A STUDY ON THE EFFECT OF DEEP REINFORCEMENT LEARNING IN CULTIVATING ATHLETE DECISION BEHAVIOR AND PSYCHOLOGICAL RESILIENCE

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Abstract. In order to explore the relationship between the psychological resilience level and risk decision-making behavior of volleyball players, the author proposes a study on the effect of deep reinforcement learning in the cultivation of athlete decision-making behavior and psychological resilience. A survey and analysis were conducted on the psychological resilience level and risk decision-making behavior of 64 volleyball club athletes (29 males and 35 females) using the Psychological Resilience Inventory (PPI-A) and Sports Scenario Risk Decision Questionnaire. Construct a random forest regression model based on questionnaire data. The results indicate that there is a significant difference in risk decision-making behavior between athletes with high and low levels of psychological resilience in terms of benefits and losses =4.700,P=0.017,=22.065,P=0.000; There is a significant difference in risk decision-making behavior between athletes with high and low levels of psychological resilience when risk preference loss occurs =4.351,P=0.024, and in the context of positive and negative framing effects, the level of psychological resilience has no significant impact on decision-making behavior. The risk decision-making behavior of volleyball players is influenced by the framing effect, with negative framing and preference loss resulting in more risky behavior and a preference reversal; The level of psychological resilience affects the risk decision-making behavior of athletes in stressful situations, and athletes with high levels of psychological resilience have more adventurous behaviors.

Key words: Volleyball player, Psychological resilience, Framework effect, Risk decision-making, preference reversal

1. Introduction. In 2019, the General Office of the State Council officially issued the "Outline for Building a Sports Strong Country", deploying the promotion of the construction of a sports strong country and fully leveraging the important role of sports in the new journey of building a socialist modernized strong country, and proposed five strategic tasks [1]. The second aspect is to enhance the comprehensive strength of competitive sports and enhance the ability to bring glory to the country by establishing a modern competition system with Chinese characteristics and promoting the development of professional sports [2].

In modern competitive sports, athletes making quick and accurate decisions during competitions is one of the key to achieving victory. However, with the tension and pressure of the competition, the decision-making ability and psychological state of athletes may be affected, which in turn can affect their competitive performance. Therefore, how to cultivate the decision-making ability and psychological resilience of athletes has become a focus of attention for many coaches and researchers [3]. Deep reinforcement learning, as an important branch of artificial intelligence, has shown tremendous potential in various fields, including gaming, finance, and healthcare. Its method of learning optimal strategies through interaction with the environment based on intelligent agents provides a new approach to solving the optimization of athlete decision-making behavior. Meanwhile, psychological resilience, as an important psychological trait possessed by athletes when facing pressure and challenges, is inherently linked to the concept of deep reinforcement learning [4]. Whether athletes can have strong psychological qualities to withstand pressure at critical moments in competitive competitions, and be able to maximize their learned skills, reduce mistakes, and steadily demonstrate their rightful technical level is an important factor in winning. In the face of difficulties and obstacles, having excellent sports skills is a prerequisite, and strong psychological qualities can support the performance of athletes' skills. Moreover, any skill in competitive sports requires years and months of accumulation to be acquired. Therefore, the cultivation of athletes requires starting from the grassroots level to grasp the spirit of work style, perseverance, and never giving up [5].

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2. Literature Review. Existing research has confirmed that students who participate in physical exercise for a long time have higher levels of psychological resilience. The impact of different exercise intensities on psychological resilience also varies, regular participation in moderate intensity exercises leads to better psychological resilience. Cai et al. proposed a cloud edge device computing offloading method based on multi-agent deep reinforcement learning (MADRL), aimed at meeting various requirements of different tasks [6]. Sacchi, N. et al. proposed an essential redundant robot fault diagnosis and control scheme based on deep reinforcement learning (DRL) method combined with a set of sliding mode observers [7]. Wang, B. et al. used deep reinforcement learning (DRL) methods to actively control the flow of elliptical cylinders. The results indicate that DRL can learn active control strategies for the current configuration [8]. Eryilmaz, A. et al. investigated variables related to psychological resilience in pre adolescent youth, which is a trainable skill associated with psychological and academic performance [9]. Psychological resilience needs to have characteristics such as traits, processes, differences, outcomes, and dynamics, and is not a single or independent concept, but a three-dimensional and multi-level concept.

