Pisco Med Publishing

Original Research Article

Application of Biofeedback Training in Sports Science

Jiawen He*

Shanghai Shiteng Juhui Sports Training Centre. E-mail: hejw@sina.com

Abstract: Biofeedback is a way to learn how to regulate body function and control through a series of training sessions. Using biofeedback training in sports science to adjust the level of sports arousal can also enhance athletes' control ability. In this article, literature is used to explain the overview of biofeedback training, its application in sports science, problems and prospects.

Keywords: Biofeedback Training; Sports Science; Application

1. Introduction

Biofeedback is a way to adjust physical function and train step science. The information that biofeedback can provide mainly includes skin surface temperature, blood pressure, and muscle tension. This technology uses electronic facilities to selectively process information related to physiological and psychological processes in the body, so that it can be displayed in the instrument in auditory and visual ways. Individuals gradually learn to control and correct these activities to the maximum extent according to changes by controlling and learning the external feedback signals provided by the instrument, and then can achieve the purpose of self-regulating internal physiological and psychological changes and cultivating good physical and mental conditions.

2. Overview of biofeedback training

2.1 The concept of biofeedback training

The biofeedback training is to use specific electronic equipment as the medium and tool to realize the complex feedback path between body and mind. The training uses electronic equipment to make strict and accurate measurements of the immediate physiological excitement of the body (such as muscle tension, EEG activity, heart rate, blood pressure, skin surface temperature, skin conductivity, etc.), so that the parameters of the physiological excitement can be informationized and concretized, and timely fed back to the body in the form of visual and auditory signals. It is convenient for the body to perceive its own physiological condition objectively and accurately. Under the guidance of professionals, the subjects are allowed to consciously adjust and control psychological and physiological reactions. Through repeated training, they can form operational conditioned reflexes, learn to control the activities of internal organs at will, correct abnormal physiological changes or regulate the training process of sports behavior, so as to effectively realize the function of consciously adjusting the physiological activities of the body through the mind. Commonly used biofeedback indicators mainly include EEG feedback, EMG feedback, skin electrical feedback, skin temperature feedback, respiratory feedback, and heart rate variability feedback.

doi: 10.18282/iss.v2i2.384

2.2 The connotation of biofeedback training

The generation of biofeedback dates back to the 1960s, and it developed on the basis of medical technology, and is defined as operational conditioned reflex in the scientific community. Biofeedback training requires electronic instruments and equipment to measure the actual conditions of human neuromuscular and autonomic nervous system under certain external stimulus. The experimenter makes further research on the data provided by electronic instruments and equipment, makes targeted selection on the data, amplifies the effective information into auditory signals and visual signals, and then feeds back the processed signals to the subjects. The goal of biofeedback is to understand the physiological functions of the subjects through a series of training, and to make the subjects understand the changes of physiological functions they perceive, so that they can effectively adjust the psychological changes and promote the subjects to have good psychology, thus achieving the purpose of preventing mental diseases. The biofeedback training has been further developed on the basis of biofeedback. The biofeedback training is based on modern instruments. By measuring people's physiological functions, the measured data are transmitted to athletes, so that athletes can have a correct grasp of their own physiological conditions and carry out standardized physical training under the guidance of physiological information. On the one hand, it can ensure athletes' physiological health; on the other hand, it lays a foundation for sports training to achieve good results.

With the help of modern electronic instruments, individuals have a comprehensive and correct understanding of their own autonomic nervous system, and their ability to control nervous system activities has also been significantly improved, which breaks the deadlock of blind training in traditional training. Biological electronic instruments and equipment can accurately reflect the physiological activities of the subjects, embody the abstract physiological activities, and transmit them to the subjects by visual and auditory means, so that the subjects can accurately grasp their actual state, carry out effective training based on the transmitted physiological function information, and timely and effectively correct abnormal psychological changes. Biofeedback training is the most effective way of psychological training, which is widely used in modern sports activities. It provides effective data support for athletes' training and lays a foundation for athletes to improve their own abilities.

3. Application of biofeedback training in sports science

3.1 Adjusting the arousal level

Good competitive condition and the best arousal level before the competition are the main factors that determine the sports performance. According to Yerkes-Dodson's law, the relationship between performance and arousal level can be drawn as an inverted U-shape curve. Before gradually changing from low arousal level to medium arousal level, the performance will be improved with increasing arousal level. After the critical point of medium arousal level is slightly lower than medium arousal level, it will further develop towards high arousal, which makes its performance decline. For athletes, the level of arousal should be effectively reduced in many cases. Related research shows that biofeedback training is an effective intervention method, which is beneficial to reduce the athletes' arousal level. For example, Wang Huimin, *et al*. found that if the muscle tension and arousal level were too high before the competition, it could reduce the athletes' performance. The technology of EMG feedback could effectively help athletes relax their bodies and relieve their muscle tension. Song Shuxian used EMG feedback instrument to train archers in real time. It was found that after training, the EMG value and excessive arousal level could be obviously reduced, and archers could be helped to improve the consistency of exertion of main working muscles from bow opening to spreading, thus improving the stability of movements. Further research found that biofeedback is not only effective for voluntary muscles, but also for visceral functions controlled by autonomic nervous system. For example, the tension of smooth muscle in blood vessels, trachea and intestine, and the rhythm of respiration and pulse are also effective. In short, the related research helps to find the best arousal point of athletes themselves by controlling and observing different biofeedback indicators, and use it in the competitive competition of athletes, transforming the athletes' excessive arousal to the energy direction, and then making athletes enter a good competition state.

