STRENGTHENING TRAINING METHODS FOR MOTOR PERCEPTION ABILITY IN TENNIS

REFORÇO DOS MÉTODOS DE TREINAMENTO PARA A CAPACIDADE DE PERCEPÇÃO MOTORA NO TÊNIS

REFUERZO DE LOS MÉTODOS DE ENTRENAMIENTO DE LA CAPACIDAD DE PERCEPCIÓN MOTRIZ EN EL TENIS

Original Article
Artigo Original
Artículo Original

Xiaodong Sun[1]
(Physical Education Professional)

1. Beijing University of Chinese Medicine, Department of Physical Education, Beijing, China.

Correspondence:
Xiaodong Sun
Beijing, China. 100029.
SXD880925@163.com

ABSTRACT

Introduction: Specialized perception in tennis is simply learning the "feel of the ball". Expertise refers to whether a player can handle and control the ball as he wishes, also known as fitness. Objective: Study the effect and mechanism of motion tracking training to improve the perception training methods of tennis players. Methods: This paper conducts a temporal experiment on 38 professional tennis players divided into two groups. The experimental group used optokinetic tracking training for tracking and feedback on their movements. The control group received no interventional treatment. Players' perception and brainwave data at different training times were recorded and analyzed. Results: The subjects in the experimental group had high accuracy in discriminating the spatial location of the ball. The experiment produced a significant occipital M1 signal after the 360ms trial. The M2 signal in the occipital region also had noticeable main effects in each period. The level of the M2 signal in the experimental group showed an increase. Conclusion: Visual motion tracking training has been shown to significantly impact tennis players' perception. This training can improve tennis players' perceptual ability, proving to be an ally in strengthening current training methods. ***Level of evidence II; Therapeutic studies - investigation of treatment outcomes.***

Keywords: Tennis; Athletes; Physical Fitness; Psychomotor Performance.

RESUMO

Introdução: A percepção especializada do tênis é simplesmente o aprendizado da "sensação de bola". A especialização refere-se a se um jogador pode manusear e controlar a bola como ele deseja, conhecida também como aptidão física. Objetivo: Estudar o efeito e o mecanismo do treinamento de rastreamento de movimento para melhorar os métodos de treinamento da percepção dos jogadores de tênis. Métodos: Este trabalho conduz um experimento temporal em 38 jogadores profissionais de tênis, divididos em dois grupos. O grupo experimental utilizou o treinamento de rastreamento opto cinético para rastreamento e feedback de seus movimentos. O grupo de controle não recebeu nenhum tratamento intervencionista. Foram registradas e analisadas a percepção dos jogadores e os dados de ondas cerebrais em diferentes momentos do treinamento. Resultados: Os sujeitos do grupo experimental tiveram uma alta precisão na discriminação de localização espacial da bola. O experimento foi capaz de produzir um sinal M1 occipital significativo após o ensaio de 360 ms. O sinal M2 na região occipital também teve efeitos principais perceptíveis em cada período. O nível do sinal M2 no grupo experimental demonstrou um aumento. Conclusão: O treinamento visual de rastreamento de movimento demonstrou refletir um impacto significativo sobre a percepção dos tenistas. Este treinamento pode melhorar a capacidade perceptiva dos jogadores de tênis comprovando-se um aliado no reforço nos métodos atuais de treinamento. ***Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.***

