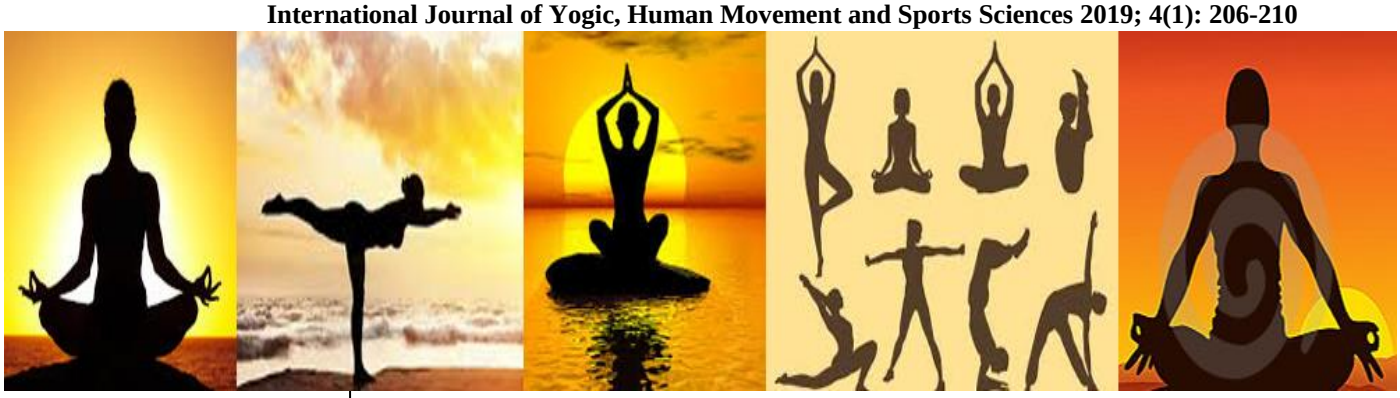
International Journal of Yogic, Human Movement and Sports Sciences 2019; 4(1): 206-210



ISSN: 2456-4419
Impact Factor: (RJIF): 5.18
Yoga 2019; 4(1): 206-210

www.theyogicjournal.com
Received: 14-11-2018
Accepted: 17-12-2018

Sukriti Anand
Senior Research Fellow (Sports Psychology), Human Performance Lab Sports Authority of India Jawahar Lal Nehru Stadium, New Delhi, India

Dr. Anuradha Solanky
Junior Scientific Officer (Sports Psychology) Human Performance Lab Sports Authority of India Jawahar Lal Nehru Stadium, New Delhi, India

Correspondence
Sukriti Anand
Senior Research Fellow (Sports Psychology), Human Performance Lab Sports Authority of India Jawahar Lal Nehru Stadium, New Delhi, India

Correlation between psychomotor skills and visual parameters of racquet sports

Sukriti Anand and Dr. Anuradha Solanky

Abstract
Background/Aims: The main aim of the study was to assess specific coordination motor abilities and to determine how visual perception and reaction time correlate with time-movement anticipation in racquet sports.
Methodology: Subjects for the study comprised 30 male athletes from different sports (table tennis, tennis and badminton) from Jawaharlal Nehru Stadium, New Delhi aged between 13 to 21 years and their mean experience was 2.24 years. The tests conducted were Reaction test (RT), Peripheral Perception test (PP) and Time/Movement Anticipation (ZBA) test in the Vienna Test System sport (Schufired).
Results: It was found that the best developed ability in participants was reaction time, while the other abilities showed average development. Participants were able to develop their response abilities to very high levels by means of practice. A correlation coefficient of r=0.61 was found between motor time and tracking deviation, and between time anticipation and the number of correct responses to stimuli appearing in the left (r=0.90) and right (r=0.84) field of vision. Athletes who achieved better results in time anticipation omitted fewer visual stimuli (r=0.71) in the peripheral field of vision. Significant correlations were found between movement anticipation and reaction time to stimuli in the central field of vision (r=0.54).
Conclusions: Perception abilities have a significant effect on time anticipation. The range of one's field of vision does not determine the reaction time to a visual stimulus. Perception efficiency and divided attention in conjunction with time/movement anticipation create a complex of specific psychomotor skills that is indispensable for achieving success in racquet sports.

