

Full Length Research Paper

Effect of skill level and indirect measurements in the attack situations in handball

Zahra Nezakat Alhosseini*, Shila Safavi and Mehdi Namazi Zadeh

Physical Education and Exercise Science Faculty, Azad Islamic Khorasgan University, Esfahan, Iran.

Received 1 March, 2014; Accepted 14 January, 2015

The purpose of the study was to compare the effect of visual search and skill-level on the spatial occlusion anticipation in handball players. Thirty skilled and thirty unskilled handball players aged 20 to 35 years anticipated the situation of seven handball attack video movies. Visual search behavior was measured by using validated researcher made questionnaire. The results of anticipation illustrated that, skilled players were better than unskilled players in all of the situations but the important point was that skilled players anticipated situations based on their roles and position in game. Also, there were significant difference between skilled and unskilled players in regard to anticipation, skill-level and visual search behavior. In summary, the results indicated that visual attention of skilled players was on the attacker player's upper body. In general, consideration of involved factors in sports performance can reveal substantial cues in exercise and training of different sports to facilitate and be effective in executing different handball skills.

Key words: Anticipation, visual search, spatial occlusion.

INTRODUCTION

Vision obviously plays a crucial role in athletes' pick-up of environmental information for spatial positioning, balance optimization and the planning and adaptive modification of action (Abernethy and Russel, 1987; Goulet et al., 1989; Abernethy, 1990; William and David, 1998; Williams et al 1999). Advance visual cue utilization refers to a player's ability to make accurate predictions based on information arising from an opponent's posture and bodily orientation previously to a key event such as football contact (William, 2000). Visual search processes can be assessed by two measurement methods: the direct method and what has been elsewhere termed the 'indirect measurement of visual search' (Cauraugh and

Janelle, 2003). Experimental methods known as 'indirect measurements' make use of the temporal- and spatial-occlusion paradigm of the visual scene. The occlusion approach involves filming the appropriate display from the athlete's customary perspective and this offers the possibility of determining differences in cue dependence between participations. The temporal-occlusion paradigm requires players to observe video sequences that are occluded at a number of specific points, typically several frames before or after the moment at which the opponent produces a stroke.

After the video clip has been occluded, the players indicate the opponent's future actions or the direction in

which they believe the ball will go. The spatial-occlusion paradigm has been employed to investigate the nature of the anticipatory cues the performer uses in the anticipation process (Mecheri, 2011). Temporal and spatial occlusion techniques have been employed to systematically demonstrate expert/non expert differences in the use of information presented early in the visual display across a variety of sports (Shim et al., 2005), including tennis, badminton, squash, cricket, baseball, volleyball, fencing and football (Abernethy and Russel 1993; Buckloz et al., 1988; Starkes et al., 1995; William, 2002; Jackson and Morgan, 2007; Casanova et al., 2009; Takeuchi and Inomata, 2009, 2012; Muller et al., 2011; Ward et al., 2012; Hagamann et al., 2006) aim to demonstrate the effect of cue occlusion in the predication of ball trajectories. Muller et al. (2006) specified that, if predication error increased when a particular part was blacked out, it meant that this part not only had to be providing a great deal of useful information to the anticipator, but also that the information conveyed by this cue was unique and could not be provided effectively or concurrently from another unconcluded source.

Researchers have recently argued that performers are more likely to extract global, motion-related information from an opponent's postural orientation than a specific information cue. The suggestion is that, skilled performers use the relative motion between joints and limbs to guide successful performance rather than a specific cue(s) (Lavalle et al., 2004). In the situation or strategic sport, such as team sports, players have to make fast and accurate decisions in a complex and variable environment (Mori and Shimada, 2013; Mann, 2007). Athletes' decisions are made upon information coming from different sources like the ball, teammates and opponents (Williams et al., 1994), and the decision-making process occur under pressure with opponents trying to restrict the "time" and "space" available. Therefore, the present studies follow explore these subjects, what different are between skilled and unskilled players in indirect measurements (spatial-temporal occlusion)? And could the result of the study be given to instructors as a strategy to train and educate players, and cause to rapid progress of players within a shorter time and spending less energy and cost?