Descritores: *Tênis; Atletas; Aptidão Física; Desempenho Psicomotor.*

RESUMEN

Introducción: La percepción especializada en el tenis consiste simplemente en aprender a "sentir la pelota". La pericia se refiere a si un jugador puede manejar y controlar el balón a su antojo, lo que también se conoce como aptitud física. Objetivo: Estudiar el efecto y el mecanismo del entrenamiento de seguimiento del movimiento para mejorar los métodos de entrenamiento de la percepción de los tenistas. Métodos: Este trabajo realiza un experimento temporal con 38 tenistas profesionales, divididos en dos grupos. El grupo experimental utilizó el entrenamiento de seguimiento opto cinético para el seguimiento y la retroalimentación de sus movimientos. El grupo de control no recibió ningún tratamiento de intervención. Se registraron y analizaron los datos de percepción y de ondas cerebrales de los jugadores en diferentes momentos del entrenamiento. Resultados: Los sujetos del grupo experimental tuvieron una alta precisión en la discriminación de la ubicación espacial de la pelota. El experimento fue capaz de producir una señal M1 occipital significativa después del ensayo de 360 ms. La señal M2 en la región occipital también tuvo efectos principales notables en cada período. El nivel de la señal M2 en el grupo experimental mostró un aumento. Conclusión: Se ha demostrado que el entrenamiento de

seguimiento visual del movimiento refleja un impacto significativo en la percepción de los tenistas. Este entrenamiento puede mejorar la capacidad perceptiva de los tenistas demostrando ser un aliado en el fortalecimiento en los métodos de entrenamiento actuales. ***Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.***

Descriptores: *Tenis; Atletas; Aptitud Física; Desempeño Psicomotor.*

DOI: http://dx.doi.org/10.1590/1517-8692202329012022_0650 Article received on 11/01/2022 accepted on 11/30/2022

INTRODUCTION

Researchers in sports cognitive psychology believe that cognitive ability in sports competitions is a significant activity. It has gradually developed into a new branch of sports cognitive psychology. Sports cognitive psychology refers to the corresponding response by predicting and analyzing the opponent's sports ability in fierce competition.[1] Researchers in sports cognitive psychology believe that cognitive ability in sports competition refers to the athlete's recombination of stored knowledge in the immediate sports environment. In this way, the judgment of the speed and accuracy of the movement is realized. Action perception is essential for players to perceive action skills and win competitions. Perception improvement is also one of the main goals pursued by coaches and sports cognition scholars. This paper uses event-related potential (ERP) technology and the early developed optokinetic tracking training technology to study the influence and neural mechanism of tennis players' perception prediction.

METHOD

General information

In this paper, 38 tennis players with a sports level higher than level 2 were randomly divided into a control group and an experimental group according to their sports level and gender.[2] All players have healthy vision. They had no color blindness or psychological and neurological problems. (Table 1)

Test scheme

This paper uses a 2x3 two-factor experimental design. Visual perception abilities were independent of action and difficulty (T1: 120ms after hitting. T2: 240ms after hitting. T3: 360ms after hitting). Variables include reaction time, correct judgment rate, M1, M2 amplitude, latency, and so on.

In this paper, the optokinetic tracking training method is used to track the motion of the experimental group. This study includes three training units: motion visual tracking training, 3D motion visual tracking training, and virtual reality visual tracking training. In this paper, the motion tracking of athletes is realized based on smooth motion tracking and compensatory eye jumping theory. 3D motion tracking uses 3D special effects to achieve moving image tracking from near to far. The technology is based on the traditional stereo perception model and according to the average flight speed of the tennis ball.[3] The virtual reality scene tracking training simulates the tennis ball's extraordinary vision based on the tennis ball's flight path, speed, and landing point. The system can also provide students with quantitative assessments. The subjects in the experimental group practiced visual perception ability before receiving the perceptual prediction task. The control group underwent a perception test without intervention.

Table 1. Main data of subjects.

Group	n		Age/age	Sport level/n		Years of training/year
	Male	Female		Level 1	secondary	
Control group	10	9	22.15±1.34	1	18	7.89±2.23
test Group	10	9	20.98±1.46	1	18	8.22±1.14

The 192 competition videos are divided into three groups according to the degree of difficulty. The number of each group is 64 segments. Subjects are performed in order of BLOCK from high to low. Then play the corresponding video in BLOCK. Each subject was tested 12 times before the trial to understand the process and key points.[4] At the same time, subjects gave correct and incorrect feedback.

