babe Ruth were 12% faster than other athletes (Classé, Semes, Daum, Nowakowski, Alexander, Wisniecki & Beisel, 1997). Additional data from research undertaken has since shown that athletes do have better visual skills than the general public (Stine, Arteburn & Stern, 1982; Laby, Rosenbaum, Kirschen-Davidson, Rosenbaum, Strasser & Mellman, 1996; Classé *et al.*, 1997). Reichaw and Stern (1986) explained sport vision as performance oriented, comprehensive vision care programmes involving the education, evaluation, correction, protection and enhancement of an athlete. Developments in the field have highlighted areas that have potential for improving visual performance,

namely: screening and evaluation of athletes for specific visual skills related to their sport (i.e. peripheral awareness, saccades and pursuits) and vision and training to improve visual skills necessary for athletic excellence (Christenson & Winkelstein, 1998).

In 1982, Stine *et al.* (1982) proposed three basic assumptions, which have become the cornerstone for evaluation, diagnosis and management of visual defects of athletes. The assumptions state that: i) athletes have better visual skills than non-athletes, an assumption that has since proven to be a fact (Classé *et al.*, 1997; Christenson & Winkelstein, 1998), ii) visual abilities are trainable and iii) visual training of visual abilities is transferable to the performance of the athlete (Stine *et al.*, 1982; Laby *et al.*, 1996; Du Toit, van Vuuren, van Heerden & de Wet, 2006).

Vision is the process through which light reflects from objects in our environment and is translated into a mental image. Electric signals from the eye are transported via the optic nerves to the optic chiasm where some fibres cross to the opposite side. In the thalamus, the neurons synapse in the lateral geniculate nucleus and terminate at the visual cortex in the occipital lobe (Molia, Rubin & Kohn, 1998). The lens is attached to the ciliary muscle inelastic fibres known as zonulas. When no pressure is applied to the zonulas, the lens assumes a rounded shape, adapted for near vision. When pressure is applied, the lens flattens and becomes adapted for distance vision (Molia *et al.*, 1998).

The visual system can be trained to respond faster to certain stimuli by using certain techniques and exercises. Exhaustion may have a negative effect on hand-eye- coordination (Classé *et al.*, 1997; Du Toit *et al.*, 2006). The ability to interpret what is seen and rapidly integrate that critical information with the requisite motor skills in sports is one of the component skills necessary for proficiency and achievement in sport (Abernethy & Wood, 2001; Silverthorn, 2001; Du Toit *et al.*, 2006; McMorris & Rayment, 2007).

Sport vision does not merely encompass the visual system but is made up of an integrated network of different systems, i.e. the visual system, the brain, the central and somatic nervous systems and the skeletal muscle. Together, this network functions to maintain hand-eye coordination, peripheral awareness, depth perception (Thompson, Dilda & Creem-Regehr, 2007) visual anticipation,

short-term memory and visual concentration (Du Toit *et al.*, 2006). The parameters mentioned above are all essential for total sport vision. Underdevelopment in any one of these aspects greatly affects sport vision and consequently sports performance (Du Toit *et al.*, 2006).

This study was carried out in order to determine the relevance of sport vision testing in soccer players. It also seeks to determine the visual skills of soccer players and to determine whether it is necessary for soccer players to receive visual skills training.

### **Materials and Methods**

Forty-eight (48) soccer players between the ages of 12 and 20 years were assessed. The soccer players were invited to participate in this study and these players were tested at selective venues, soccer fields and a sports vision laboratory. Ethical clearance was obtained from the university's ethics committee. The players signed informed consent forms where they were advised that their participation was voluntary. Data were presented as means and standard deviations to compare visual skills between age groups and different field positions. For the purpose of this study, the participants were tested on six visual skill tests, namely: depth perception, accommodation flexibility, peripheral awareness, eye tracking (saccades), eye jumps (pursuits) and visual memory.

