

Analysis of the competitive cognitive trait anxiety of aerobics athletes and research on the intervention of virtual reality technology

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Abstract: This study aims to explore the relationship between Organizational Stressors for Sport Performers, Sports Mental Toughness and aerobics athletes' Competitive Cognitive Trait Anxiety, and to analyze the role of virtual reality technology in the regulation of Competitive Cognitive Trait Anxiety. The study used literature methods to sort out the use of virtual reality technology in sports training, and tested the mental status of 91 aerobics athletes through questionnaires. The results found that there is a significant correlation between aerobics athletes' Competitive Cognitive Trait Anxiety, Organizational Stressors for Sports Performers and Sports Mental Toughness; virtual reality technology can reduce aerobics athletes' Competitive Cognitive Trait Anxiety. According to the research results, virtual reality technology can be used to simulate training and competition scenarios to reduce Competitive Cognitive Trait Anxiety, thereby effectively improving aerobics athletes' performance levels.

1. Introduction

Virtual Reality Technology (VRT) refers to the use of computer technology as the core to simulate and generate a realistic closed three-dimensional space. Through special input and output devices and the interaction between people and objects in the virtual space, users can get an immersive all-round experience.^[1] Virtual reality technology creates an "autonomous learning" environment where learners can acquire knowledge through their interaction with the information environment. New ways of learning skills have gradually replaced the traditional "teaching to promote learning" learning method.^[2] This is a revolutionary development in educational technology. Research shows that integrating virtual reality technology into classroom teaching can improve students' enthusiasm, increase learning interest, and has a significant effect on maintaining long-term learning effects compared with traditional teaching.^[3] Therefore, the application of virtual reality technology in sports training is particularly important, especially aerobics projects that emphasize presence and technical details.^[4] In sports training, athletes can use virtual reality technology to simulate training scenes to accurately master technical movements; before the game, by repeatedly simulating game scene to adapt to the various conditions in the game, thereby reducing anxiety and performing at their best.

Competitive Cognitive Trait Anxiety is a personality trait that perceives sports situations as threats and reacts to sports situations with fear and tension.^[5] Anxiety

before the game will affect the performance of athletes, especially for sports events with high difficulty and aesthetic value. Fluctuations in psychological emotions can easily cause mistakes in certain difficult movements, leading to poor performance. Excessive anxiety will underestimate athletes' judgment of themselves. In aerobics training, excessive anxiety will cause athletes to underestimate their own judgment. In aerobics training, excessive anxiety should be overcome, so that they can have a reasonable cognitive evaluation of their own abilities. Therefore, if aerobics athletes want to perform at their best and perform high-quality movements, they must not be affected by anxiety.

Sport Mental Toughness refers to a state of psychological resource that an individual exhibits characteristics such as determination, flexibility, and efficiency when formulating or maintaining goal pursuits.^[6] People who are mentally strong tend to be sociable and extroverted, because of their ability to remain calm and relaxed, they can be competitive in many situations and have lower anxiety levels than others. Abnormal mental states such as sports competition anxiety will hinder the development of psychological toughness.^[7] The higher the level of mental toughness of aerobics athletes, the more confident and firm they are, and they are relatively unaffected by anxiety. In the process of aerobics training, coaches should pay attention to the athletes' anxious mental state and improve the Sports Mental Toughness. The high level of Sports Mental Toughness can give the aerobics athletes greater self-confidence and firm belief, so as to show more excellent performance in the competition.

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Organizational Stressors for Sport Performers refers to the environmental needs directly and primarily related to the organization.^[8] Athletes' stress can be divided into two categories: during competitive sports, some sudden events and scenes that have a negative impact on the athlete's psychology are called acute stress; while a stressful situation for a long period of time is called chronic stress.^[9] Multiple psychological pressures are a huge burden for many athletes. These pressures can lead to severe anxiety, resulting in movement errors, poor performance, and even early retirement.