Optimization model simulation of tennis serve trajectory

The rotation of the ball in mid-air. It moves with the player's arm movement. The position distribution probability density of the ball in the air is as follows:

$$F(E)=\psi k_{id}(d)+\alpha_1\beta_1(f_{id}-\gamma_{id}(t))+\alpha_2\beta_2(f_{pg}-\gamma_{id}(t)) \quad (1)$$

e represents a predetermined value between frames. If pixel i is a fixed inter-frame code, then its associated offset value can be treated as 0. e_n is the value of pixel D. The above process can be reconstructed by quantification and inverse quantification within the encoder.[5] This paper uses this technique to obtain the equation of motion of the perspective transformation of the three-dimensional model of the tennis player on multiple sides.

$$\frac{\partial h(\gamma,y;d)}{\partial d}=\frac{\sigma}{\rho s}\nabla M(\gamma,y;d)=\left[\frac{\partial M_{\gamma}(\gamma,y;d)}{\partial\gamma}+\frac{\partial M_{y}(\gamma,y;d)}{\partial y}\right] \quad (2)$$

When throwing and swinging, the athlete's direction of motion is 360° to the ground. This paper uses a standard usual distribution method to analyze the variation of technical characteristics in continuous motion.

$$fk=\left\langle\gamma_0(\gamma_i)_{0\le i\le\tau},(\gamma'_i)_{0\le i\le l-1},(\Pi_i)_{0\le i\le l-1}\right\rangle \quad (3)$$

Assume that the position transformations related to the root coordinate in the moving coordinate system is δ_{gool}. Assuming that the motion amplitude of the serving part and the catching logic controller in time d is $E[MB]=1$, then its arbitrary sampling is expressed as

$$\eta=\frac{a}{a+b+c}*\frac{E(M_A)+E(M_B)}{E(V_A)+E(V_B)} \quad (4)$$

The measurement equation for the wrist to serve the ball in the diagonal teeing area under natural conditions is:

$$i(1-f)^i f=\frac{1-f}{f} \quad (5)$$

In this paper, the optimal motion characteristics from waist to arm ends are obtained by establishing the world coordinate system of A and B.

$$\begin{aligned} &\min F(d) = (f_1(d), f_2(d), \cdots, f_m(d))^T \\ &s.t.\ g_i \le 0, i = 1,2,\cdots,q \\ &h_j = 0\ j = 1,2,\cdots,f \end{aligned} \tag{6}$$

The tennis player's serve deflects the hitting surface to the inside of the angular position and velocity of $f_e, \dot{f}_e \in R^{6\times1}$, respectively. In this paper, the weight of the upper limbs is divided into two types: $\delta, \dot{\delta} \in R^{10\times1}$. When the ball is on the ball holder's thumb, this paper breaks down by the end effect of the counter-motion. In this way, the differential equation of the serve motion with visual properties is obtained

$$\dot{f}_e = J(\delta)\dot{\delta} \tag{7}$$

Where $J(\delta) \in R^{6\times1}$ is the arm Jacobian matrix of tennis serve stance. In this paper, the ball's direction, landing point, and rotational kinematics are obtained from the angle of the center of gravity and the coordinate axis.

$$\dot{\delta} = J^+\dot{f}_e + (E - J^+J)\xi \tag{8}$$

$J^+(\delta) = J^T(JJ^T)^{-1}$ is the Mohr-Penrose generalized inverse of matrix J when the tee is changed. This paper uses the above theory to study the characteristics of tennis serve.

Mathematical data collation method

This paper utilizes E-prime2.0 for data collection and classification. This paper uses E-DataAid to filter, merge and preprocess the data. One outlier other than three standard deviations was excluded.[6] In this paper, the response of T1, T2, and T3 time-fixed points and the accurate judgment of the shot are studied. This paper measured EEG using a 64-bit brainwave acquisition device from Brain Products in Germany.

Ethical Compliance

Research experiments conducted in this article with animals or humans were approved by the Ethical Committee and responsible authorities of Beijing University of Chinese Medicine following all guidelines, regulations, legal, and ethical standards as required for humans or animals.