*Depth perception (PERCEPT).* To test depth perception, a stereogram with nine blocks and four circles in each block was used. Each participant had to identify the 3-D circle in each block whilst wearing goggles. The time and the number of correct circles identified were noted.

*Accommodation flexibility (FLEX).* This parameter was tested by counting the number of letters each participant could read whilst alternating the dioptre prism flippers in one minute at a viewing distance of 30 cm. The score recorded was the number of rotations the player achieved in one minute.

*Peripheral awareness (PER AWAR).* The test was performed on the Wayne Trainer. The participants were asked to stand on a wobble board as they were performing the test. The examiner noted the total number of lights depressed during the allowed time, expressed as number of touches and percentage

*Eye tracking (TRACKING).* A wooden disc with 26 holes is placed on a turntable and rotated at 33.3 rpm. Each of these 26 holes is numbered with a letter of

the alphabet. The subject has 3 minutes in which to place a golf tee into each hole. The placings must be done in alphabetical order.

*Eye jumps (JUMPS).* The participants were asked to stand an arm's length away from an A3 chart with letters (26pt, double spaced) on either side of the chart and had to read the letters as fast as they could without moving their heads. The number of errors made, if any, was noted. The score recorded was the time it took the participants to complete reading

*Visual memory (MEMORY).* This test was performed on computer using the HEALTHgenius™ sport vision CD. The participant had to remember the correct sequence of flashing colours. The participants were asked to sit on an exercise ball for the duration of the test. Time was not noted. The examiner noted the number of correct sequence answers expressed as a percentage.

**Results**

*Accommodation flexibility:* Looking at Figure 1, at least 40 % of the participants have a score greater than or equal to the norm of 22.

*Depth perception:* Depth perception is a measure of stereopsis. The normal expected value would be 9. Half of the players have values that are comparable to the norm, as is shown in Figure 2.

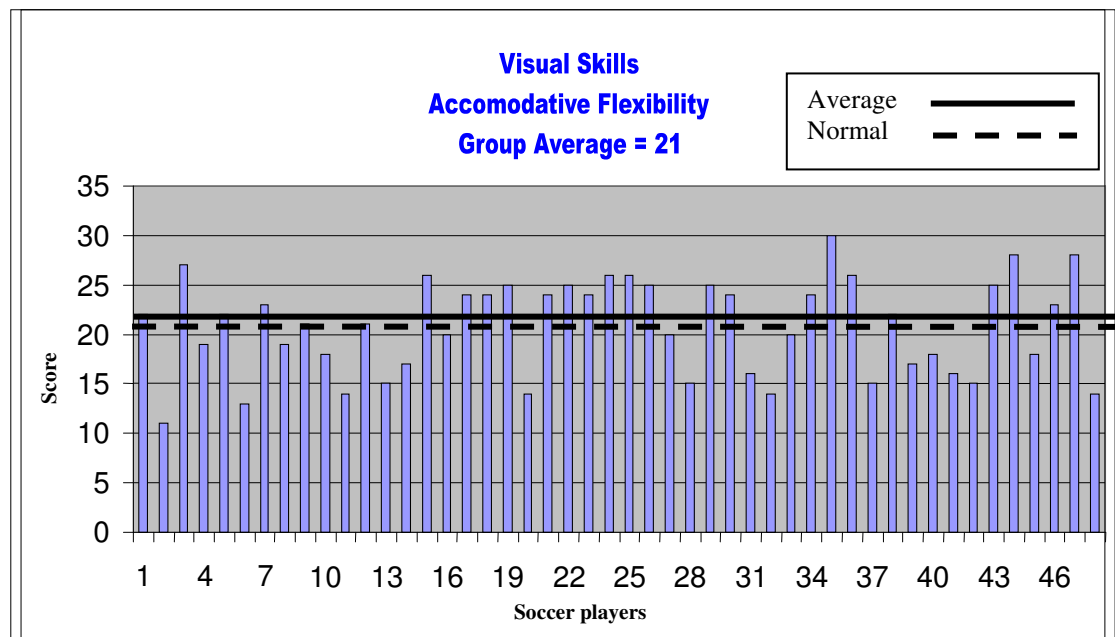


Figure 1: Comparison of accommodation flexibility between the participants.

