Visual Search, Prediction Ability and Brain Neural Mechanisms of Different of Female Volleyball Players

Yuchen Zhou*

ABSTRACT

In order to explore whether the experience within the role of movement influences information processing, this paper studies the visual search and prediction abilities of different women volleyball players and their brain neural mechanisms. A laboratory composing of a preparatory room, a master control room, and a test room was established. Subjects were required to perform experimental tasks in the test room alone. The results of multivariate analysis of variance showed that the main effect of the role was significant, indicating that different roles have different responses to different types of attacks. Volleyball players of different roles use different visual search strategies for visual search. The main attack team and the supporting attack team use short search durations more frequently for gaze duration.

Key Words: Volleyball, Visual Search, ERP

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Introduction

Perceptual-motor skills refer to the ability of an individual to combine existing knowledge with potentially selected and completed responses to identify and obtain environmental information (Handy *et al.*, 2000). Both definitions emphasize the perception of Perceptual-motor skills as responding to the organization and interpretation of sensory information. Thus, Perceptual-motor skills are the imprints left by sensory systems when motor skills and stored knowledge and experience interact with each other (Williams *et al.*, 1994). These skills include visual search ability, ability to use lead cues, ability to recognize patterns, and the ability to predict the possibility of situation. In a wide range of informational stimuli, information relating to our goals or tasks and irrelevant information are always included. What the athlete sees and does not see is what requires selective attention. In fact, the individual always screens a large amount of information in order to complete the target task to ensure that the limited cognitive resources can be used to effectively complete the current major task (Jackson *et al.*, 2007).

The visual selective attention is to pay attention to the specific information (like clues) in the environment with the participation of the visual activity, which will influence the preparation and execution of the action. How to focus and focus on a certain type of target information in a wide range of information stimuli, and how the target information attracts people's attention in a stimulating context (Kluka *et al.*, 2000) involve visual search problems. Visual search refers to the process of finding related information (targets) from irrelevant information (interference information) in the context of a visual input (Basia *et al.*, 2015). In essence, visual search is the process of pointing

Corresponding author: Yucheng Zhou
Address: Chongqing Jiaotong University, Chongqing 400074, China
e-mail ✉ yuchengzhou2894@aliyun.com
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visual attention to relevant environmental information. The manner in which an individual attempts to direct visual attention toward a relevant source of information while the eye scans back and forth on displayed information is referred to as a visual search strategy. In sports, athletes often face a lot of information, and they must make quick response choices within a limited time. Therefore, selective attention to only the most relevant information sources is obviously the basis for successful performance.

Faced with complex and complicated relevant or irrelevant visual information, people's neural processing capability is limited. Excessive information processing at the same time may exceed the processing capacity of the brain, causing information overload and making the brain incapable of normal work (Ward *et al.*, 2003). In order to deal with information overload, humans can only select parts of information (clues) for processing, while ignoring other information (cluea) (Ward *et al.*, 2003). “Selective attention refers to the process of preferentially selecting information that requires specific processing and ignoring irrelevant information.” Therefore, cognitive psychologists believe that attention a selection mechanism that is due to the limited information processing capacity. The purpose of selective attention is to improve the efficiency of the mental processing process. In sports, the ability to select attention is of great importance to sports operations (Vaeyens *et al.*, 2007). Because there are much task-related and irrelevant information in the sports competition, and even many seemingly relevant information are illusions, focusing on the most appropriate clues is crucial for predicting judgment and decision making. Therefore, the motor scientists think that the perceptual-motor skill refers to the individual's ability to react according to the environment and the clues (mainly visual cues) presented by the opponent's actions.

This study studied the visual search and prediction abilities of different women's volleyball players and their brain neural mechanisms. It is considered that different players use different visual search strategies for visual search.

Methods

Research method

Forty-three women volleyball players participated in the study. According to their position in the team, they were divided into five groups: second pass, main attack, supporting attack, collusion and free group. The number, average age and average years of training of athletes in each group are shown in Table 1. The athletes were from the major women's volleyball teams, the Shanghai Youth Women's Volleyball Team and the Shanghai Women's Sports Volleyball Team, including the first six teams of the domestic women's volleyball A-class league. Table 1 shows basic information of women volleyball players of different roles.

