



Influences of Physical, Environment, Task, Timing, Learning, Emotion, Perspective (PETTLEP) Intervention on Psychological Resilience, Psychological Skills, Anxiety and Depression of Athletes

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Abstract

Background: High-intensity competition pressure leads to psychological problems for athletes, which need to be improved through intervention. We aimed to explore the influences of PETTLEP (physical, environment, task, timing, learning, emotion, perspective) intervention on the psychological state of athletes, and provide references for their psychological improvement.

Methods: Overall, 120 basketball players were enrolled through the convenience sampling method from Shaanxi, Yunnan, Fujian, and the national basketball team in China from April to June 2022. PETTLEP-based imagery intervention was given to all athletes, and their psychological resilience, training state, psychological skills, anxiety, and depression before and after the intervention were evaluated using a questionnaire survey.

Results: The psychological resilience value of athletes after the intervention was higher than that before the intervention ($P < 0.05$). The psychological resilience index of athletes who trained for more than three years was higher than that of athletes who trained for less than 3 years ($P < 0.05$). The athletes who trained for over three years felt better after the intervention concerning good feelings, self-efficacy, self-adjustment, and physical fitness recovery than before the intervention ($P < 0.05$). No statistical differences in self-confidence, coordination ability, and motivation were observed among the athletes trained for different years before and after the intervention ($P > 0.05$). The athletes who trained for over three years have shown better results regarding focal attention and cognitive regulation after the intervention than before the intervention ($P < 0.05$).

Conclusion: The PETTLEP-based imagery intervention can improve the athletes' psychological skills, relieves anxiety and depression, and enhance their psychological resilience.

Keywords: Athletes; Psychological resilience; Psychological skill; Training state; Anxiety; Depression

Introduction

Competitive sports have always pursued superior sport performance. However, the International Olympic Committee has recently started attaching importance to the mental health of athletes. Many athletes have experienced psychological

problems to various degrees. For instance, famous swimmer Michael Phelps was infected with major depressive disorder and once had the motive for suicide numerous times (1). Owing to psychological problems, the playing condition of



many athletes reached rock bottom, which is regrettable. Various competitive psychological traits cultivated in the multi-year sports training process, such as perfectionism, sense of competition, and self-centeredness, are almost not conducive to the regulation of such psychological illnesses. Instead, it will aggravate the negative psychological status of athletes (2). Psychological skills and psychological resilience exert significant effects on promoting the mental health of athletes and improving their psychological skills (3). Mutual help and mutual promotion, being previous traits, may positively influence athletes.

Athletes' psychological skill is an important psychological operating system formed through relevant training, which influences the individual psychological state and psychological process, and an innate or acquired ability of athletes (4). Compared with ordinary athletes, outstanding athletes are of a relatively higher psychological skill level (5). Psychological resilience is a psychological development phenomenon manifested by greater braveness in face of adversity or serious pressure (6). However, psychological resilience has not been explained uniformly in China yet, where it is usually referred to as resilience, restoring force, and mental elasticity. According to some researchers, it is a continuous aggregation of successively coping with setbacks, accompanied by the process theory, consequentialism, and trait theory (7). Sport psychological resilience denotes the undefeated psychological property presented by athletes after perceiving threatening stimuli in the sports process. When faced with unfavorable sports scenarios, athletes with higher psychological resilience can keep a stronger anti-pressure ability, greater perseverance, and higher self-confidence level, while pursuing perfectness and higher goals, along with positive self-discipline, high tolerance of pain, fatigue, and intense absorption. Most wrestling coaches think that psychological resilience is an important psychological feature in deciding whether an athlete can succeed or not (8). Athletes with higher psychological resilience and psychological skills perform better in athletics (9). The on-the-spot data of basketball players presented a certain positive

correlation with their psychological resilience (10). As proven by numerous studies (11-12), the sports performance of athletes is closely related to their psychological resilience and psychological skills, where the former plays a decisive role in the progress of competitions. Hence, good psychological resilience is especially important for high-level athletes and also an important guarantee of superior performance.