However, there is currently no in-depth research on the use of virtual reality technology to reduce anxiety and improve the psychological condition of aerobics athletes. Based on this, this study takes aerobics athletes as the research object, and on the basis of analyzing the psychological status of aerobics athletes, explores the application of virtual reality technology in aerobics training and its impact on the athletes' psychological status, in order to reduce the Competitive Cognitive Trait Anxiety and improve athletic performance.

This study analyzes the Competitive Cognitive Trait Anxiety of aerobics athletes. Based on the use of virtual reality in training, the athletes' organizational stressors and Sports Mental Toughness are used as independent variables, and Competitive Cognitive Trait Anxiety is used as the dependent variable. Accordingly, the following research hypotheses are proposed: Hypothesis H1: Organizational Stressors for Sport Performers have a significant positive predictive effect on Competitive Cognitive Trait Anxiety; Hypothesis H2: Sports Mental Toughness has a significant negative prediction effect on Competitive Cognitive Trait Anxiety; Hypothesis H3: There is a significant negative correlation between Organizational Stressors for Sport Performers and Sports Mental Toughness. Hypothesis H4: Exercise level has a significant negative predictive effect on exercise Competitive Cognitive Trait Anxiety. Hypothesis H5: Years of sports have a significant negative predictive effect on Competitive Cognitive Trait Anxiety. Hypothesis H6: The use of virtual reality technology can reduce aerobics athletes' Competitive Cognitive Trait Anxiety. The results of this study are crucial for athletes, coaches and sports researchers to deeply understand that virtual reality technology plays a key role in reducing aerobics athletes' anxiety. It has practical significance for reducing stressors for athletes and cultivating mental toughness to improve sports performance. The theoretical model of this study is as follows (see Figure 1).

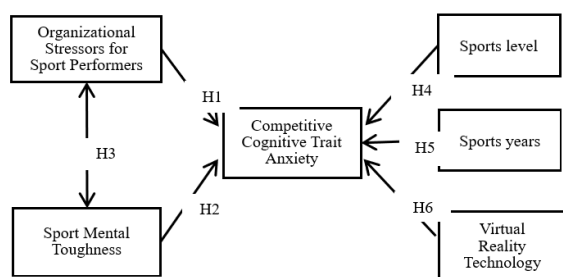


Figure 1 Factors affecting trait anxiety in sports cognition

2. Materials and Methods

2.1. Respondents

This questionnaire was distributed in the form of an online questionnaire. A random sampling method was used to select 91 aerobics athletes from Sichuan, Guangzhou, Hubei and other regions. 91 questionnaires were distributed and 91 valid questionnaires were recovered, with an effective recovery rate of 100%. Among them, there are 25 male athletes, accounting for 27.5%, and 66 female athletes, accounting for 72.5%. The average age is 20.23 years old (SD=1.739), and the average training years is 5.02 years (SD=2.793). There are 5 athletes with athletic levels, 10 first-level athletes, 22 second-level athletes, and 54 others.

2.2. Methods

2.2.1 Documentation method

Using literature databases such as China National Knowledge Infrastructure, IE, and EBSCO, cross-retrieval was carried out using the keywords "Virtual Reality in sports", "Sports Mental Toughness", "Pressure source", and "Competitive cognition anxiety" to obtain literature. All literature materials were read through The titles and abstracts were used to screen out irrelevant literature, and literature materials closely related to the research of this article were read, and effective information was obtained from them to summarize and summarize, so as to provide relevant theoretical basis for this article.