Keywords: Psychomotor skills, peripheral perception, reaction time, time/movement anticipation, vienna test system sports

Introduction
The participation in modern sports is influenced by various factors like psychological factors, physical, physiological and sociological factors. In training, besides good physique and physical fitness of the athlete, main emphasis is laid on the development of various types of motor skills involved in the game through acquiring the strategies, techniques and tactics of the game. It is only recently that sports administrators and coaches have realized the importance of the psychological preparation and training of players to enable them to bear the strain and stress inherent in sports participants.
Today racquet sports involve the domination of a defensive game, which is very quick and aggressive. This requires not only an excellent physical condition and overall coordination level, but also specific coordinative motor skills, which may be regarded as psychomotor predispositions; these are directly related to skills which are mostly dependent on visual perception like Peripheral Perception, Reaction Time and Time/Movement Anticipation.
During sports competition a high level of visual perception is a critical factor. Man communicates with the environment using this sight mainly and a large part of the CNS concentrates on the analysis of visual stimuli (Mackimoon; P, Morris's 2002). Selection of stimuli is a characteristic aspect of perception in racquet sports.
The visual system is the most complex sensory system which is engaged in creating feedback and dominates the other sensory systems. Visual perception is the ability to recognize and interpret visual stimuli in the context of previous experiences, although it is a process of creation rather than recreation.

It is an element of almost all human actions and is assessed through reaction time to a stimulus appearing in central or peripheral field of vision (Ando S. 2013) [2].

In elite sports athlete shows the highest possible level of reaction time to stimuli in both central and peripheral (left & right) field of vision, because the initial processing of visual information which is usually followed by the player's selection of the most significant stimuli from a quickly changing series of short duration to make game performance as effective as possible.

The first scholar to notice and describe the relationship between visual perception, the human body and the ball was Galen (in the second century BCE). His findings motivated others authors to conduct further research on the correlation between visual perception and success in sports (Beckerman S., Hitzeman S.A. (2003) [3].

Peripheral awareness is a very important visual skills acquired to know the position of the opponents and teammates. Good peripheral also facilitates anticipation and movement between gaps. This dimension measures the ability to receive and process information on the edge of the visual field. The visual field measured in the VTS SPORT by the PP test (Peripheral Perception). Administration of this test requires the foot operated keys and an external input medium consisting of light diode strips that are attached to the left and right of the monitor. These strips produce regular light stimuli. Critical stimuli appear at pre-defined intervals and require the respondent to react by depressing the foot pedal. At the same time a moving ball on the screen must be keep in the crosshairs; this prevents the respondent turning his head.

The ability to predict the actions of one's opponent and immediately make an appropriate response is termed anticipation. It can be regarded as a cognitive process by means of which factors that are relevant to the subsequent action can be identified promptly, evaluated and taken into account in programming one's own movement (Ritzdorf, 1982).

Anticipation of movement is measured by the Time/Movement Anticipation (ZBA S2). In this test a green ball appears on the screen, moving slowly. At an unpredictable moment the ball has just disappears and two red lines appear. One line passes through the point at which the ball has just disappeared. The other is the target line.

Material and methods

The study participants comprised 30 athletes from different sports (table tennis, tennis and badminton) from Jawaharlal Nehru Stadium, New Delhi age between 13 to 21 years and their average experience was 2.24 years. The study involved three tests from Vienna Test System: the Time/Movement Anticipation Test (ZBA), the Reaction Time Test (RT) the Peripheral Perception (PP).

The PP test assessed peripheral perception and central tracking. During the test, each participant focused his attention on the centre of his field of vision while computer software generated 40 stimuli (20 stimuli from the right side and 20 from the left side) on the side panels of the device. The participant performed a tracking task, at the same time responding to visual stimuli in the peripheral field of vision. The results of the test also provided information about divided attention. The lasted 10 minutes. The primary variables assessed in the test were the viewing angle of the left eye, the viewing angle of the right eye, and the total field of vision (i.e. the sum of the left and right viewing angle of the eye). The control variable was the tracking displacement, which characterized the displacement of the crosshair from the moving target.

