Activation Process of Brain Perception during the Serve Action of Table Tennis Players

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ABSTRACT
With a view to consolidating and strengthening the sports level of Chinese table tennis players, this study focuses on the activation process of brain perception in serving. Based on the principles of kinematics and sports biomechanics, 3dsMax2012 software is used to simulate pictures, and active coaches and second-class athletes are asked to screen out pictures showing the actions could be employed to send out side back spin. The composition characteristics in this study indicate that the number of athletes’ activated neurons that are sensitive to stimulus features is larger. In the perception stage of information with a single feature, table tennis athletes have a higher degree of activation of the cerebral cortex, and are very sensitive to the physical characteristics of the stimulus related to the specific sports.

Key Words: Table Tennis, Brain Perception, Activation Process

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Introduction
The pattern recognition feature proposes that in the process of pattern recognition, the features of the stimulus are first analyzed, and then the extracted features are combined and then compared with the stimulus features in the long-term memory. Once the best match is obtained, the external stimulus is identified. Patterns are composed of several elements or components in relation to each other and which may be referred to as features (Abernethy, 1988). In sports, the essence of a complete technical action is a complete information structure pattern, thus the judgment of the action is actually the recognition of the information structure pattern of the action (Abernethy et al., 1999).

At present, the following problem still exists in the researches on recognition of action pattern of sports techniques. Action pattern recognition of sports techniques is a continuous process including feature extraction, feature merging (integration), feature comparison, match recognition, and reaction output, etc. The analysis of only one or several of these processes obviously cannot fully reveal the cognitive processing mechanism of pattern recognition (Abernethy, 1994). Actions of sports techniques are almost the collection of spatial information and temporal information. The pattern recognition of spatial information alone is inconsistent with the perceptual representation of technical actions in long-term memory of athletes, resulting in inconsistent research results (Akiyama et al., 2000). In addition, action pattern recognition of sports techniques has an implicit feature, thus it is difficult to determine the perceptual representation of a technical action in athletes’ long-term memory without taking effective research paradigm (Allard et al., 2010). Therefore, with the help of the task of the athletes’ brain perception activation process of the ball serve rotation, this study focuses on the components of the sports information pattern structure and the brain perception activation...
process of the athletes' perception of the pattern structure.

Based on the current researches on recognition of action pattern of sports techniques, and according to feature integration theory, pattern recognition feature theory, inhibition control theory, and activation diffusion theory, this study proposes the following hypotheses. 1. In sports, the essence of a complete technical action is a complete information structure pattern, and the judgment of the action is actually the recognition of the information structure pattern of the action. 2. With sports experience, athletes simplifies the original information pattern and extract one or some of the features from the fast and complete information flow, and perform information processing based on the objects composed of these eigenvalues or limited eigenvalues to complete the judgments, decisions, and reactions to athletic information. The specific operation process adopts the "expert-novice" research paradigm, the experimental paradigms of "Oddball Go/No Go" and "Cuing", and the research methods of laboratory experiments (Marslen-Wilson et al., 1989). In this study, the mechanics foundation of table tennis rotation is analyzed from the perspective of kinematics and sports biomechanics. 3D technology is used to simulate the information structure pattern picture of the hitting position of the table tennis ball serve, as shown in Figure 1. Table tennis is made strictly according to the specific parameters of the original entity (Table Tennis Competition Rules, 2011) 82. At the positions of 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, and 360° on the surface of the table tennis body, the hitting parts are marked with black shadows in sequence, and a total of 8 3D pictures with a size of 1360×768 are rendered (all pictures exemplify the forehand serve with the right hand). 2 coaches and 2 second-class athletes on active service are asked to screen out pictures that can be used to send out side back spin. Experts all agreed that positions of 135° and 225° in the picture are most likely to send out side back spin, with a 100% of consistency.