The author employs a questionnaire survey methodology to delve into the psychological resilience levels and risk decision-making behaviors among elite volleyball athletes in China. The aim is to establish a deeper understanding of these aspects and to explore potential correlations between them. The ultimate goal is to furnish valuable insights that can inform and enhance sports training programs and competitive performance strategies for these athletes.

3. Research Methods.

3.1. Research Object. Two men's volleyball teams (A team ranked third and B team ranked ninth) and three women's volleyball teams (C team ranked first in the league, D team ranked fifth, and E team ranked eighth) participated in the Chinese Volleyball League, with a total of 64 athletes. Among them, there are 29 males and 35 females; 52 strong generals, 12 at the first level; 31 active and previous national team athletes, 33 local team athletes; The average age is 22 years old; The average training period is 9 years. All athletes voluntarily participate in this survey study.

3.2. Research Methods. The author conducted a survey on 65 male and female athletes from 5 volleyball teams using the Psychological Resilience Inventory (PPI-A) and the Sports Scenario Risk Decision Questionnaire. The questionnaire is distributed and filled out by the relevant scientific researchers of the sports team. Before filling it out, the responsible scientific researchers explain in detail to the athletes the precautions for filling out the questionnaire. The questionnaire will be distributed one month after the end of the 2013-2014 season and will be collected one week later. A total of 65 questionnaires were distributed in this survey, with a response rate of 100%. Among them, 1 invalid questionnaire and 64 valid questionnaires were distributed. Finally, 64 athletes were included in this study. Then, according to the scoring criteria of the Psychological Resilience Scale, the psychological resilience score of each athlete is calculated, and the top 25% and bottom 25% are selected as the high and low psychological resilience groups in descending order of questionnaire scores. Next, statistical analysis was conducted on the framework effect and risk preference scores of athletes in the high and low psychological resilience groups in the four questions of the sports scenario risk decision-making questionnaire, in order to explore the relationship between psychological resilience level and risk decision-making behavior [10].

3.2.1. Research tools.
(1) Psychological Resilience Inventory (PPI-A). This questionnaire was developed by Colby et al. based on the Physical Performance Inventory (PPI) and is currently one of the main tools used by foreign researchers to evaluate exercise psychological resilience. It includes four dimensions: determination, self-confidence, positive cognition, and visual representation, with internal consistency coefficients of 0.86, 0.84, 0.82, and 0.75, respectively. The scale consists of 14 items, and the sum of the scores from the 4 dimensions is the total score of psychological resilience. This study translated the questionnaire into English and Chinese English by professional English teachers, and consulted two sports psychology experts to determine the final translation version of the questionnaire. Then, 20 college students were selected as the survey subjects, and two questionnaire evaluations were conducted with a one month interval before and after, and their retest reliability was tested. The results showed a retest reliability of 0.74 for both measurements.

Table 4.1: Four dimensional scores of psychological resilience for different teams (M±SD)

| | man (n=29) | | woman (n=35) | | |
	Team A (n=20)	Team B (n=9)	Team C (n=10)	Team D (n=15)	Team E (n=10)
determination	11.52 ± 2.11	11.35 ± 2.07	11.83 ± 1.20	10.21 ± 2.34	10.36 ± 1.20
Bao Confidence	15.16 ± 2.37	14.12 ± 1.63	15.48 ± 1.17	14.00 ± 2.07	12.56 ± 2.06
positive perception	15.40 ± 2.71	13.04 ± 2.53	14.54 ± 0.75	13.21 ± 2.05	12.30 ± 1.24
visual imagery	10.10 ± 2.30	10.58 ± 1.78	10.36 ± 1.73	10.57 ± 2.04	11.16 ± 2.01

(2) Sports Scenario Risk Decision Questionnaire. This questionnaire has a total of 12 test questions, each with only two choices: A and B, using the forced choice method of either choice, among them, there are 3 test questions about reference point effect, 4 test questions about framework effect and risk preference, 1 test question about decreasing sensitivity, and 4 test questions about psychological account. The scenario design includes technical and tactical choices, competition selection, reward and punishment preferences, etc. Based on the research content and survey subjects, the author selected four questions: framework effects and risk preferences, and replaced the involved sports scenarios with problem scenarios in volleyball matches, while using the "insider" problem scenario [11].