2.2.2 Materials

a) Organizational Stressors Indicator for Sport Performers(OSI-SP)

The questionnaire uses the Organizational Stressors Indicator for Sport Performers compiled by Arnold and Fletcher et al.^[10], which has 23 items and includes five dimensions: goals and development, logistics and management, team and culture, coaching and selection. The Cronbach's alpha coefficient of this questionnaire is 0.959, which can be used for the next step of analysis.

b) Sports Mental Toughness (SMT)

The questionnaire used the Sports Mental Toughness Questionnaire developed by Sheard et al.^[11] The questionnaire has 14 items in total, including two dimensions: confidence and control. The higher the score, the stronger the psychological toughness. The Cronbach's alpha coefficient of this questionnaire is 0.831, and the results show that the quality of this questionnaire is high.

c) Competitive Cognitive Trait Anxiety Inventory(CCTAI)

The questionnaire was originally compiled by Martens and subsequently revised by Dr. Ye Ping in 2000 as China Standardization Results.^[12] The questionnaire has 33 items in total, including 6 dimensions: social evaluation anxiety, competition preparation anxiety,

competitive performance anxiety, failure anxiety, opponent strength anxiety and injury anxiety. Three of them are lie detection questions. The higher the score, the

higher the anxiety level. high. After the reliability test, the Cronbach's alpha coefficient of the questionnaire was 0.947, which can be used for the next step of analysis.

Table 1 standard deviations of each research variable and Pearson correlation coefficient between variables (N=91)

	M	SD	OSI-SP	CCTAI	SMT
OSI-SP	2.88	1.07	1.00		
CCTAI	2.61	0.63	0.61**	1.00	
SMT	3.08	0.70	-.44**	-.52**	1.00

Note: **p<0.01 is the same as the table below

2.2.3 Data processing

This study uses SPSS27.0 to organize and analyze the data obtained from the questionnaire. The statistical methods include reliability and validity testing, descriptive statistics, correlation analysis, and multiple linear regression analysis.

2.3. Procedures

This study first investigated the relationship between aerobics athletes' Competitive Cognitive Trait Anxiety, Sports Mental Toughness, and Organizational Stressors for Sports Performers. The questionnaire survey first invited 23 aerobics athletes for pretesting. A total of 23 questionnaires were distributed, and 23 valid questionnaires were recovered, with an effective recovery rate of 100%. The test results showed that there were 13 items in the "Competitive Cognitive Trait Anxiety Inventory" such as "Compared with the results of the competition, I am more worried about injuries", and 5 items in the "Sports Mental Toughness Questionnaire" including "I would choose to give up in a difficult situation". The validity and reliability of 11 items including "travel arrangements during training and competition" in the "Organizational Stress for Sports Performers" were not good, so they were eliminated. At the same time, it was found that the collection of athlete information was incomplete, so questions such as "What measures are taken in psychological control before competition to reduce the psychological state of anxiety?" were added. After modification, it was officially distributed.

In order to reduce Competitive Cognitive Trait Anxiety, this study used open-ended questions to

understand athletes' feelings about virtual reality technology in reducing anxiety levels. The questionnaire asked participants a series of open-ended questions. Specific questions included: "Do you think virtual reality technology can provide a more realistic experience in aerobics training?" "Do you think virtual reality technology can help you better control and regulate your anxiety?" "What are your expectations for aerobics training using virtual reality technology?" Qualitative analysis of participants' responses allowed us to understand their perceptions and expectations of VR technology in reducing anxiety. Such analysis results can provide valuable reference for future research on the integration of virtual reality technology into sports training.

3. Discussion

3.1. Descriptive statistics and correlation analysis of each variable

Table 1 lists the means and standard deviations of Organizational Stressors for Sports Performers, Sports Mental Toughness, and Competitive Cognitive Trait Anxiety, as well as the Pearson correlation coefficients between each variable. The results show that there is a significant positive correlation between Organizational Stressors for Sports Performers and Competitive Cognitive Trait Anxiety, and a significant negative correlation with Sports Mental Toughness; there is a significant negative correlation between Competitive Cognitive Trait Anxiety and Sports Mental Toughness. Studying the significant relationship between the three provides prerequisite conditions for subsequent testing.