Table 1. Basic information of women volleyball players of different roles

	Average age		Average training time	
	M	SD	M	SD
Setter(n=7)	20	5.18	10.5	4.97
Themain(n=11)	19.42	3.45	8.42	4.03
Font(n=11)	19.73	2.65	8	3
Getaway(n=7)	21	2.94	10.14	4.14
Freeman(n=7)	20.14	2.73	9.29	1.7
Total(n=13)	20.06	3.39	9.27	3.57

All athletes who participated in the experiment have normal or good vision, good health, and no history of brain damage or neurological disease. No drugs or alcoholic beverages are taken are taken within 24 hours before participating in the experiment. All athletes volunteer to participate in the experimental test, and are informed of the experimental testing process and requirements before the experimental test. Appropriate remuneration is given after the experiment.

Experimental procedure

Some of the experiments were conducted in the brain-electricity laboratory of the Shanghai Sport University Sports Psychology Research Center. The laboratory consists of a preparation room, a master control room and a test room. Subjects performed experimental tasks alone in the test room. Another part of the experiment was conducted in the training base of the sports team. Sound insulation, light separation, and room temperature were selected to make the experimental test site comply with the test requirements of the ERP experiment. Participants were informed were required to have an experimental task; their consent is obtained; and they filled in individual's basic information sheet and are introduced basic requirements for ERP and eye movement experiments. They were asked to relax as much as possible during the experiment, especially the relaxation of the head and facial muscles, try to control the blink of an eye, do not move heads or bodies during the experiment. The participants were given an electrode cap and sat comfortably in a chair in front of the lab bench. The eyes were on the same horizontal line as the center of the stimulus monitor screen, 70 cm apart, and both hands were placed on the two small numeric keypads. The participating athletes are demonstrated the experiment and informed that there are two directions for attacking the smasher - straight or oblique lines (or right field or left field), and response requirements. Eye movement confirmation and gaze position correction are then performed. The eye movement recording system was initially calibrated with the nine-point map presented on the screen. In order to make the subjects familiar with the experimental task, the participants were given enough practice time. When the participating athletes are fully familiar with the experimental procedure and key operation requirements, they enter the formal experiment. Before each set of experiment was performed, the match between eye movements and gaze position was re-evaluated. The problem found in the experiment would be corrected.

The specific process of the experiment is shown in Figure 1. The participant presses any key to start the experiment. First the guideline appears on the black screen: Welcome to this experiment. Your task is to pretend to be a player in the back row (your role in the defense) and judge the smash line of the offense in the video. Please make a key reaction within 1.5 seconds of video playback or a black screen, and you are asked for a quick and accurate response. If the opponent is attacking at the 4th position, you judge it as a straight line, press the "9" key to react; if you judge it as the buckle slash, press the "1" key; if the opponent is attacking at the 2nd position, it is judged to be a straight line, press "1" ; buckle slash needs to press “9” key to respond; if the opponent is attacking at position 3 or 6 , it is judged as a left field ball, press “1”; the right field ball requires pressing “9” to react. Press "Enter" to practice, observe the opponent's offense and predict the smash line. End of practice, enter the formal experiment below! Subjects understand the experimental requirements and practice after the key is pressed, and then press “Enter” to start the formal experiment. First, a white “+” fixation point appears in the center of the screen. The presentation time is 500ms. Then a video is displayed. The playback time is 1000ms. Then the black screen time is 1500ms, and the judgment response can also be performed. Finally, the black screen will last for 1500ms to 2500ms, and repeat. Test video will be played randomly.

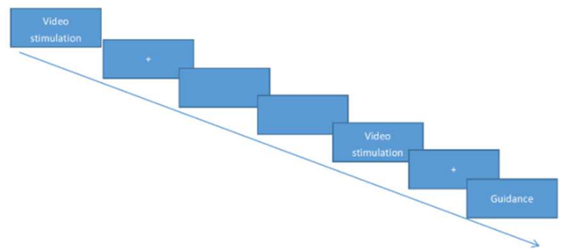

Figure 1. Visual prediction and ERP flow chart for predicting the direction of spiking

Results and discussion

Results of reaction speed

Multivariate analysis of variance shows that the main effect of the role is significant ($F=10.211$, $p<0.01$), indicating that different players has different responses to different types of attacks. The results of the Post Hoc Tests show that free people respond significantly faster than other players (see Figure 2).