METHODOLOGY

Participants

The total numbers of the participants were 60. They were all in full health, had a normal vision and their age ranged from 20 to 35. The skilled group participants were 30 skilled athletes from handball, who were the members of Esfahan Zobahan and Esfahan SepahanFulad sport clubs. The unskilled participants also were 30 students of physical education from Islamic Azad University Khorasgan branch, Esfahan, who had fulfilled handball credit course 1 or 2 or both, during education and were familiar with basic techniques of handball and had never taken part in any handball match officially. All of the participants provided informed consent.

Apparatus and procedure

In the experiment reported in this article, the researcher made use of real circumstances and situation of a series of attack situation in the recorded films of handball competitions of London Olympic in 2012. The researcher used MRT software (Ano AVI DivX to DVD SVSD VCD Converter 1.3) for separation and pause of the handball films, and in critical points on the motion of the ball. The players' motion in the handball court was showed to the participant through a RM-PJ7 Sony projector. Also, a G470 Lenovo lap top and Media Player Classic software 1, 2, and 3 were used to show the clips to the participants. The participants sat down on a chair behind a desk where a 2× 3 meter projection screen was settled 3 meter away from them. All conditions testing such as light, temperature, place, chair and desk type, etc. were similar.

Test conditions

In the present study, the researcher used seven clips of handball competitions of 2012 Olympic and kept three ones saved. The clips presented to the participants were repetitive then the repetitive clip would be omitted and from the saved clips one would presented to the participants the same circumstance as that of the omitted clip. In this research, the spatial occlusion film pause technic in such a way that the film was pause in a critical point on the motion of the ball, and the subject was asked to anticipate the ball situation. The situations the researcher had taken into account were as follows: shooting toward goal and scoring goal, catching or word off the ball by the goalkeeper, word off the ball by the defenders, passing the ball to a team mate and the going out of the ball (Figure 1). The clips were randomly displayed to the participants.

For each clip, a researcher made questionnaire from (performance anticipation questionnaire) what was used including two questions; the first one measured the participant's anticipation of the ball situation including five options that are the very situations the researcher have taken to account and the participant must choose one from among the other options. The second question related to visual cues search performance and contained 9 choices as well as another option as a tenth choice (free choice) in which the participant could write and mention any cues other than the cues mentioned in the 9 options or any special technic or any additional explanation participant had about the clip in this option. Furthermore, the subject must consider that, in second question, participant could choose any number of the 9 choice and had no limitation in choosing the choices. Within one session, the goal of performing the test and the way to perform it was described for the participants, and then based on a timed schedule the participant went to the test place (the conference chamber of Azad Islamic University of Khorasgan branch). With regard to the timed schedule, the subjects could not notice the quality of the performance of each other. In the place of testing, it was the subject and the tester that were present.

After the seven clips were presented and the anticipation form completed, at the end the subject four questions was asked from each clip in oral manner; the first question was "what did you pay attention to, before the clips paused? To ball direction, to the opposite back, or to the teammate in attack". The second question was "what did you pay attention to when the clips stopped? The situation of your teammate in attacks, the situation of the defense, the posture player of the body of the ball shooter". The third question was "when the player shoot the ball, to what part of his/her body did you pay attention? The head, the upper trunk, the hand and ball, middle trunk (hips or waist areas or the belly of the player), the lower trunk". And finally the fourth question was "which of the six regions of the handball court was invisible to you (was less important) and did you pay attention to these regions? Region 1 (the right wing), region 2 (the left wing), region 3 (the right back),