Table 2 Linear regression analysis affecting cognitive anxiety in aerobics athletes (N=91)

	non standardized coefficient		standardized coefficient	t	p	95% confidence interval for B	
	B	standard error	Beta			lower limit	upper limit
constant	1.005	0.259		3.872	<0.001		
gender	0.189	0.148	0.134	1.277	0.205	-0.105	0.482
sports level	-0.217	0.072	-0.307	-3.040	0.003	-0.360	0.075
sports years	-0.065	0.023	-0.286	-2.815	0.006	-0.110	-0.019
goals	0.342	0.045	0.625	7.562	<0.001	0.252	0.432
logistics and management	0.346	0.049	0.599	7.049	<0.001	0.249	0.444
team and culture	0.234	0.048	0.461	4.900	<0.001	0.139	0.329

coaching	0.306	0.046	0.579	6.703	<0.001	0.215	0.397
selection	0.263	0.047	0.512	5.617	<0.001	0.170	0.356
control	-0.194	0.082	-0.244	-2.374	0.02	-0.220	0.453
confidence	-0.026	0.092	-0.283	-2.780	0.007	-0.102	0.324

Note: The dependent variable is motor cognitive trait anxiety

As can be seen from Table 2, exercise level can significantly and negatively predict Competitive Cognitive Trait Anxiety ($\beta=-0.307$, $p=0.003$); exercise years also significantly and negatively predict Competitive Cognitive Trait Anxiety ($\beta=-0.286$, $p=0.006$); 5 dimensions of Organizational Stressors for Sports Performers can significantly and positively predict Competitive Cognitive Trait Anxiety: goals ($\beta=0.625$, $p<0.001$), logistics management ($\beta=0.599$, $p<0.001$), team culture ($\beta=0.461$, $p<0.001$), coaching ($\beta=0.579$, $p<0.001$), selection ($\beta=0.512$, $p<0.001$); both dimensions of Sports Mental Toughness can significantly and negatively predict Competitive Cognitive Trait Anxiety: control ($\beta=-0.244$, $p=0.02$), confidence ($\beta=-0.283$, $p=0.007$).

In summary, Organizational Stressors for Sports Performers can significantly and positively predict Competitive Cognitive Trait Anxiety, so hypothesis H1 is verified. Sports Mental Toughness can significantly and negatively predict Competitive Cognitive Trait Anxiety, so hypothesis H2 is confirmed. There is a significant negative correlation between Organizational Stressors for Sports Performers and Sports Mental Toughness, thus verifying hypothesis H3. Sport level can significantly and negatively predict exercise cognitive trait anxiety, so false H4 was verified. Years of sports can significantly and negatively predict Competitive Cognitive Trait Anxiety, so hypothesis H5 is confirmed.

3.2. Analysis of the Current Situation of Anxiety Regulation Strategies of Aerobics Athletes

In order to examine whether aerobics athletes adopt some specific psychological strategies to cope with anxiety, this study investigated the "adoption of coping strategies for anxiety". The results of the study showed that there is a certain trend in the regulation of anxiety among athletes. In the questionnaire survey, 48.3% of the athletes stated that they lacked specific psychological adjustment strategies, while 38.5% of the athletes had certain strategies, and only 13.2% of the athletes stated that they had adopted special psychological adjustment strategies (Figure 2). This reflects that the recognition and processing of anxiety psychology have not received widespread attention. However, among the open questions regarding the use of virtual reality technology, athletes generally believe that the technology can simulate a more realistic training environment that is closer to actual competition scenarios. This sense of realism may involve the comprehensiveness of visual, auditory and motor feedback, making training more challenging and realistic. This feeling can help them better cope with the stress of competition, thereby reducing Competitive Cognitive Trait Anxiety, therefore, validating research Hypothesis H6.