3.2.2. Data Analysis. Use SPSS 17.0 statistical software to conduct statistical analysis on the questionnaire results, including conducting independent sample t-tests and one-way ANOVA on the psychological resilience levels between different sports teams [12]. Conduct a multiple factor analysis of variance on the influencing factors of psychological resilience level (gender, sports level, and whether the national team is an athlete); The chi square test was conducted on the risk decision-making behavior of athletes, as well as the relationship between psychological resilience and risk decision-making behavior, with a significance level of 0.05.

4. Result analysis.

4.1. Sports psychological resilience.

4.1.1. Psychological resilience of different teams. The independent sample t-test results showed that there was no significant difference in determination, self-confidence, and visual representation between team A and team B. Positive cognition (t=1.801, p=0.048) showed marginal significance, and team A's positive cognition was to some extent superior to team B. The results of the analysis of variance showed significant differences in the determination of psychological resilience (F=4.098, P=0.022), self-confidence (F=9.282, P=0.000), positive cognition (F=8.013, P=0.001), and total score (F=3.248, P=0.028). The results of multiple comparisons (LSD) showed that the determination, confidence, and positive cognition of Team C were significantly better than those of Team D and Team E. Team D had significantly better confidence than Team E. However, there was no significant difference in the visual representation between Team C, Team D, and Team E (Table 4.1).

4.1.2. Psychological resilience of athletes of different genders, sports levels, and national teams. The results of multivariate analysis of variance showed that gender had a significant main effect on positive cognition (F=12.057, P=0.001), with male athletes having significantly better positive cognition than female athletes; Whether there are significant differences in determination (F=6.687, P=0.011), self-confidence (F=4.025, P=0.036), positive cognition (F=6.542, P=0.011), and visual representation (F=6.525, P=0.012) among national team athletes; The main effect of exercise level is not significant; The interaction between gender and sports level is significant in the positive cognition (F=4.682, P=0.021) dimension. The interaction between national team athletes and sports level is significant in the determination (F=7.201, P=0.007), self-confidence (F=4.854, P=0.017), and visual representation (F=15.434, P=0.000) dimensions. The interaction between gender and national team athletes in the positive cognition (F=7.057, P=0.009) dimension is significant (Table 4.2).

Table 4.2: Comparison of psychological resilience among athletes of different genders, sports levels, and whether they are national team members (M±SD)

	man (n=29)	woman (n=35)	master sports--man (n=52)	Class A (n=12)	national team (n=31)	local team (n=33)
Determination	11.40± 2.04	10.73± 2.00	11.21± 1.71	10.30± 2.80	11.32± 1.82	10.80± 2.04
Bao Confidence	14.84± 2.20	14.01± 2.08	14.47± 2.10	14.00± 2.47	14.52± 2.32	14.22± 2.00
positive perception	15.00± 2.73	13.36±1.68	14.24± 2.27	13.05± 2.17	14.52± 2.53	13.54± 2.60
visual imagery	10.24± 2.14	10.66±2.01	10.54± 2.01	10.18± 2.33	10.28± 2.31	10.67± 1.80

Table 4.3: Proportion of Risk Decision Behaviors of Athletes from Different Teams [n (%)]