Auxiliary variables comprised the following: the number of correct responses to stimuli in the left and right field of vision (the participants pressed a pedal when a flashing line appeared on the right or left panel of the device); the number of incorrect responses (i.e. the number of times the pressed the pedal when no stimulus appeared); the number of omitted responses (i.e., the number of times the participant failed to press the pedal when a stimulus appeared); and mean reaction time from the left and right side (i.e., the time of correct responses to a stimulus) (Vienna Test System 2013) [19].

Reaction ability is measured in the VTS SPORT by the RT S1. This test requires the respondent to press a particular button as quickly as he can when a particular stimulus appears. It is possible to separate the "Reaction Time from the "Motor Time".

The ZBA test assessed the ability to predict the spatiotemporal position of an object. The short (task-based) version of the test was used i.e. S2, 12. Time anticipation was measured by means of a green ball that appeared on the screen and began to move slowly. At some point, the ball disappeared and two red lines appeared. One line crossed the point where the ball disappeared, while the other line was the target. The participant's task was to indicate when the ball would reach the target line pressing a key at the time he deemed correct. In addition, the participant was asked to indicate the spot in which the ball would cross the target line, which would make it possible to assess his movement anticipation. This was done by rotating two dials on the main panel that controlled the pointer on the screen. In the trail phase, the participant received feedback in the form of his response and the correct response appearing together on the screen. In the testing phase, the participant was not shown the correct response. The test lasted 10 minutes (Vienna Test System 2013) [19].

The RT test assessed reaction time to visual stimuli (yellow light) appearing on the screen, the participant held his finger on the rest key located on the response panel. When a yellow light appeared on the screen, he responded by moving his finger and pressing the reaction key (a black key located above the rest key). The primary variables assessed in the RT test were reaction time (ms) (i.e., the time between a stimulus appearing on the screen and the participant moving the finger away from the rest key) and motor time (MRT; ms) (i.e., the time between participant moving the finger away from the rest key and pressing the reaction key).

Auxiliary variables comprised reaction time dispersion (i.e. the measurement of the reaction time dispersion after transforming the standard deviation of reaction time values using the Box-Cox transformation) and motor time dispersion (i.e. the measurement of the motor time dispersion after transforming the standard deviation of motor times values using the Box-Cox transformation). This study used the S1 form of the test (simple reaction to yellow light). The test lasted for four minutes and was formed with right hand (Vienna Test System 2013) [19].

The results obtained were analyzed statistically, using the SPSS-17Software. The Spearman's rank correlation coefficient was used to check for any correlations between skills. Test results were compared with T-score available in the VTS software. The T-score is a result of comparing the test results with the standardization sample, which takes into account a respondent's age and gender. Values between 40 and 60 are considered to indicate that the value is within the norm (Vienna Test System 2013) [19].

Results

In Reaction test (RT) the players average reaction time to the visual stimuli equaled 321.22 ± 43.26 ms. The best result was 159 ms; the below average was 389 ms. The average measure of the reaction time dispersion also suggest a high stimulus reaction readiness throughout the whole exercise. The average motor time also received very high scores on the T- score, though they are slightly lower than the reaction time scores. Also, in the case the measurement of the motor time dispersion indicates high motor reaction stability.

Table 1: Average values scored by the athlete in Reaction Time (RT), Time/ Movement (Anticipation (ZBA) and Peripheral Perception (PP) are shown:

Variables	Units	X ± SD	Reliability
Reaction Time			
Mean reaction time	Ms	321.22 ± 43.26	0.931
Mean motor time	Ms	109.93 ± 48.38	0.982
Reaction time dispersion	Ms	34.67 ± 11.65	0.960
Motor time dispersion	Ms	17.29 ± 7.54	0.973
Anticipation of Time and Movement			
Anticipation of Time	S	2.09 ± 0.82	0.91
Anticipation of Movement	Pixel	83.74 ± 22.50	0.55
Visual Perception			
Tracking deviation	-	16.24 ± 4.61	0.93
Overall field of vision	º	247.16 ± 5.10	0.96
Visual angel- right	º	96.47 ± 3.80	-
Visual angel - left	º	98.41± 2.80	-
Number of hits left	N	20.20 ± 4.00	-
Numbers of hits right	N	22.83 ± 3.70	-
Numbers of omitted reactions	N	3.5 ± 3.26	-
Median reaction time left	S	0.74 ± 0.26	-
Median reaction time right	S	0.56 ± 0.09	-