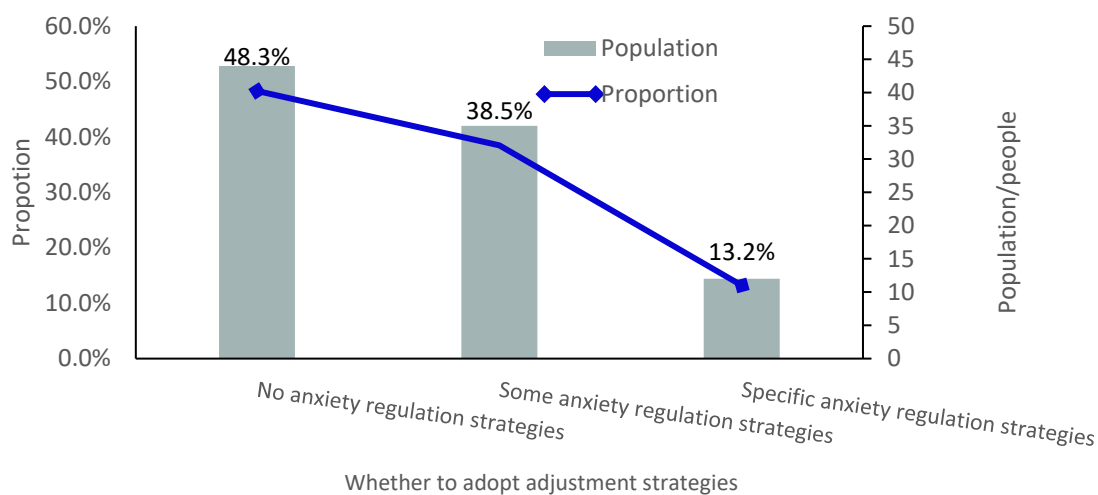


Figure 2 Distribution of anxiety regulation strategies among aerobics athletes

4. Conclusions

4.1. Descriptive statistics and correlation analysis of each variable

This study conducted correlation analysis on various variable data collected from 91 aerobics athletes and

found that there is a significant correlation between Organizational Stressors for Sports Performers, Sports Mental Toughness, and Competitive Cognitive Trait Anxiety, which is related to many qualitative factors, this is consistent with the view of many qualitative studies. For example, For example, Baumeister et al.^[13] believe that performance pressure will increase self-consciousness and anxiety about performance accuracy, which may undermine the accuracy of

movements and lead to poorer performance. Mojtahedi et al. [14] pointed out that athletes with better mental toughness had lower levels of cognitive and physical anxiety and higher self-confidence before competition. Relative to athletes with lower mental toughness, athletes with higher mental toughness are more confident and can handle stressors more effectively, thereby reducing the occurrence of anxiety. Zhang Lipeng et al. [15] proposed that the higher the stress level of athletes, the worse their psychological level. Aerobics athletes are under pressure from many aspects such as technical level, competitors, team expectations, etc. This multiple pressure will have a negative impact on their mental endurance. This suggests that coaches should reduce Organizational Stressors for Sports Performers, improve Sports Mental Toughness, and reduce Competitive Cognitive Trait Anxiety.

4.2. Factors influencing Competitive Cognitive Trait Anxiety in aerobics athletes

According to the previous research results, aerobics athletes generally have psychological characteristics of anxiety. Competitive aerobics is a sports with high difficulty and aesthetic value, which requires athletes to have high physical fitness, flexibility and other aspects of competitive ability, which can easily cause them to develop cognitive anxiety in sports. This study selected five indicators: sports level, sports years, Organizational Stressors for Sports Performers (goals, logistics and management, team and culture, coaching, selection), and Sports Mental Toughness (control, confidence) to explore the factors affecting Competitive Cognitive Trait Anxiety factors.

4.2.1 Sports level factor

Higher sports levels mean that athletes have higher technical levels and competitive abilities, and are more familiar and confident in the competitive process. Whether it is difficulty or operational movements, their skills and control are better. This kind of self-confidence can reduce The generation of anxiety. This study found that the higher the exercise level, the lower the cognitive trait anxiety of aerobics athletes. This view is consistent with the view proposed by Qu Zonghu [16] that athletes' anxiety control abilities increase with the improvement of their sports level.