	Team A(n=20) adventure	Team A(n=20) conservative	Team B(n=9) adventure	Team B(n=9) conservative	Team C(n=10) adventure	Team C(n=10) conservative	Team D(n=15) adventure	Team D(n=15) conservative	Team E(n=10) adventure	Team E(n=10) conservative
Front frame	10(50)	10(50)	3(22)	6(56)	3(20)	7(60)	5(22)	10(56)	5(40)	5(40)
Negative framework	13(54)	7(24)	6(56)	3(22)	5(40)	5(40)	13(76)	2(02)	9(80)	1(10)
Preferential benefits	4(20)	16(70)	3(22)	6(56)	3(20)	7(60)	5(22)	10(56)	4(30)	6(50)
Preference loss	15(64)	5(14)	8(78)	1(11)	9(80)	1(10)	15(100)	0(0)	8(70)	2(10)

Note: Adventure=seeking risk; Conservative=risk avoidance. The following table is the same.

Table 4.4: Comparison of Risk Decision Behaviors of Athletes under Positive and Negative Framework Effects Scenarios [n (%)]

	adventure	conservative	amount	χ^2	P
Front frame	25(30)	37(48)	62		
Negative framework	45(61)	17(17)	62		
amount	70(45)	54(33)	124	12.587	0.000

Table 4.5: Comparison of Risk Decision Behaviors of Athletes under Risk Preference Benefit and Loss Scenarios [n (%)]

	adventure	conservative	amount	χ^2	P
Preferential benefits	18(20)	44(60)	62		
Preference loss	54(75)	8(03)	62		
amount	72(47)	52(31)	124	41.403	0.000

4.2. Risk decision-making behavior of athletes.

4.2.1. Risk decision-making behavior of athletes from five teams. Frequency statistics were conducted on the risk decision-making behaviors of five teams, and the results showed that in terms of positive and negative framing effects, athletes tended to adopt conservative strategies (50% to 70%) in positive situations, while in negative situations, athletes tended to adopt more adventurous strategies (50% to 90%); In terms of risk preference, athletes tend to adopt conservative strategies (60% to 80%) when benefiting, and more inclined towards adventurous strategies (75% to 100%) when losing (Table 4.3). The test results indicate that compared to positive framing effects and risk preference benefits, athletes exhibit more risky behavior when negative framing and risk preference losses occur, and the difference is significant, χ^2=12.587, P=0.000, χ^2=41.403, P=0.000 (Tables 4.4 and 4.5).

4.2.2. The impact of gender, sports level, and national team athlete status on risk decision-making behavior. The chi square test results indicate that there is no significant difference in risk decision-

Table 4.6: Risk decision-making behavior of national and local team athletes in the context of positive and negative framework effects [n (%)]

	Front frame		χ^2	P	Negative framework		χ^2	P
	adventure	conservative			adventure	conservative		
national team (n=31)	7(12)	24(66)			22(60)	9(18)		
local team (n=33)	18(44)	15(34)	6.750	0.022	23(60)	10(20)	0.012	0.801

Table 4.7: Impact of risk preference on risk decision-making behavior of athletes with different levels of psychological resilience [n (%)]

	Preferential benefits		Preference loss		χ^2	P
	adventure	conservative	adventure	conservative		
High psychological resilience	4(16)	11(62)	11(62)	4(27)	4.700	0.017
Low psychological resilience	2(02)	13(76)	15(100)	0(0)	22.065	0.000

Table 4.8: The impact of different levels of psychological resilience on risk decision-making behavior in preference for gains and losses [n (%)]

	Preferential benefits		Preference loss		χ^2	P
	adventure	conservative	adventure	conservative		
Preferential benefits	4(16)	11(62)	2(02)	13(76)	0.207	0.538
Preference loss	11(623)	4(16)	15(100)	0(0)	4.351	0.024

Table 4.9: Impact of Positive and Negative Information Frameworks on Risk Decision Behavior of Athletes with Different Levels of Psychological Resilience [n (%)]

	Front frame		Negative framework		χ^2	P
	adventure	conservative	adventure	conservative		
High psychological resilience	7(36)	8(42)	10(56)	5(22)	0.432	0.350
Low psychological resilience	5(22)	10(56)	8(42)	7(36)	0.432	0.350

making behavior between gender and sports level in positive and negative frame effects and risk preference benefit losses. Is there a significant difference in decision-making behavior among national team athletes in positive frame effects, χ^1=6.750, P=0.022 (Table 4.6, only showing significant results) [13,14].