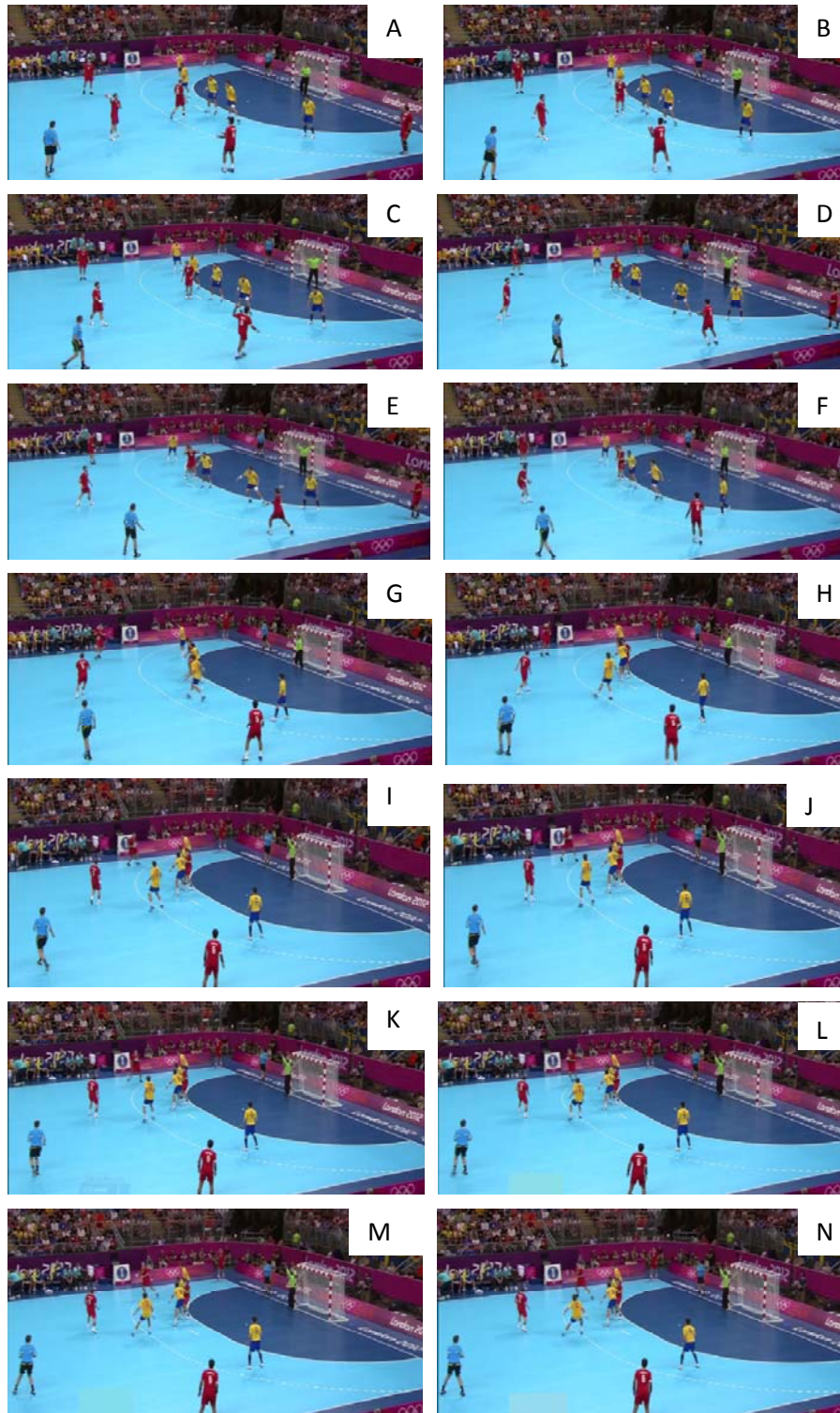


Figure 1. One of the clips that were displayed for all participants. Frame (N) illustrates critical point on the motion of the ball and anticipation of the ball situation.

region 4 (the left back), region 5 (the center back), region 6 (the pivot)". Of course these regions were given to the subject when

testing that participant refers to when they need them to answer the researcher made questionnaire.



Figure 2. The comparison of the anticipation score of the skilled and unskilled.