4.2.2 Factor of sports years

Aerobics athletes who have trained for a long time have more confidence in their performance by accumulating more experience and skills. They have a more accurate assessment of their own abilities and are therefore less likely to feel anxious. In addition, long-term training can cultivate their positive attitude. mentality and adaptability, and are therefore better able to cope with challenges and stress, thereby reducing the occurrence of anxiety. The results of this study found that the longer the years of exercise, the lower the anxiety level of aerobics athletes. This is consistent with previous studies. Liu Jing and Wei

Xiaowei [17] used aerobics athletes as subjects to study their psychological anxiety control and found that as the athletes' training years increased, As the amount of exercise increases, the athlete's ability to control anxiety also improves.

4.2.3 Organizational Stressors factors

The data obtained from this questionnaire shows that the main sources of athlete pressure include: personal technical level, sports goals, training arrangements, team atmosphere, coach's blame, selection of competition qualifications, etc. From the perspective of goals, the setting of personal skills and sports goals has an important impact on sports cognitive trait anxiety. When athletes face high goal pressure, they may experience greater cognitive anxiety, worry about whether they will be able to achieve their intended goals, and have doubts about their abilities. From the perspective of logistics management, factors such as training and competition venues, injuries, etc. will also have an impact on sports cognitive trait anxiety. If the training venue is not suitable, athletes may feel uncomfortable, have difficulty adjusting, and have poor training results, leading to anxiety; or if athletes are injured due to accidents, this will interrupt training and competition plans, causing physical and psychological consequences. They may worry about the impact of the injury on their competitive ability and performance as well as the uncertainty during the recovery process. These unstable factors will also increase their cognitive anxiety. From the perspective of team culture, when the team atmosphere is positive and friendly, and the support and cooperation between teammates are good, athletes will feel more secure and confident, thereby reducing anxiety; when participating in the training stage before participating in a team competition, if they are not happy with their teammates, It is likely to lead to problems such as being unable to complete the formation arrangement, and will also cause more anxiety to the athletes. From a coaching perspective, when the coach gives positive support and encouragement to the athletes, the athletes will feel more confident and relaxed; but if the coach keeps blaming the athletes for poor completion of a certain action, this is very likely to prevent the athlete from performing the action to the best of his ability. From the perspective of selection, athletes may face the pressure of competition and evaluation during the selection process, worry about whether they can pass the selection, or have doubts about their abilities. This uncertainty factor will increase aerobics athletes' Competitive Cognitive Traits Anxiety.

4.2.4 Sports Mental Toughness factors

Sports Mental Toughness is an important psychological advantage to overcome anxiety, which helps individuals cope with stress successfully, maintain and promote physical and mental health. [18] This study found that the higher the Sports Mental Toughness of sports, the lower the anxiety level. From the control dimension, aerobics athletes with high emotional control ability can stay calm

and collected during competitions, and can effectively regulate the interference of anxiety. They can reduce the impact of anxiety by using emotion regulation strategies, such as cognitive restructuring and attention shifting, thereby improving the level of Competitive Cognitive Trait Anxiety; from the perspective of self-confidence, athletes with higher self-confidence levels are more likely to believe their own abilities and have a positive attitude towards their own performance and achievements, they are able to view potential threats as favorable opportunities. Athletes with higher levels of self-confidence show lower levels of physical and cognitive anxiety and can control their negative emotions more effectively. ^[19]At the same time, they also believe in their abilities, do not suffer from stage fright even in large competitions, and believe that I can maintain the accuracy and coordination of my movements during the competition and achieve excellent results.

4.3. The role of virtual reality technology in regulating anxiety among aerobics athletes

According to the previous article, coaches and athletes pay relatively little attention to anxiety and lack adequate anxiety regulation strategies. This makes aerobics athletes face more Organizational Stressors when facing pressure, and their Competitive Cognitive Trait Anxiety levels are correspondingly higher. Therefore, the application of virtual reality technology plays an important role in dealing with this problem, which is mainly reflected in the following aspects.