*Eye tracking:* Eye tracking test results (Figure 3) showed that almost 50% of the players could not complete the exercise within the allowed 180 seconds (s) and that all the players were above (worse than) the norm of 90 seconds.

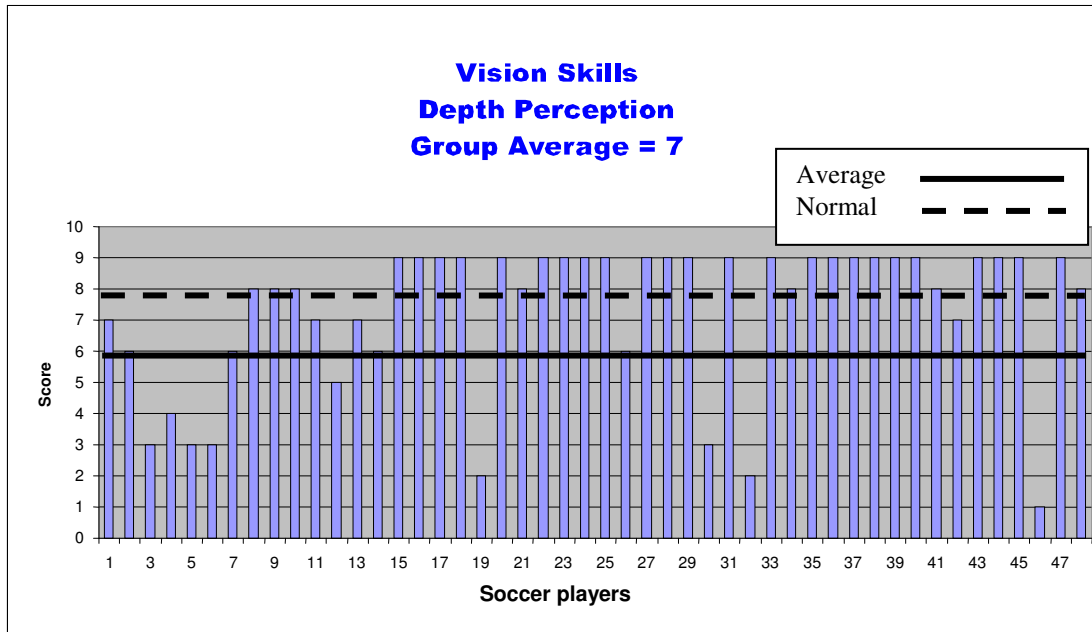


Figure 2: Comparison of depth perception between the participants.