RESULTS

Behavioral Results

Repeated determination of variance results showed that the main effect between groups was insignificant in determining the drop of the shot. There were significant differences in the main effects of different periods. There was no statistically significant difference in the effects of different periods and groups. Subjects' response time to post-hitting motion decreased with prolonged post-hitting.[7] The time point of T3 at 360ms after impact was significantly faster than T2 at 240ms after impact and T1 at 120ms after impact. There was no significant difference in the subjects' responses at T1 and T2 time points.

Under different test conditions, subjects judged the accuracy rate with an apparent main effect. The subjects showed significant initiative in time. There were no significant effects across time and groups. The results of the simple effect test showed that the discriminant accuracy of the experimental group was significantly greater than that of the control group.[8] After hitting the ball, the correct judgment rate of the subjects gradually increased with adequate information after the throw.

Outcomes of ERP

The subjects in the experimental group had larger M1 and M2 at 80-400 ms after excitation in the ERP (Figure 1). M1 amplitude had no apparent main effect at selected electrode sites.[9] The main influencing factor is that time is not apparent. Interactions between different periods and between different groups were significantly correlated. There was no significant difference in the M1 peak between the experimental and control groups at T1 and T2 time. The M1 peak at T3 time was significantly higher than the control. There was no significant difference in the latency of M1 composition in different periods. The M2 amplitude had a pronounced main effect at the selected electrode site, and the amplitude of the experimental group was significantly higher than that of the control group.[10] The main influencing factors are not evident in time. There were no significant interactions across time and across groups. There was no significant difference in the incubation period of M2 components.

DISCUSSION

Particular perception is a technique used to evaluate an athlete's movement skills from the point of view of sports psychology. It is an essential factor in ensuring movement technique.[11] Particular perception refers to the player's "ball feel," and particular perception refers to whether the player can control the ball as he wants. Athletes need to reasonably anticipate the opponent's attack and consider the opponent's spatial and temporal changes. If the opponent's ball is not of good quality and a chance ball appears, and we are in a suitable open position, the player needs to concentrate all his energy on the spiking. If the opponent is under strict control and we cannot use force, we must fight with less force or use "borrowing force" to counterattack. "Appearance" is the human brain's perception of the world.[12] The visual and kinesthetic images of sports images are athletes' thinking activities. It is an athlete's reflection of past actions, game scenes, etc. The method simulates the opponent's different tactics to motivate the athlete to remember the opponent's actions through memory, imagination accurately, and other methods. Athletes build technical concepts from surface to thinking to master technical movements.

Intuition is a subconscious way of thinking. Athletes have a profound understanding of the overall judgment by analyzing the nature and laws of things. Intuition is done in an instant. Its understanding and processing of superficial cognition form a specific behavior. This seemingly simple knowledge processing. It is the sublimation from perceptual to rational understanding. The integrity of the ball sense refers to an all-round and

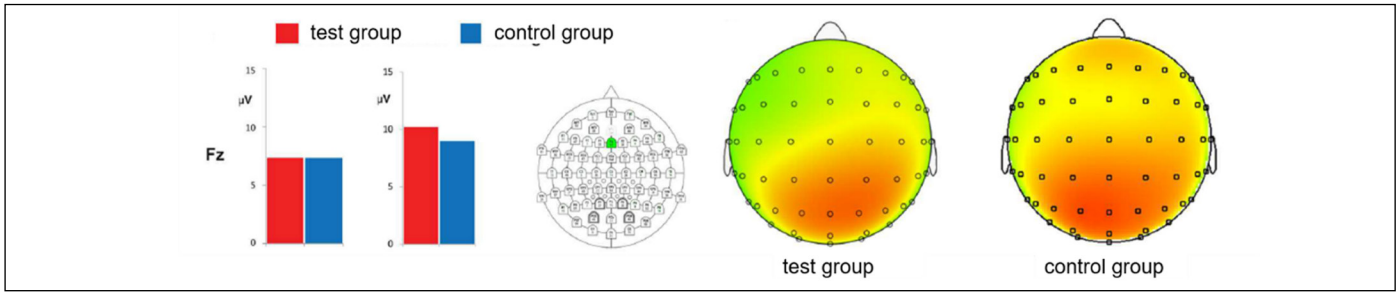

Figure 1. Comparative analysis of the overall mean waveform and brain topography of the electrode points POz (A) and Pz (B).