4.3. The relationship between different levels of psychological resilience and risk decision-making behavior . The chi square test and random forest results indicate that there is a significant difference in risk decision-making behavior between athletes with high and low levels of psychological resilience in terms of benefits and lossesχ^2=4.700,P=0.017,χ^2=22.065, P=0.000 (Table 4.7); There is a significant difference in risk decision-making behavior between athletes with high and low levels of psychological resilience when risk preference loss occurs χ^2=4.351, P=0.024 (Table 4.8), but in the positive and negative framing effect scenario, the level of psychological resilience has no significant impact on decision-making behavior (Tables 4.9 and 4.10).

4.4. Random Forest Regression. The library function for random forest regression in MATLAB is also TreeBagger.

4.4.1. Original dataset. The original dataset contains 1017 samples and 37 feature variables. The minimum sample size L of the leaf node is used as the hyperparameter for the random forest regression model. When selecting hyperparameters for the model, the training set is used to train the random forest regression model, and the out of bag error value (MSE) returned by the model is used as the evaluation indicator, when

Table 4.10: The impact of different levels of psychological resilience on risk decision-making behavior under positive and negative information frameworks [n (%)]

| | High psychological resilience | | Low psychological resilience | | χ^2 | P |
	adventure	conservative	adventure	conservative		
Front frame	7(36)	8(42)	5(22)	10(56)	0.128	0.708
Negative framework	10(56)	5(22)	8(42)	7(36)	0.128	0.708

MSE is at its minimum, L=14. After determining the hyperparameters, a random forest regression model was trained using the training set, and the performance of the model was tested using the test set. The results showed that MAE=0.1074,MSE=0.0164 R^2=0.6105, R^2_{adj}=0.3824. Using the entire dataset containing all 1017 samples, continue training the model to obtain the importance coefficients of feature variables and the random forest regression model [15]. The importance coefficients of 37 characteristic variables, the larger the value, the higher the importance. A negative value indicates that the importance is lower than 0. In this model, the top ten feature variables with the highest importance, from high to low, are positive coping, depression level, mindfulness level, health status, sleep quality, age, anxiety level, and stress level.

4.4.2. Filtering Datasets. The selected dataset contains 1017 samples and 8 feature variables. The out of bag error, MSE, is used for hyperparameter selection in the random forest regression model, when MSE is at its minimum, L=13. After determining the hyperparameters, the random forest regression model was trained using 916 samples from the training set, and the performance of the model was evaluated using 101 samples from the testing set. The results showed that MAE=0.1291,MSE=0.0239, R^2=0.6365, R^2_{adj}=0.6049. Finally, the entire dataset containing all 1017 samples was used to continue training the model, resulting in importance coefficients and a random forest regression model containing 8 feature variables. The importance coefficients and importance rankings of the 8 feature variables were ranked from high to low, followed by positive coping, depression level, mindfulness level, sleep quality, health status, and negative coping [16].

4.5. Psychological resilience levels of different teams. The results of this study show that the psychological resilience level of Team A is better than that of Team B, but there is no significant difference. The psychological resilience levels of Team C and Team D are both better than those of Team E. According to the results of the five teams in the past two years, Team A is in the top four of the league, Team B is in a middle and lower position, Team C is a top three team and won last year's league championship, and Team E is on the brink of relegation almost every season. Psychological resilience is an important factor affecting sports performance, and a higher level of psychological resilience is more conducive to improving sports performance.

4.6. The impact of gender, sports level, and national team athlete status on psychological resilience. The results of this study show that male athletes have significantly better positive cognition than female athletes, while general athletes have better psychological resilience than first level athletes, but there is no significant difference. National team athletes have better determination, self-confidence, and positive cognition than local team athletes, but there is no significant difference. Previous studies have suggested that psychological resilience is a dynamic development process, and excellent athletes have a higher level of psychological resilience. Generals and national team athletes have richer training and competition experiences, which continuously improve their psychological resilience, making them more confident, resilient, and resilient, and able to actively cope with training and competition problems, demonstrating obvious psychological advantages.