RESULTS

Measure in the present study was to score. In this study, unit of measure was for right anticipation number 1 and wrong anticipation number zero. Players had right anticipation, researcher investigated visual's cues and also search them while each of the right visual's cues had a score of one.

Anticipation

The results from the present study shows that the skilled players ($M=2.7$, $SD=0.61$) had more precise anticipation in all of the situation in spatial occlusion compared to the unskilled players ($M=1.4$, $SD=0.75$) and the comparison of the two groups by independent T-test ($T= - 7.65$, $df=58$, $\alpha=0.05$), is an indicative of a significant difference between the skilled players and unskilled players in the anticipation scores (Figure 2). Among the unskilled players, 46% gave incorrect anticipation and among the skilled players also 23.3% had incorrect anticipation. That is, perhaps due to the fact that some of the players have not accomplish autonomous stage (the three- phase model of PoulFitts& Michael Posner, 1976) the less amount of the players' experience (players' level of skill) could be referred to as another reason of incorrect anticipation. Also, it is likely that within the clips presented to the players during which the pause was on the ball, perhaps one of the main cues required for correct anticipation in some of the clips has been the ball itself. That has caused the omit of cue with stopping the clip and the player could not have presented a correct

anticipation.

Visual search

The comparison of visual search of skilled players (Mean Rank= 302.85), and unskilled players (Mean Rank= 220.58), with each other showed that (Mann-Whitney $U= 21692$, $\alpha=0.05$), (Wilcoxon $W= 32867$, $\alpha=0.05$), and ($Z= - 5.43$), there is a significant difference in the skilled players' visual search and the unskilled players' visual search. The data from visual search showed that the skilled players selected more relevant cues of the performance compared to the unskilled players. The search of the visual cues related to the performance depended on the players' level of skill, because the skilled players' experience was more than the unskilled players. The unskilled players paid attention also to the irrelevant cues due to less experience. From among the selected cues by the skilled players, the body movement of the ball hitter was 24.3%, and then, that of the opposite defense was 23.3% (Figure 3). Also, the results obtained showed that the skilled players consider their region (play post) and roles in which the play mode was anticipated. They took into account the entire court before the film stopped (defenses, attacker teammate, the ball hitter his/her self, the goal keeper). But the unskilled with the film stopped, focused on the player's body, the opposite defense and the teammates and the goalkeeper's movement, respectively.

Yet, when the film stopped, the unskilled players focused more on the player and attacker teammates. They paid no attention to the court corners (the region 1, region 2, the defenses and attacker in these regions).

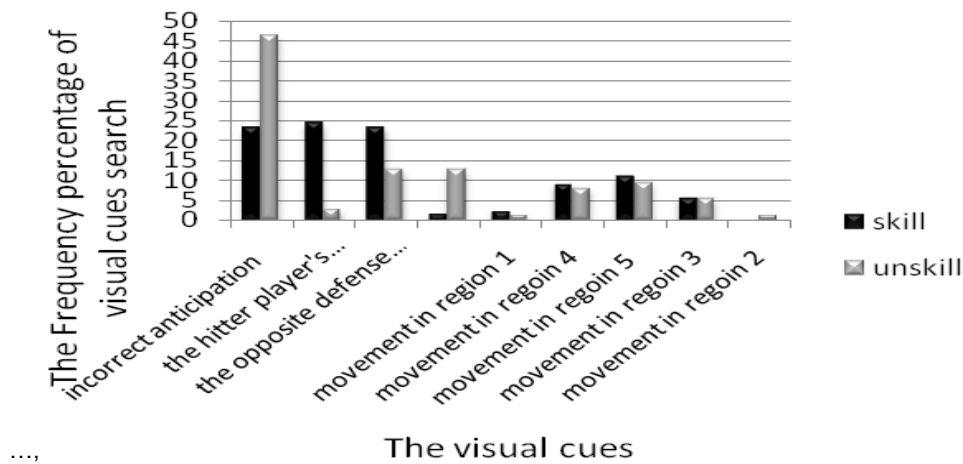


Figure 3. The comparison of visual search frequency percentage of the two groups of skilled and unskilled players.