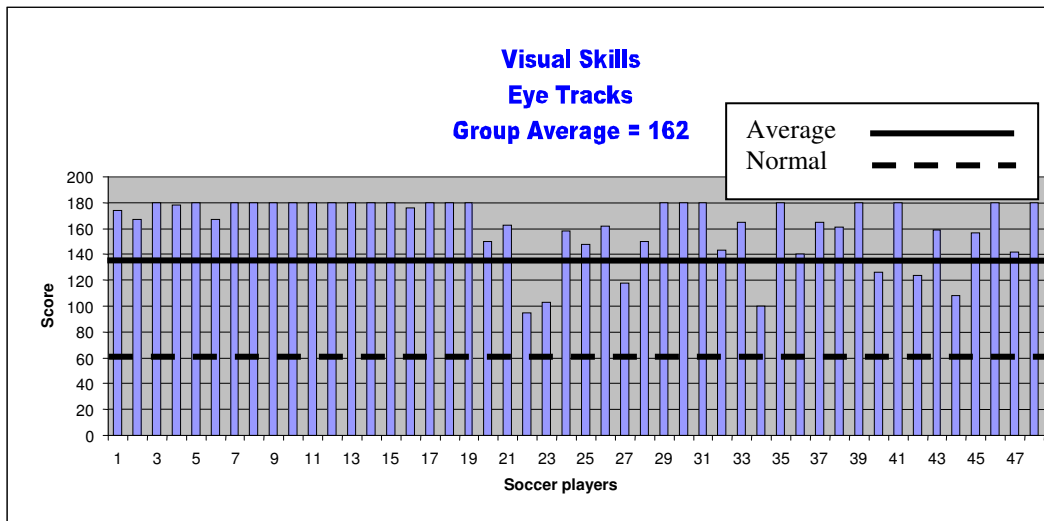


Figure 3: Comparison of eye tracking between the participants.

*Eye jumps:* The group average for eye jumps was 10 seconds(s) higher than normal (Figure 4).

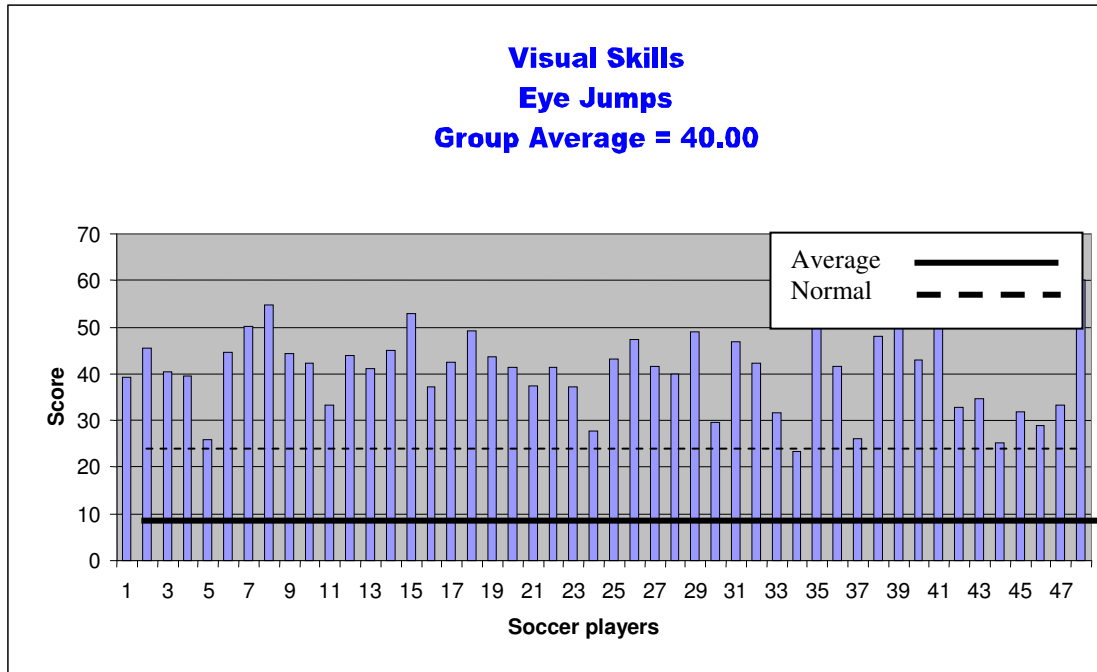


Figure 4: Comparison of eye jumps between the participants.

*Peripheral awareness:* Peripheral awareness is the ability to keep track of what is happening around you. The subjects in the study (average = 60%) have performed worse than the norm of 80 % (Figure 5).