4.7. Risk decision-making behavior of athletes.

4.7.1. Overall risk decision-making behavior. People exhibit significant framing effects in risk scenarios and exhibit preference reversal in their behavioral choices. Previous studies have found that the risk decision-making behavior of team project athletes is significantly influenced by the framing effect. The results of this study also show that volleyball players exhibit risk avoidance in positive information and benefit situations, and risk seeking in negative and loss situations [17]. Moreover, compared to the positive framework and preference gain scenario, more athletes exhibit risky behavior and exhibit a significant preference reversal

when the negative framework and preference loss occur. This indicates that the risk decision-making behavior of athletes is also influenced by the framing effect and exhibits preference reversal. In addition, athletes did not show a significant risk aversion tendency in the positive framework, but showed a significant risk seeking tendency in the negative framework. Previous studies have also found that athletes do not exhibit a risk preference in their decision-making behavior under a positive framework, but only exhibit a clear risk preference phenomenon under a negative framework. There are also studies that have found that college students tend to seek risk within a positive and negative framework, and there is no gender difference. In addition, this study found that athletes showed significant risk avoidance when receiving benefits and obvious risk seeking when receiving losses. Previous studies have found that college students showed significant risk avoidance when receiving positive returns, and there was no significant difference between risk avoidance and risk preference when receiving negative returns. Compared to the general population, athletes are a special group, and strict sports training shapes their unique personality traits. Especially for athletes, the unique social and cultural background has a significant impact on success and failure. Athletes are sensitive to positive information during training and competition, and are more sensitive to negative information. For example, success (reward) and failure are goals that athletes deliberately pursue and avoid, especially in order to avoid potential loss of benefits caused by failure, which in turn affects their decision-making behavior in competition [18]. In addition, athletes often face leading or falling behind situations, such as serving at key moments in volleyball matches. High quality serving can disrupt the opponent's pass and take the initiative, but it also increases the risk of serving errors. In this situation, different athletes may adopt different risk decision-making behaviors. Therefore, diverse scenarios (or gains and losses) provide athletes with more risk decision-making opportunities than ordinary people.

4.7.2. The impact of gender, sports level, and national team athlete status on risk decision-making behavior. The results of this study show that in a positive framework, female athletes exhibit higher levels of conservative behavior than male athletes, and lower levels of adventurous behavior than male athletes. In a negative framework, female athletes exhibit higher levels of adventurous behavior than male athletes, and lower levels of conservative behavior than male athletes; Women's risk-taking behavior is higher than that of male athletes in both negative frames and losses. For example, 74% of female athletes choose risk-taking behavior in negative frames, and 91% of female athletes choose risk-taking behavior when facing losses. Both male and female athletes are affected by the framing effect, but there is no significant difference. Previous studies have also found that both men and women tend to seek risk in both positive and negative frameworks, but there is no significant difference.

Women's risk seeking in negative frameworks is more pronounced and significantly different compared to positive frameworks. This may be due to women's higher sensitivity to language frameworks. But some studies have also found that female referees tend to be more adventurous in a positive framework, while men tend to be more conservative, and there is no difference between men and women in a negative framework. This may be due to women being more susceptible to stress events than men, and experiencing more conflicts, setbacks, and accompanying negative emotions, which can affect their decision-making behavior. There are also studies that have found that male athletes are significantly affected by the framing effect in the player problem, while female athletes are not affected by the framing effect. This may be because women have a natural tendency towards conservatism and lower risk-taking, thus leaning towards conservative behavior. From the above results, it can be seen that future research needs to further explore the gender effects of risk decision-making behavior. For the relationship between skill level and framing effect, whether it is in player or outsider problems, average level athletes are affected by framing effect, while excellent athletes are only affected by framing effect in player problems, and low-level athletes are affected by framing effect in positive framing situations. The results of this study also show that both first level athletes and top athletes are affected by the framing effect, but lower level first level athletes are slightly more affected by the framing effect than top athletes. Low level athletes are more susceptible to framing effects, which may be closely related to their sports experience [19].