Another test was the time/movement anticipation test (ZBA).The analysis of the results indicated that for the athletes the correct anticipation of the movement direction proved more difficult than the time anticipation. The average value of errors made by the athletes in the case of movement anticipation reached 83.74 ± 22.50 pixels; the time error equal to 2.09 ± 0.82 s (table.1). The level of both abilities was classified according to the T- scale and PR percentage scale, within the normal range for the population.

The last test was Peripheral Perception (PP) test, its complexity allowed for the assessment of both the complete field of vision (247.16º ± 5.10) and the range of left (98.41º ± 2.80) peripheral perception as well as tracking deviation (16.24º ± 4.61). In addition, the number of correct reactions to 40 visual stimuli was assessed. During the exercise, 20 stimuli appeared on the right side of the field of vision (correct: 22.83 ± 3.70); another 20 stimuli appeared on the left side of the field of vision (correct 20.20 ± 4.00) (table.1).

It was noted that the athletes answered correctly for more stimuli appearing on the right side. The minimal times obtained in the exercise are almost equal: 0.60 s for the right side and 0.64 s for the left side and the slowest reaction 0.85 s, noted when the signal appeared on the left side.

Linking together a number of exercise performed simultaneously by each study athlete allowed for the assessment of an athlete's divided attention. However, the average value of the central tracking deviation showed poor result among the abilities studied.

Discussion

Research using the Vienna Test System has so far been conducted among athletes from different sports disciplines, including racquet sports (badminton & table- tennis), martial arts (taekwondo ITF, wrestling & fencing) and team sports (volleyball, football & handball) (Poliszcuzuk T., Mosakowska M. *et al*. (2009) [13]. The research results in print also include those that emphasize the correlation between visual capability and other motor abilities. Hence, a number of publications state an urgent need to train perception, as it directly affects performance in sports (Kohmura Y, Yoshigi H. (2004) [12], Boryuski Z., Waskiewicz Z. (2008) [4]. The results of the study were compared to those obtained in studies conducted using VTS among the National representation of male badminton players aged 23.33 ± 2.35 years and among male second-league handball players aged 21.86 ± 1.09 years (Poliszczuk T., Mosakowska M. (2009) & Zwierko T. (2007) [13].

Table 2: Correlation between Reaction Time, Time-Movement Anticipation and Visual Perception:

Variables	Anticipation of time	Anticipation of Movement	Tracking Deviation
Mean reaction-time (ms) Central field of view	0.46	0.53*	0.26
Mean motor time (ms) Central field of view	0.34	0.08	0.54*
Overall field of vision (PP)	-0.24	0.01	-0.02
Visual angel - left	-0.38	-0.24	-0.13
Visual angel - right	0.01	0.18	0.01
Number of hits - left	0.90*	-0.39	-0.30
Number of hits - right	0.84*	-0.28	-0.31
Number of Omitted Reactions	0.71*	0.33	0.38
Number of Incorrect Reaction	-0.11	-0.48	-0.27

*- Statistically significant correlation ($p<0.05$).

The participation of this study showed a greater range of the field of the Vision (247.16 º ± 5.10) than male badminton players (172.9 º ± 4.45) and male handball players (170.95 º ± 9.15) (Zwierko T.(2007) [21]. They also displayed the lowest difference between the viewing angles of the left and right eye. No statically significant difference in the lateralization of reaction time to stimuli in the peripheral field of vision was observed. However the participants responded correctly to stimuli appearing from the right side. The participants reacted more quickly to stimuli in the peripheral field of vision (left side: 0.74± 0.26; right side: 0.56±0.09) than male badminton players (left side: 0.66±0.07; right side: 0.66±0.05) and slightly more slowly than male handball players (left side: 0.55±0.07; right side 0.54± 0.05) ((Poliszczuk T., Mosakowska M. (2009) [13] & Zwierko T. (2007) [21].