4.3.1 Reduce goal setting anxiety

Anxiety arises when an athlete's goals are set slightly above personal skill. Provide personalized training plans through virtual reality technology, analyze the specific needs and weaknesses of each athlete, and customize a specialized training plan. For example, the system can adjust the training difficulty according to the athlete's performance to ensure that training is always challenging but not too stressful, thus helping to improve athletes' psychological adaptability and avoid anxiety caused by excessive goals.

4.3.2 Avoid injury anxiety

When an athlete is injured due to incorrect execution of technical movements, anxiety arises accordingly. The sports simulation system using virtual reality technology can capture, acquire and reproduce the three-dimensional movement information of aerobics athletes during training through its three-dimensional technical means, so as to scientifically and accurately present all kinds of instant movements of athletes. The use of this technology in training can reduce the unexpectedness of injuries, effectively reduce the injury rate of athletes during training, and avoid injury anxiety.

4.3.3 Improve teamwork anxiety

When athletes don't get along with teammates, it can also trigger feelings of anxiety. Virtual reality technology is used to simulate teamwork and competitive game scenarios, allowing athletes to better understand and adapt to the importance of teamwork. Through virtual team exercises, athletes can improve their understanding and cooperation with teammates in simulated games, thereby improving their performance in actual games. work together more effectively. Avoid the anxiety caused by teammates not getting along well.

4.3.4 Eliminate coach blame anxiety

Athletes may feel anxious when a coach constantly scolds an athlete for a poor performance of a certain movement. Virtual reality technology can directly provide real-time feedback, and use the simulation system to compare and analyze athletes' simulated movements and actual movements on the same screen, allowing athletes to intuitively understand their own movement problems and make timely adjustments. This method does not require too much reliance on the coach's verbal guidance, and avoids the anxiety of athletes caused by the coach's blame.

4.3.5 Reduce selection pressure and anxiety

Aerobics athletes often experience anxiety during the selection and competition process. Through virtual reality technology, the selection process is simulated, allowing athletes to conduct selection training in a virtual environment and evaluate their own abilities, and conduct specialized training based on their own shortcomings, striving to do their best in the real selection process and avoid selection anxiety.

4.3.6 Other aspects

Virtual reality technology can also reduce athletes' anxiety in many ways. First of all, virtual reality technology can also gradually guide athletes to face the root causes of their cognitive trait anxiety through progressive exposure, helping athletes gradually adapt to factors that may cause anxiety during competition. For instance, virtual reality can simulate the preparation process before a competition and gradually introduce the visual and auditory effects of the audience to help athletes gradually adapt to and accept the uncertainty and pressure in the competition environment, thereby reducing anxiety. Secondly, virtual technology can be used to train psychological tolerance. By creating various competitive pressures in the virtual environment, such as camera shooting, the presence of the jury, etc. athletes can gradually adapt and improve their psychological tolerance in a relatively safe environment. receptive nature. This helps reduce anxiety during real competition and improves athletes' performance levels under high pressure.

An athlete with a good mental state is more likely to

perform well in critical moments. In the future, virtual reality technology can be combined with sports training to reduce aerobics athletes' Competitive Cognitive Trait Anxiety and improve their mental state. Virtual reality technology can provide personalized psychological adjustment training, allowing athletes to focus more on training and competition, ultimately enabling athletes to achieve excellent sports results.

4.4. Research deficiencies and prospects

There is a large gap in the ratio of male to female subjects in this study, making it difficult to generalize about the anxiety levels of male aerobics athletes. In the future, more efforts can be made to test the anxiety levels of male athletes to test the findings of this study. In addition, this study did not conduct an in-depth study of the psychological intervention of virtual reality in the training of aerobics athletes. In the future, the effectiveness of virtual technology in psychological intervention can be strengthened and the impact of more individual differences on psychological support effects can be explored. In addition, this study did not conduct long-term tracking and evaluation of aerobics athletes. Future research can conduct long-term tracking and evaluation through a research design that spans the entire training cycle, which can better reveal the lasting effects of virtual technology on athletes' mental health. Influence.

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