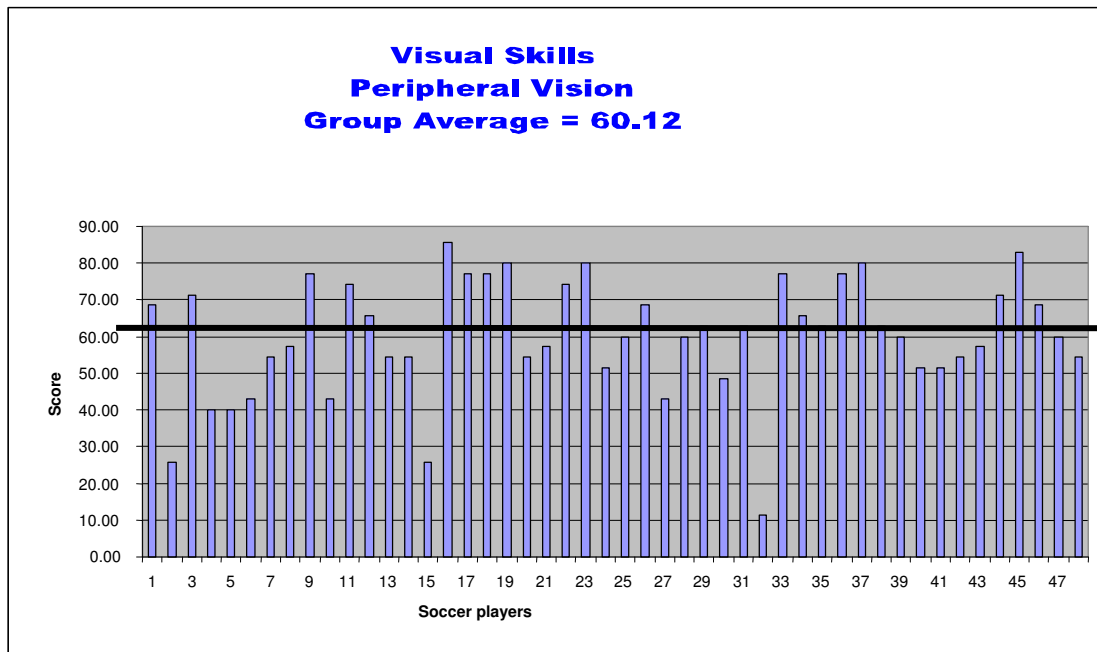


Figure 5: Comparison of peripheral awareness between the participants.

*Visual memory:* The participants visual memory results (Figure 6) was well below (average = 22.09%) the norm of between 75-85%.

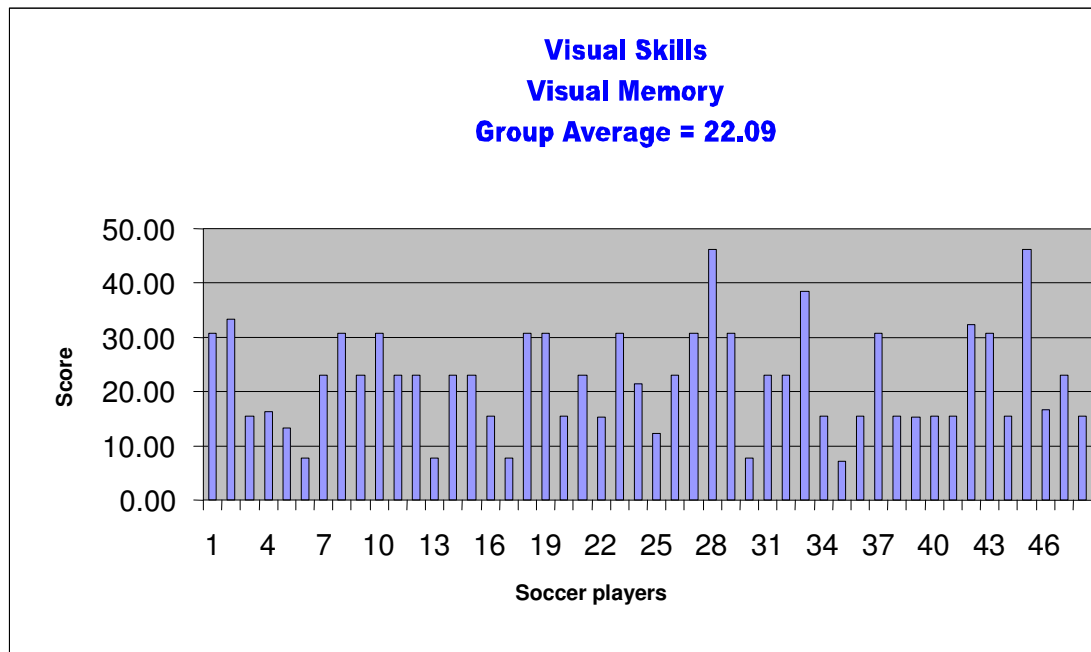


Figure 6: Comparison of visual memory between the participants.