Methods

Subjects

A total of 15 table tennis major college students are selected as subjects, who are divided into expert groups and novice groups according to their sports levels. The former includes the national second-class athletes (Age: 21.20±0.77; Exercise duration: 7.80±2.30), while the latter consists of the subjects without any specific sports levels (Age: 20.60±1.05; Exercise duration: 1.73±0.88). All the subjects are male, right-handed, with normal visual acuity or corrected visual acuity. All of them volunteer to participate in the experiment, and are given the corresponding reward after the experiment.

Experimental materials

According to the principles of kinematics and sports biomechanics, and with reference to the self-photographed table tennis serve video, the action spots of force are selected and the computer 3dsMax 2012 software is used to simulate the information structure pattern picture of the hitting position of the table tennis ball serve, as shown in Figure 1. Table tennis is made strictly according to the specific parameters of the original entity (Table Tennis Competition Rules, 2011) 82. At the positions of 0°, 45°, 90°, 135°, 180°, 225°, 270°, 315°, and 360° on the surface of the table tennis body, the hitting parts are marked with black shadows in sequence, and a total of 8 3D pictures with a size of 1360×768 are rendered (all pictures exemplify the forehand serve with the right hand). 2 coaches and 2 second-class athletes on active service are asked to screen out pictures that can be used to send out side back spin. Experts all agreed that positions of 135° and 225° in the picture are most likely to send out side back spin, with a 100% of consistency.

Figure 1. 3D picture of table tennis ball
Experimental process
In the process of the experiment, as shown in Figure 2, a sign “+” appears first in the center of the screen, and then appears a picture of table tennis, with the black shadow on the surface indicating the hitting position by the opponent at the moment of hitting the ball. The subjects are asked to identify the picture that can be used to send out the side back spin, without pressing the key.

Figure 2. Experimental process

Results and discussions
Experimental results
Figures 3, 4, 5, and 6 show the electrical coherence of electrode pairs, P3-C3, P4-C4, P3-F3, P4-F4, P3-O1, P4-O2, P3-T7 and P4-T8, in different frequency bands, including low frequency alpha, high frequency alpha, low frequency beta, and high frequency beta. It can be seen from the Figure that the coherence of most electrodes to sports experts is lower than that to novice. The analysis is as follows.

C1 component
Taking C1 component latency as dependent variable, three factors of 2 sports levels (expert, novice)×2 stimulation types (positive stimulation, negative stimulation)×12 electrode points (Fz, Cz, Pz, Oz, etc.) are analyzed by variance analysis. The results show that the main effect of sports levels is significant; the main effect of the types of stimulation is not significant; the main effect of the electrode points is significant; the interaction edge between sports levels and stimulation types are significant; the interaction between sports levels and electrode points are significant; the interaction between stimulation types and electrode points is significant. The interaction of sports levels, stimulation types and electrode points is significant.

Analysis of ERP characteristics of table tennis players in the perception stage of judging serve rotation using single feature information
The results of the ERPs in this experiment show that more obvious C1 and P1 components are induced in the cerebral cortex occipital region, during the process of table tennis player’s rotation determination using single feature information (hitting position of the ball). Compared with the sports major college students, the athletes have the C1 with a shorter latency and larger amplitude, and the P1 with a longer latency and larger amplitude. The C1 component
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Conclusions

In this experiment, the “Oddball” paradigm is used to explore the ERP features of table tennis players in determining the serve rotation of the table tennis ball using single feature information. According to cognitive psychology, pattern recognition is the detection, discrimination and confirmation of stimulus patterns. Therefore, this process is divided into two stages, perception and recognition, for discussion. During the process of table tennis athletes determining the rotation of the ball using single feature information, more significant C1 and P1 components are induced in the cerebral cortex occipital area, significant N1 component is induced in central area and P3 component is induced in frontal-central area to parietal-occipital area. The results show that: 1. In the stage of table tennis players' perception of single feature information, the activation degree of cerebral cortex of is high, and they are very sensitive to the physical features of stimulus related to specific sports; 2. In the stage of table tennis players' recognition of single feature information, the activation degree of cerebral cortex of is high, the recognition speed is fast, and the amount of input psychological resources is large.

References

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