General athletes have relatively less sports experience and less competition training, and their confidence differs significantly from that of excellent athletes. These factors affect their decision-making behavior, which may also be the reason why low-level athletes exhibit significantly higher risk-taking behavior in a positive framework than national team athletes. But some studies have also found that referee level does not affect the

risk decision-making behavior of gymnastics referees.

In addition, this study also examined the decision-making behavior of national team athletes, and the results showed that national team athletes had more conservative decision-making behavior in positive and beneficial situations, especially in positive situations where conservative behavior was significantly higher than that of local team athletes. This may be related to the identity characteristics of national team athletes, who are more susceptible to the influence of success and benefits, less willing to fail, and therefore more inclined to avoid negative information. In a positive framework, they exhibit more conservative behavior.

4.8. Relationship between psychological resilience level and risk decision-making behavior . Regarding the relationship between psychological resilience level and risk decision-making behavior, research has found that in the context of positive and negative framing effects, compared with college students in the low psychological resilience group, college students in the high psychological resilience group are significantly more inclined to seek risk. This may be because individuals with high psychological resilience have better adaptability when dealing with stress in risk situations, can respond to risks and setbacks with a positive attitude, and are more inclined to seek risk. On the other hand, individuals with low psychological resilience tend to consider the potential losses of risk when facing risk situations, and therefore make higher assessments of risk and adopt risk avoidance. The results of this study showed that in the context of risk preference, athletes with high and low levels of psychological resilience had consistent decision-making tendencies when it came to risk preference. There was no significant difference in conservative behavior when it came to benefits, but there was a significant difference in risky behavior when it came to losses. Athletes with high levels of psychological resilience had more risky behaviors, namely risk seeking tendencies. This result is consistent with previous research, indicating that athletes with high levels of psychological resilience exhibit a clear risk seeking tendency in risk scenarios. This performance may be related to individuals with high levels of psychological resilience having better adaptability and recovery abilities when dealing with stress or setbacks. At the same time, athletes with high levels of psychological resilience can still demonstrate their technical and tactical skills even in difficult situations, maintaining sustained self-confidence, focus, and control over stress in stressful situations. These may also be important reasons why high resilience athletes exhibit more risky behavior in negative risk decision-making situations.

In addition, emotions influence people's risk decision-making behavior in stressful situations. Research has found that individuals with higher levels of positive emotions accumulate more resources such as psychological resilience, making them more likely to make optimistic judgments and exhibit higher risk seeking preferences, while negative emotions such as anxiety levels show a significant negative correlation with risk decision-making, making them more likely to make pessimistic judgments and exhibit higher risk avoidance preferences. This is because anxiety promotes pessimistic evaluations of future events [20].

Individuals with high levels of psychological resilience often have more positive emotional experiences because they make athletes more outgoing and communicative, allowing them to remain relaxed and calm, and to be competitive in many situations. They also have lower levels of anxiety, a better perception of self-confidence, and an unshakable belief in their ability to control adversity, making them more conducive to making good decisions in stressful situations. Due to the fact that positive mentality is one of the important characteristics of sports psychological resilience, athletes with high levels of psychological resilience have lower levels of negative emotions, which may be an important reason for differences in risk decision-making behavior among athletes with different levels of psychological resilience.

5. Conclusions.
1. The overall psychological resilience level of the top ranked teams is better than that of the bottom ranked teams;
2. The risk decision-making behavior of volleyball players also follows the framework effect of prospect theory, and when negative frameworks and risk preference losses occur, athletes exhibit higher risk taking behavior, leading to a phenomenon of preference reversal;
3. The influence of gender and sports level on the risk decision-making behavior of volleyball players is not significant, and national team athletes have more risk seeking tendencies;
4. Psychological resilience affects the risk decision-making behavior of volleyball players, and volleyball players with high levels of psychological resilience tend to engage in more risky behaviors, namely risk

seeking tendencies.

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