As a way of determining whether the visual skills were common throughout the study population, a comparison was done according to age groups (Table 1). The general trend that was noted was that visual skills seem to improve with age (Figure 7). Accommodation flexibility and depth perception improved with age (12 to 18 years), while eye tracking, eye jumps, peripheral awareness and visual memory improved from 12 to years. This is important as it means that as the player progresses in age his visual skills might improve which can translate to an improvement in his performance on the field.

Table 1: Mean and standard deviations of players' visual skills according to age groups

AGE GROUP	N	FLEX		PERCEPT		TRACKING		JUMPS		MEMORY		PER AWAR	
		Norm: 22		Norm: 9		Norm: 90		Norm: 30		Norm: 75-85		Norm: 80	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
12 – 13	16	20	±5	6	±2	175	±14	44.90	±7.50	54.11	±16.41	20.27	±8.20
14 – 15	13	21	±5	8	±2	165	±25	39.47	±9.67	64.62	±12.21	22.69	±8.04
16 – 17	9	21	±5	8	±2	147	±34	37.68	±9.25	64.13	±12.95	25.57	±15.47
18 +	10	22	±5	8	±2	149	±18	39.23	±7.39	60.29	±20.13	21.07	±6.43

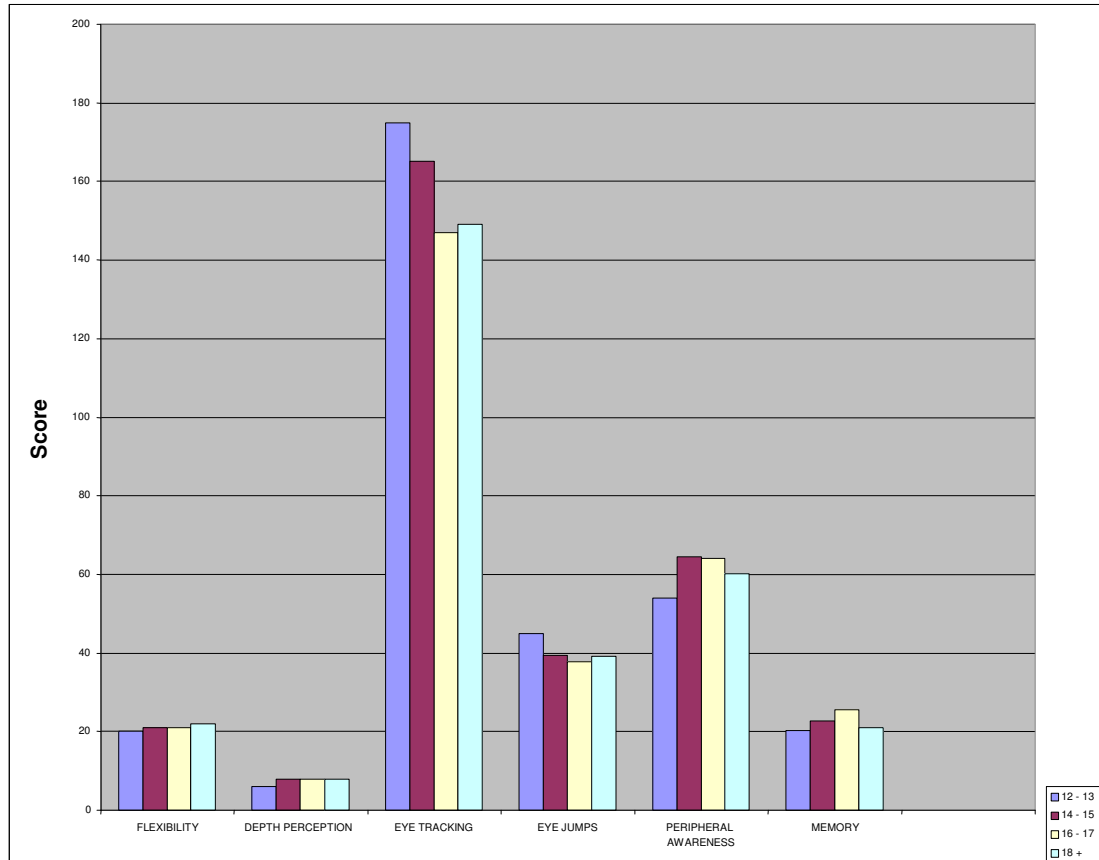