Research done by other authors indicates that a higher level of perception abilities results from the skill to quickly recognize and respond to stimuli more than from the functioning of peripheral vision (Ghasemi A., Momeni M., Rezaee M., Gholami A. (2009) [9]. Most studies conducted among athletes and person not engaged in sports support this thesis. Moreover, a wider range of vision does not guarantee a quicker reaction to stimuli in the peripheral field. Athletes react more quickly and more accurately to stimuli than persons not engaged in sports (Ghasemi A., Momeni M., Rezaee M., Gholami A. (2009) [9] & Ando S. (2013) [2].

The findings of this study in relation to the findings of the other researchers proves more difficult as far as the reaction time test is concerned, due to vast number of research tools used to assess this ability. Mean human reaction time to a visual stimulus amounts to approximately 250 ms, with athletes showing lower values. Systematic training reduces reaction time in both healthy young persons and elderly persons (Jaworski J., Tchorzewski D., Bujas P. (2011) [11].

The ability to predict the actions of one's opponent and immediately make an appropriate response is termed as anticipation and the role of anticipation ability as a determining factor of effective play is being addresses more frequently on the international level (Tanaka M., *et al.* (2011) [18], William A.M., *et al.* (2009) [20], Reid M. (2012) [16] & Fujii K., Shinya *et al.* (2014) [8]. Recent research indicates that focusing on the opponent's trunk does not provide all the information necessary to efficiently predict the final direction of the opponent's movements. A study by Fuji *et al*. suggested that enhancing one's defense against the attacker is only possible if the trunk is observed in the central field of vision and the feet position is simultaneously observed in the peripheral field of vision (Fujii K., Shinya M., Yamashita D., Kouzaki M., Oda S. (2014) [8].

The result showed in this study showed that the ability to quickly assess the position and direction of an object in space correlated significantly with reaction time and motor time. Athletes who were better at predicting the position of an object in space and time reacted faster to visual stimuli.

Similar results were found in Pawelak Z., Laykh V., Witkowski W. (2009) [14] study, which involved conducting fitness test in a group of female handball players and in a study with females soccer players (Starosta W. (2003) [17]. Both studies observed average correlations, primarily between the indicators of spatial orientation and reaction rate. With respect to the other abilities studied, 70% to 95% of the cases showed no statistically significant correlations.

A study that used the VTS with a badminton team proves that the time anticipation ability also correlates significantly with total field of vision (r= -0.82) (Poliszczuk T., Mosakowska M. (2009) [13]. However, an analysis the results of the test in the group of racquet players showed a correlation between the number of omitted responses to stimuli appearing in the peripheral field of vision and time anticipation (r= 0.76) tab.2, as was the case in the study with handball players (r=0.89).

A correlation was found between motor time and tracking deviation (r=0.54), and between time anticipation and the number of correct responses to stimuli appearing in the left (r=0.90) and right (r=0.84) field of vision. Statistically significant correlations were also noticed between movement anticipation and reaction time to a stimulus in the central field of vision (r=0.53). This study proves that highly developed ability to analyze visual stimuli in the central and peripheral fields of vision results in a better ability to predict the spatiotemporal position of an object, which in turn directly affects athletes' defensive and offensive abilities during play, as also found by other researchers (Fujii K., Shinya M., Yamashita D., Kouzaki M., Oda S. (2014) [8].

Conclusion

Visual perception abilities were found to significantly affect time anticipation. This proves that perception efficiency and divided attention, in conjunction with time and movement anticipation, create a complex of specific psychomotor abilities that is indispensible for success in racquet sports.

The study participants were able to develop their response abilities by practice. It may be concluded that the high level of reaction time in the study participants may have compensated for the average level of other abilities.