3.2 Improve cognitive function and enhancing athletic performance

Shen Hejun, *et al*. found that biofeedback intervention training can improve athletes' psychological state with remarkable effect. Skin temperature, brain waves and heart rate can all be obviously changed, and the ability to concentrate and relax can be obviously enhanced. Wang Yongshun, *et al*. found that eight weeks' EEG biofeedback skills can significantly improve the performance of shooters, which is related to biofeedback training to improve the power of α-wave in the left temporal lobe. The training of α-wave neural feedback can effectively enhance athletes' ability to concentrate their attention, and can promote the circuit of their own brain network operating system, so as to quickly enter a good state of action execution, make nerves become efficient, and then improve athletes' sports performance. Chang Shuzhi, *et al*. found that biofeedback training can effectively improve gymnasts' independent relaxation ability, help athletes complete difficult movements and improve their sports performance through breathing adjustment training and attention concentration training.

3.3 Helping to stabilize mood and eliminate sports mental fatigue

Raymond, *et al*. have found that EEG biofeedback can help control athletes' emotional fluctuations, effectively reduce their negative emotions and increase their positive emotions, so that they can have better sensitivity to rhythm. According to Xu Zhao's research, the feedback training of heart rate variability can improve athletes' emotional stability, relaxation ability and self-regulation, relieve the physiological activities such as nervousness, irritability and sleep disorder caused by psychological fatigue, and alleviate the physical behavior reaction caused by psychological fatigue, thus changing athletes' psychological fatigue. Other related studies have pointed out that when athletes apply EEG biofeedback facilities to carry out psychological training activities, by fully mobilizing the frequency wave stimulation of athletes' brain activities, they can adjust their individual consciousness and accelerate their entry into the brain physiological environment adapted to their work tasks. High concentration of attention can not only enhance athletes' ability to exercise their own appearances, but also play a positive role in eliminating mental fatigue.

4. Problems and prospects

At present, biofeedback training is mostly conducted in laboratory situations, and the research focuses on experimental procedures, psychological preparation, training courses and intervention effects of biofeedback training. As these research data are mainly obtained under the control of experimental conditions, there is a big gap between them and the real sports situation, so some researchers question the ecological validity of the research. That is, whether the biofeedback training effect obtained from the experiment can be transferred from the laboratory to the real sports training and competition situation. Although some studies have tried to train sports in the sports field, the research in this area is still very limited and needs to be further strengthened.

In addition, each sport has its own different characteristics, so different sports need to choose suitable biofeedback to gain better training effect. For example, judo and Taekwondo need strength and highly sensitive muscle movement sense, so EMG and skin electricity may be better training methods; shooting and archery require good psychological preparation and high concentration of attention, so EEG feedback training is more appropriate. On the other hand, from the perspective of athletes, different athletes, especially high-level athletes, have great differences in their psychological needs and performance characteristics during sports. It will be better to formulate personalized biofeedback training programs according to athletes' sports specialties, different sports training methods and individual psychological characteristics.

5. Conclusion

The biofeedback technology is helpful to capture the change information of athletes' physiological indexes in competition and training immediately. With the help of biofeedback instrument, athletes can have a correct and comprehensive understanding of the vegetative nervous system, and carry out standardized sports training activities based on feedback information, which can not only significantly improve the ability of the body to control the nervous sys-

tem, but also ensure the health of athletes themselves, laying the foundation for good effects of sports training activities. Biofeedback training can speed up the scientific process of training control.

References

1. Li J, Tian B. Study on the influence of biofeedback training on the sports effect. Journal of Shandong Institute of Physical Education 2005; (4).
2. Sun S. Research on using biological feedback-graphto ease the sports fatigue. Journal of Qinghai Normal University (Natural Science Edition) 2004; (3): 94–96.
3. Chen D, Zhang J, Ren J, *et al*. The effect of biofeedback technology on fencing athletes' psychological control ability training (in Chinese). Journal of Shanghai University of Sport 1997; (2): 54–60.
4. Wang H, Cui Q. Research on psychological control training with EMG feedback technology (in Chinese). Sports Science 1991; (4): 84–87.
5. Song S, Tian Y, Ren W. Research on improving archers' movement consistency with EMG feedback (in Chinese). Sports Science 1994; (5): 78–81.
6. Shen H, Zhang Z, Pang J. Biofeedback intervention training for improving psychological adjustment in Jiangsu men's epeeteam. Journal of Nanjing Institute of Physical Education 2011; 25(5): 121–125.
7. Chang S, Ji C, Zhou Y, *et al.* Study on the influence of biofeedback training on gymnasts' independent relaxation ability (in Chinese). Ninth National Sports Psychology Conference.
8. Raymond J, Sajid I, Parkinson LA, *et al*. Biofeedback and dance performance: a preliminary investigation. Applied Psychophysiol & Biofeedback 2005; 30(1): 64.
9. Xu Z. Effect of HRV feedback training on sportsmen's mental fatigue. Journal of Shandong Institute of Physical Education 2009; 25(11): 46–48.