Considering the regions and post in which they played, the skilled players paid attention to the different parts of the ball hitter's body. In total, the skilled players paid attention to the hitter player's upper trunk (the trunk, hand, ball and the belly area), but unskilled players paid attention only to the hitters' hand and ball.

CONCLUSION AND DISCUSSION

Anticipation

The results of the present study were in line with the results of the study of Savelsbergh et al. (2002, 2010) on novice and expert goalkeepers in football and finding talent in football, the study of Shim et al. (2006), tennis novice and expert players, the study of Hagemann et al. (2006, 2010), on the expert and novice players of badminton and fencing, the study of Vaeyense et al. (2007), on football players, the study of Ranganathan and Carlton (2007), novice and expert baseball pitcher, the study of Casanova et al. (2009), on novice and expert players in football, the study of Clarke et al. (2009), on rugby players, the study of Lee (2010), on novice and expert players in Volleyball, the study of Muller et al. (2010, 2011), on the novice and expert pitchers in cricket, the study of Takeuchi and Inomata (2009, 2012) on novice and expert players of baseball and the study of Mori and Shimada (2013) on the novice and expert players of rugby. Despite the fact that in all of these studies, different methodology such as temporal occlusion and eye movement record and spatial occlusion were used for visual search, the results of the present study were in line with results of the mentioned studies in anticipation skill. In all of these studies, the anticipation skill between the novice group and the expert group was significantly different.

Visual search

Spatial occlusion measure allows the researchers to expect their elicitation on the observations of athletes (Mecheri et al., 2011). The results of the present study on the visual cues and performance specific cues search are in line with the study of Takeuchi and Inomata (2009, 2012). They showed in their study that the expert baseball players pay attention to the pitcher's wrist, forearm and ball compared to the novice players. In addition, the expert players keep their look change power during different stages of pitching the ball, they extract more relevant information of task from each concentration (look) compared to the novice players (Mann et al., 2007). Totally, it could be said that the expert pitchers in baseball start stepping before the ball is released from the pitcher's hand. They start stepping with the movement patterns of pitchers not with the flying of the ball (Ranganathan et al., 2007). In this regard, Shim et al. (2005) carried out a study on tennis expert players that shows that the movement pattern information related to skill allows the expert ball hitting the tennis swing the racket backward earlier than hitting the ball by the rival; in fact the expert players can anticipate the future events based on their rivals' movement patterns.

Through the oral conversation that these researchers had with skilled players about the anticipation of the type of the ball and its descent point, the skilled players referred to a series of visual cues related to seeing their rival's body such as the turning of the rival's shoulder and his/her legs movement. The expert players, like the novice players, firstly look at the rival's arm and racket, when anticipating the rival's hit, but the expert players pay attention to their rival's upper trunk and legs as well as the two mention areas, and get information about the type of hit and the descent point of the ball (Hagemann et al., 2006). Muller (2010, 2011), expresses that when the

cricket bowler's hand and arm has not been omitted through the occlusion technic, only the expert players has had more precise anticipation, in continue he says that anticipation is the ability of selecting concentrated information and that the selection of information not only depends on the player's level of skill but also the different limitation enacted by the bowler (adjustment in the type or range of the ball) can influence the player's anticipation, and that for anticipating the rival's intention in an adequate time, the level of skill and the recognition of performance specific cues are essential.

Similarly, Hagemann et al. (2010) showed that when the fencers' upper trunk, weapon and hand were occluded, the expert players had an incorrect anticipation of the performance but no difference was observed in the novice players' anticipation. Mecheri et al. (2011), expresses that the expert players are capable of collecting visual information in the form of a significant collection, and when the number of probable answers increases, the expert players use higher amount of visual search to extract information from different information sources (Vaeyens et al., 2007). Casanova et al. (2009), used the points of light method and said that experience allows them to recognize the rivals' pattern of movement and to have a better anticipation of his/her intentions, and that the expert players make use of the movements between the joints of their legs and hands to successfully guide the performance of specific cues. To show this, Clarke et al. (2009), divided the expert players of rugby into three groups and gave me three types of exercise; one group did the physical exercise of rugby, the other group did the physical exercise in addition to have a visual training session, and the last group was the control group.