Figure 7: Comparison of visual skills according to age groups.

In soccer, players are not only divided into age groups but are also categorised by the positions they play. A comparison between the different positions would be fair as this would help to identify the different skills that are required by each position (Table 2). Figure 8 compares the skills of the participants according to the position played. Certain visual skills are more acute in some positions, e.g. accommodation flexibility in strikers; depth perception in strikers and midfielders; eye tracking in strikers; eye jumps, peripheral awareness and visual memory in defenders.

Table 2: Mean and standard deviations of players' visual skills according to field position

POSITION	N	FLEX Norm: 22		PERCEPT Norm: 9		TRACKING Norm: 90		JUMPS Norm: 30		MEMORY Norm: 75-85		PER AWARE Norm: 80	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<b>Defender</b>	13	21	±4	7	±2	161	±31	39.12	±8.63	65.92	±11.18	25.53	±8.66
<b>Striker</b>	10	22	±5	8	±2	160	±22	40.77	±7.49	62.29	±18.99	22.09	±9.09
<b>Midfielder</b>	21	21	±5	8	±2	162	±24	41.04	±8.84	56.46	±16.61	20.85	±9.94
<b>Goalkeeper</b>	2	14	±1	6	±4	180	±0	52.35	±11.05	48.57	±8.08	11.54	±5.44