References

1. Abernethy B. Selective attention in fast ball sports. II: Expert novice differences. Australian journal of science and medicine in sport. 1987; 19(4):7-16.
2. Ando S, Kida N, Oda S. Central and peripheral visual reaction time of soccer players and nonathletes. Perceptual and Motor Skills. 2001; 92(3):786-794.
3. Beckerman S, Hitzeman SA. Sport's vision testing of selected athletic participants in the 1997 and 1998 AAU. Journal Olympic Games. Journal of Optometry. 2003; 74(8):502-516.
4. Borysiuk Z, Waskiewicz Z. Information Processes, Stimulation and Perceptual Training in Fencing, Journal of Human Kinetics. 2008; 23:21-27.
5. Christenson GN, Winkelstein AN. Visual skills of athletes versus non athletes: development of a sports vision testing battery. Journal of American Optometric Association. 1988; 59(9):666-675.
6. Clyde, Everett, Nobel, Bryant J Cratty. Perceptual learning. In Encyclopedia Britannica, 2016 Retrived from http://www.britanica.com/topic/perceptual-learning.
7. Etnyre B, Kinugasa T. Post concentration influences on reaction time (motor control and learning). Research Quarterly for Exercise and sports. 2000; 73(3):271-282.
8. Fujii K, Shinya M, Yamashita D, Kouzaki M, Oda S. Anticipation basketball defenders:An explanation based on the three-dimensional inverted pendulum model. European Journal of Sports Science. 2014; 14(6):1-9.
9. Ghasemi A, Momeni M, Rezaee M, Gholami A. The Difference in Visual Skills between Experts versus Novice Soccer Referees. Journal of Human Kinetics. 2009; 22:15-20 DOI: 10.2478/v10078-009-0018-1.
10. Hitzeman SA, Beckerman S. What the literature says about sports vision. Optometry clinics. 1993; 3:145-169.
11. Jaworski J, Tchorzewski D, Bujas P. Involution of simple

and complex reaction times among people aged between 21 and 80- the result of computer tests. Human Movement. 2011; 12(2):53-158.DOI: 10.2478/v10038-011-0013-y.
12. Kohmura Y, Yoshigi H. Training Effects of visual function on college baseball players. Human Performance Measurement. 2004; 1:15-23.
13. Poliszcuzuk T, Mosakowska M. Interactions of peripheral perception and ability of time- movement anticipation in high class competitive badminton players. Studies in Physical Culture and Tourism. 2009; 16(3):259-265.
14. Pawelak Z, Laykh V, Witkowski W. The correlation between different coordinate skills and efficiency of qualified female handball players. In S. Zak, M. Spieszny (eds), The Analysis of Training Process and Competition in Sport Games (Handball) (pp. 66-74). Krakow-Wroclaw: Miedzynarodowe Towarzystwo Naukowe Gier Sportowych. [in Polish], 2009.
15. Raczek J, Mynarski W. Coordination motor abilities of children and young people: internal structure and variability. Katowicwe: in Polish Journal, 2012.
16. Reid M. The contribution of situational probability information to anticipatory skill. Journal of Science Medicine sport. 2012; 15(4):368-374. DOI: 1016/j.jsams.2011.12.007.
17. Starosta W. Global and local motor coordination in physical education and sport. Warszawa: AWF Warszawa. [in Polish], 2006.
18. Tanaka M, Sekiya H, Tanaka Y. Effects of Explicit and Implicit Perceptual Training on Anticipation Skills of Novice Baseball Players. Asian Journal of Exercise and Sports Science. 2011; 8(1):1-15. DOI:10.4146/jjspopsy.2013-1212.
19. Vienna Test System. Vision Test System Sport. Sports Psychological Assessement and Biofeedback, 2013. Retrieved May 20, 2014 on the World Wide Web; http://www,schuhfried.com/fileadmin/content/2_kataloge_en/WTS_4c_en_2013_web_ecat.pdf.
20. Williams AM, Davidsk, Williams JG. Visual perception and action in sport. Taylor and Francsis. London New York, 1999.
21. Zwierko, Teresa. Difference in peripheral perception between athletes and non athletes. Journal of Human Kinetics. 2007; 19:53-62.