The results of this study showed that the performance of the very group that had participants both in the physical exercises and in one session of visual training exercise, improved and had a more precise anticipation of floor positioning and body positioning and the relationship between the two. Savelsberg et al. (2002, 2010), also expressed the expert players in football fix their looks more upon the rival's trunk, arms and hips. Similarly, Lee (2010), said that volleyball expert players, in comparison with the novice players, firstly looked at the shoulder and arm of the serves hitter when he/she hit serves, and in the step of the flying of the ball (after hit the ball and released from the hitter's hand) follow the ball. Still on another similar case Mori and Shimada (2013) in their investigating the cheating situations in attack in rugby concluded that the expert players looked more on hips and leg areas of the rival, while the novice players looked at the rival's chest.

In this study the expert players, with regard to the play situation and role did anticipations.

The researcher, search on visual search in handball was

not found in this study. In this study, the researcher used researches in other sports since this study support researches done on

ball sports on the upper body (limbs). Also, with regard to the very issue, they paid attention to the different parts of the body of the player attacked (ball hitter). Considering the floor position and roles the players pay attention to the ball hitters' upper trunk (the hand and ball, the players' belly and waist areas and the trunk). The results showed that skilled players, with respect on the play situation and role did anticipations and skilled players were considered before stopping viewed video of all handball court (the attack players, the defense against players, ball hitter, keeper). However unskilled players were tracked ball direction before stopping viewed video. Skilled players focused during the stop movie on players' body, defense against and keeper action. Visual's cues search associated performance was dependent on the skill level of players. The skilled players paid more attention to irrelevant cues. The main cues of the selected cues between skilled players, body movement ball hitter and defense against. The results of this study can be given to available coaches and analysis as a way to teach the novice and unskilled, for skilled players practice. Coaches and analysis can identify and pay attention to important areas with rich and full information to help players progress .As a result of rapid progress of novice and unskilled players within a shorter time and spending less energy and cost.

ACKNOWLEDGEMENTS

We would like to thank Takayuki Takeuchi and Mehdi Rahbari for their help and support during this research.

Conflicts of interest

The authors declare that they have no conflicts of interest.

REFERENCES

- Abernethy B, Russel (1987). Anticipation in sport: A review. *European Physical Education Review*. 1987.10(1).5-16.
- Abernethy B, Russell DG (1987). Expert- novice differences in an applied selective attention task. *J. Sport Psychol* 9(4). 326- 345.
- Abernethy B (1990). Anticipation in squash: differences in advance cue utilization between expert and novice players. *J Sports Sci* 8(1).17-34.
- Abernethy B, Thomas KL, Thomas JT (1993). Strategies for improving understanding of motor expertise. In Starkes J L, Allard F. (Ed.), *Cognitive issues in motor expertise*. Elsevier Science 102:317- 356.
- Casanova F, Oliveira J, Williams M, Garganta J (2009). Expertise and perceptual-cognitive performance in soccer: review. *REV PORT CIEN DESP (Revista Portuguesa de Ciências do Desporto)* .Versão impressa ISSN 1645-0523.9(1):115-122.