multi-level overall grasp of the moment of the ball. It can show the comprehensive and coordinated development of all aspects of the quality of individual team members. Sharpness is a prominent feature of the ball feel. It is an essential feature of quickly discovering movement during exercise. The athlete can quickly complete the action according to the situation on the field. Athletes can make adjustments in time when the situation changes. This is a comprehensive analysis of the central nervous system. Athletes need to make judgments based on external conditions. The dynamic decision-making of the cerebral cortex requires the coordination and stability of basic movements and a high degree of mechanization. At the same time, athletes must maintain a high degree of plasticity. This is useful for changing movement movements when necessary. An athlete's muscles should be tense and excited at all times. This allows athletes to concentrate and reduce stress. This allows the athlete to concentrate, accurately analyze the essential factors around them and control the critical actions.

CONCLUSION

The research on tennis trajectory tracking can effectively improve the tennis player's judgment of the tennis landing. Motion tracking analysis can effectively enhance the mental concentration of tennis players' input and processing of visual information. This enhances the athlete's coherence and concentration of visual critical information processing at important moments.

The author declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: The author made significant contributions to this manuscript. Xiaodong Sun: writing, data analysis, article review and intellectual concept of the article.

REFERENCES

1. Lin YN, Pacheco MM, Lin YF, Huang CT, Lin J. H. The influence of expertise and experimental paradigms on the visual behavior of tennis athletes in returning a serve. Kinesiology. 2021;53(2):271-9.
2. Kocib T, Carboch J, Cabela M, Kresta J. Tactics in tennis doubles: analysis of the formations used by the serving and receiving teams. Int J Phys Educ Fit Sport. 2020;9(2):45-50.
3. Rosker J, Majcen Rosker Z. Correlations between gaze fixations to different areas of interest are related to tennis serve return performance in two different expert groups. Int J Perform Anal Sport. 2021;21(6):1149-61.
4. Ferrandez C, Marsan T, Poulet Y, Rouch P, Thoreux P, Sauret C. Physiology, biomechanics and injuries in table tennis: A systematic review. Sci Sports. 2021;36(2):95-104.
5. Navia JA, Avilés C, Dicks M, Ruiz-Pérez LM. The spatiotemporal control of expert tennis players when returning first serves: A perception-action perspective. J Sports Sci. 2022;40(1):16-23.
6. Taneja N. The Tennis Serve–a need to dissect the perception-action link further. Kinesiology. 2022;54(1):105-6.
7. Yildirim Y, Kizilet A. The Effect of Different Learning Method on the Visual Reaction Time of Hand and Leg in High School Level Tennis Trainees. JEI. 2020;6(2):414-24.
8. Chalakov M. Optimizing the control of technical performance of forehand stroke among 12-year old tennis players using martin's sigma method. Trakia J Sci. 2020;18(1):682-8.
9. Witkowski M, Tomczak E, Bojkowski Ł, Borysiuk Z, Tomczak M. Do expert fencers engage the same visual perception strategies as beginners?. J Hum Kinet. 2021;78(1):49-58.
10. Nabil A, Hegazy H, Abdelsalam M, Hussien M, Elmosalamy S, Hassan YM, et al. Usability Study of a comprehensive table tennis AR-based training system with the focus on players' strokes. JUSPN. 2020;13(1):1-9.
11. Le Noury P, Buszard T, Reid M, Farrow D. Examining the representativeness of a virtual reality environment for simulation of tennis performance. J Sports Sci. 2021;39(4):412-20.
12. Widodo H, Nahimana S. Reaction time test innovation of table tennis performance: aiken validity. PalArch's J Archaeol Egypt/ Egyptol. 2021;18(4):7103-10.