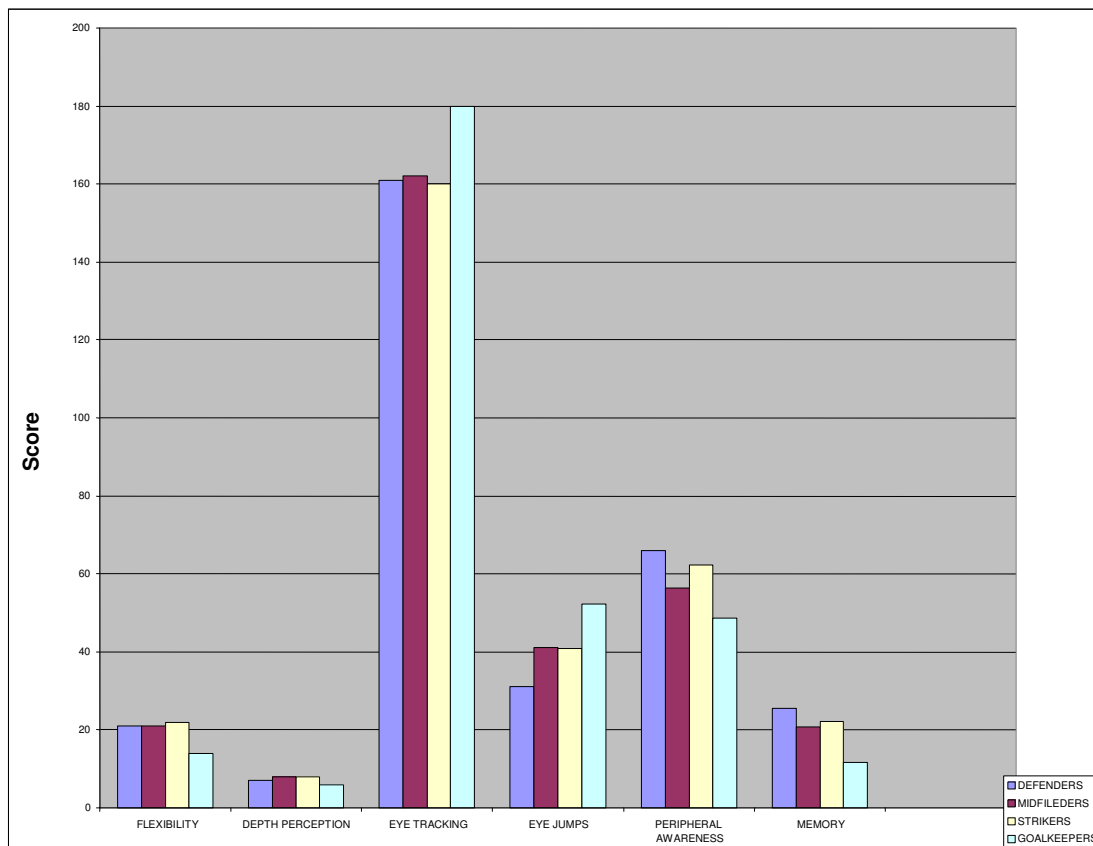


Figure 8: Comparison of visual skills according to player position.

### Discussion

As a result of the many skills that must be mastered, soccer has become a complex sport (Luongo, 1996). Soccer is multi dimensional as it is played both on the ground and in the air. The results have indicated an improvement in visual skills as the participant's age increases. This could be attributed to the type of training that is being received and to the number of years that the player has been playing in his position because having accumulated visual skills his performance will be enhanced (Chow, Davids, Button & Koh, 2008). The results have also shown that different positions do not necessarily have different levels of visual skills. This reinforces the suggestion that visual skills are not necessarily a function of the position one plays. However, the roles and duties that are expected from each position seem to require certain visual skills to be more acute in some positions (Pesce, Tessitore, Casella, Pirritano & Capranica, 2007).

Goalkeepers would need to be aware of everything that is going on around them (peripheral awareness), be able to remember where their players are positioned

(visual memory) and also they should be able to adapt easily from distant objects to near objects (accommodation flexibility) (Treadwell, 1995).

A defender needs to be aware of where his teammates are on the field in order to pass the ball accurately (Treadwell, 1995). Defenders, like the goalkeeper, need to have strong visual memory, accommodation, flexibility and peripheral awareness skills as confirmed by the results in Figure 8. Above all, they also need to be able to keep track of the moving ball.

Midfielders have to go where the ball is, i.e. they must keep their eyes on the ball. They are the decision-makers in the team as they control the flow of the game (Treadwell, 1995). As the decision makers of the team, the midfielders need to be able to anticipate the movement of the ball and how best to play it should it land in their zone. Thus, midfielders need to have sharp visual memory and peripheral awareness skills so as to make decisions that will best suit the situation they will find themselves in. The midfielders in this study can concentrate a bit more on their peripheral awareness and visual memory skills (Figure 8).

The striker needs to be able to determine when and how to take a shot at goal. The visual skills they need to master would be depth perception, accommodation flexibility, eye tracking, eye jumps, visual memory and peripheral awareness as seen by the results in Figure 8.

### **Conclusion and Recommendations**

This study was carried out in order to determine the visual skills of soccer players and the relevance of sport vision testing in soccer players. The results indicate that visual skills tend to increase with age although they do not show much change within the groups.

Sport vision is an integral part of the holistic approach to improving athletes' performances on the field and should not be taken for granted. Where possible, intervention programmes, in the form of training and awareness, should be implemented to significantly improve the performance of the athlete. Further studies using a greater sample size is recommended to evaluate the visual skills on a more extensive level.

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