- Goulet C, Barad C, Fleury M (1989). Expertise differences in preparing to return a tennis serve: A visual information processing approach. *J. Sport Exerc. Psychol.* 11(4):382-398.
- Hagemann N, Strauss B, Canal-Brulaud R (2006). Training perceptual skill by orienting visual attention. *J. Sport Exerc. Psychol.* 28(2):143-158.
- Janelle CM, Champereno JD, Coombes SA, Mousseau, MB (2003). Mechanisms of attentional cueing during observational learning to facilitate motor skill acquisition. *J. Sports Sci.* 21(10):825-835.
- Jackson RC, Mogan P (2007). Advance visual information, awareness, and anticipation skill. *J. Mot. Behav.* 39(5):341-51.
- I Clarke RD, Brummer A, Kluka DE, Goslin A (2009). Effect of visual cues and practice on decision making of touch rugby players. *Afr. J. Phys. Health Educ. Recreat. Dance.* 15(3):493-505.
- Lavalle D, Kremer J, Moran Ap, Williams Am (2004). Sport Expertise In: D.Lavalle,J.Kremer,A.P.Moran,and A.M.Williams (Eds). Sport psychology: contemporary.
- Lee SM. (2010). Does your eye keep on the ball? The strategy of eye movement for volleyball defensive players during spike serve reception. *J. Appl Sport Sci.* 22(1):128-137.
- Muller S, Abernethy B, Eid M, Mcbean R, Rose M (2010). Expertise and spatial-temporal characteristics of anticipatory information pick-up from complex movement patterns. *Perception* 39(6):745-60.
- Muller S, Abernethy B, Farrow D (2011). How do world -class cricket batsman anticipates a bowler's intention. *The Quarterly Journal of Experimental Psychology.* Psychology press publisher. No.1072954. 59(12):2162-86.
- Mori SH, Shimada T (2013). Expert anticipation from deceptive action. *Atten. Percept. Psychophys* 75(4).751-70.
- Mecheri S, Gillet E, Thouvarecq K, Leroy D (2011). Are visual cue asking and removal techniques equivalent for study perceptual skills in sport. *Perception* 40(4):474- 489.
- Ranganathan RG, Carlton L (2007). Perception-action coupling and anticipatory performance in baseball batting. *J. Mot. Behav.* .39(5):369-380.
- Savelsbergh GJ, Haans SH, Kooijman MK, Paulien M (2010). A method to identify talent: Visual search and locomotion behavior in young football players. *Hum. Mov. Sci...*29(5):764-76.
- Savelsbergh GJ, Williams AM, Van der Kamp J, Ward P (2002). Visual search anticipation and expertise in soccer goalkeepers. *J. of Sport sci.* 20(3):279- 87.
- Shim JW, Chow JG, Carlton L, Chae WS (2005). The use of anticipatory visual cues by highly skilled tennis players. *J. Mot. Behav.* 37(2):164-175.
- Shim J, Carlton LG, Kwon YH (2006). Perception of kinematic characteristics of tennis strokes for anticipating stroke type and direction. *Res. Q Exerc. Sport* 77(3):326-39.
- Takeuchi T, Inomata K (2009). Visual search strategies and decision making in baseball batting. *Percept. Mot. Skills* 108(3):971- 80.
- Takeuchi T, Inomata K (2012). Visual search strategies in baseball batting. *Jpn. J. of Sport Psychol.* 39(1). 47- 59.
- TY Mann, Williams MA, Ward P, Janelle C (2007). Perceptual Cognitive expertise in sport: A meta-analysis. *J. Sport Exerc. Psychol.* 29(4):457- 477.
- Vaeyens R, Lenoir M, William AM, Mazyn L, Philippaerts RM (2007). The effect of task constraints on visual search behavior and decision-making skill in youth soccer players. *J. Sport Exerc. Psychol.* 29(2):147- 69.
- Ward P, Ericsson KA, Williams AM (2012). Complex perceptual-cognitive expertise in a simulated task environment. *Journal of Cognitive Engineering and Decision Making.* First published, doi:10.1177/1555343412461254.
- Williams AM, Davids K, Burwitzl, Willam JG (1994). Visual search strategies of experienced and inexperienced soccer players. *Res. Q. Exerc. Sport* 5(2):127-135.
- William AM, Davids K (1998). Visual search strategy, selective attention and expertise in soccer. *Res. Q Exerc Sport.* 69(2):111-128.
- Williams AM, Davids K, Williams JG (1999). *Visual Perception and Action in Sport*.1st. London.Sport & Recreation. IL: Talor& Francis; P.464.
- William AM (2000). Perceptual skill in soccer: Implications for talent identification and development. *J. Sport Sci.*18(9):737-50.