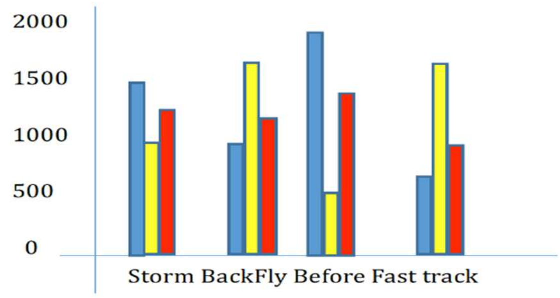

Figure 2. Predicting the average reaction speed and standard deviation of each attack type by different players (MS)

Reaction accuracy

The results of multivariate analysis of variance shows that the main effect of the role is significant ($F=3.710$, $p<0.01$), indicating that the accuracy of the volleyball player's prediction and determination of the offensive direction of the smasher differs significantly among athletes with different roles. There is a significant difference in the main effects of offensive types ($F=5.685$, $p<0.01$), indicating that volleyball players' accuracy in predicting different attack types differs significantly. The interaction effect between the role x attacking types is not significant. The results of multiple comparisons show that the forecasting accuracy of the collusion and the supporing attack is higher than that of the free man; the accuracy of the volleyball player's prediction of the 6 back attacks is higher than that of the 4 main attacks, 2 main attacks, the backward flight and the 1 back attack, and the accuracy of the prediction of the short strokes is also higher than backward flight and 1 back attack. Figure 3 shows the average and standard deviation of the correct rate of the correct rate of different types of attacks predicted by different players.

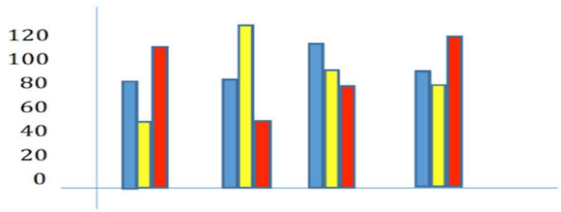

Figure 3. The average and standard deviation of the correct rate of different types of attacks predicted by different players

The analysis of gaze rate of second pass area

The results of multivariate analysis of variance showed that the main effect of the role is significant ($F=3.547$, $p<0.01$), indicating that different players have different gaze rates in the second pass area when predicting the second pass direction. The main effect of the gaze area is significant ($F=125.562$, $p<0.01$), indicating that the gaze rate of volleyball players in different regions is different. The interaction effect of the role x gaze area is significant ($F=3.372$, $p<0.01$), indicating that the roles and gaze positions have interaction effects on the gaze rate. Figures 4 and 5 predict the total average ERP of the second pass direction of volleyball players of different roles.

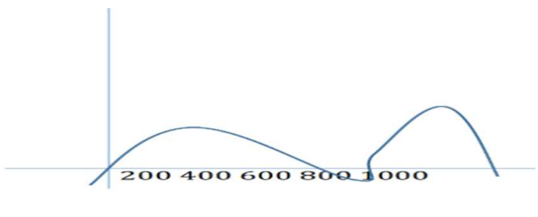

Figure 4. ERP prediction of different directions of volleyball players in different directions

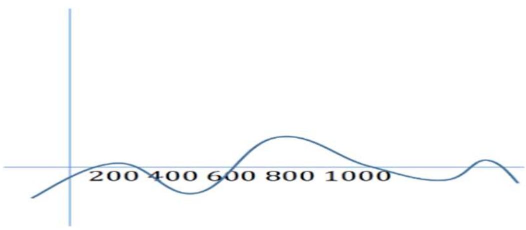

Figure 5. ERP prediction of different directions of volleyball players in different directions

Conclusion and outlook

This thesis chooses volleyball as a research project, and uses deliberate training theory as a guide. It uses the video in the actual volleyball match as the material and the volleyball player's visual search and prediction as the main thread. It discusses the volleyball players with different roles in the front and back row defenses, their visual search and prediction ability of different tactical offensive situation, and their intrinsic neural mechanisms. It is expected to provide a theoretical basis for the scientific training of volleyball sports, specifically summarized as follows:

1. Volleyball players of different roles use different visual search strategies for visual search. The main attack group and the supporting attack group athletes used more short search durations for gaze duration, and the accuracy of the prediction and judgment response are also higher than that of free athletes, indicating that this strategy helps to obtain the smasher's movement pattern, and it is an effective search strategy.

2. The higher the frequency of visual search, the greater the activation of cerebral cortex, indicating that different search strategies occupy different psychological resources. The high search rate occupies more psychological resources and the accuracy of prediction is high. The low search rate occupies less psychological resources and the accuracy of prediction is relatively low. The higher search speeds of main attackers and supporting attacks are associated with higher neural activation intensity.

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