The conventional intervention methods, although effective, are slightly boring, and athletes show low interest in such interventions, thus it is urgent to seek an intervention means adaptable for athletes that can improve their mental health. Imagery training is the most common and fundamental psychological training technique in the sports field, with significant effects in improving sports performance. However, its effects on keeping psychological resilience, arousing motives, and improving psychological skills have been less probed into. Wang et al. (13) deemed that the traditional imagery scripts contained relatively few stimulating factors and achieved relatively poor effects. Fan et al. (14) derived the PETTLEP ((physical, environment, task, timing, learning, emotion, perspective)-based imagery intervention mode based on the functional equivalence principle of psychoneuromuscular theory, and such an intervention mode has been widely applied at home and abroad. The PETTLEP-based imagery intervention could improve the self-efficacy of Youth Athletes and enhance their self-confidence (15).

By looking up literature, it is found that most of the studies have concentrated on improving sports performance through imagery training, but the improvement of psychological skills and psychological resilience has been less investigated. As for the selection of imagery scripts, most of the sport psychology researchers adopted general imagery training programs in psychological training (16). However, researchers usually take advantage of the PETTLEP-based imager intervention mode, which compared with ordinary imagery scripts, contains richer stimulating factors, thus achieving a relatively better effect in practical sports training (17).

By combining the individual characteristics of athletes and the features of sports events, the PETTLEP-based imagery scripts were formulated in this study to perform stepwise and planned imagery training, thus aiming to improve the psychological skills and psychological resilience of athletes and lay a foundation for improving their mental health.

Methods

Research objects

A total of 120 basketball players were enrolled through the convenience sampling method from Shaanxi, Yunnan, Fujian, and the national training team in China from April to June 2022. PETTLEP-based imagery intervention was given to all athletes (89 males, 31 females, 65 first-grade sportsmen, and 55 second-grade sportsmen) aged from 18-27 [average age: (19.21±2.18)] with years of training of 2.1 to 9.8 [average years of training: (6.25±2.18)].

The PETTLEP-based imagery intervention method

Before the experiment, two coaches informed all respondents who signed the informed consent. The imagery scripts used in the experiment included physical (P), environment (E), task (T), timing (T), learning (L), emotion (E), and perspective (P). In the intervention phase, the influence of each factor on the sports and their imagery degree was timely monitored.

The imagery intervention was given to all athletes four times per week, 20 min each time. In the early phase, interventional guidance was given by specially assigned advisers. In the later phase, the athletes completed the relevant training themselves. Meanwhile, the respondents kept everyday imagery training records. The meeting was held once per week to discuss the problems encountered in their training process and the corresponding guidance was given. The training lasted five weeks.

Evaluation indicators

Psychological resilience

The psychological resilience of the athletes was evaluated using the psychological resilience questionnaire (18). This questionnaire was a single-dimension measuring tool, containing eight items, such as “I overcome adversities hard and persistently” and “I believe my ability to achieve goals”, the seven-level rating method was used, ranging from “completely met” (7 scores) to “not met at all” (1 score), and the total score was obtained by adding the score of each item. A higher score meant stronger psychological resilience. The Cronbach’s α value was 0.91, indicating good structural reliability and validity.

Psychological skills

Psychological skills were evaluated using a sport psychological skill scale, which was mainly applicable to competitive athletes, containing 31 reverse and positive scoring items (19). The Cronbach’s α value of each factor was 0.75 to 0.88, and that of the total scale was 0.96, manifesting good structural reliability and validity. The scale included five dimensions: self-confidence, concentration, coordination ability, motive, and cognitive regulation, and the scoring was implemented using five points, including: “not met at all” (5 scores), “not that met” (4 scores), “uncertain” (3 scores), “basically met” (2 scores) and “totally met” (1 score), and a higher score denoted better psychological skill state.

Training state

The training state was assessed using training state monitoring scale, which included eight dimensions: psychological fatigue, psychological exhaustion, physical recovery, self-adjustment, self-efficacy, fatigue, good feeling and emotional stress, totaling 45 items (20). The internal consistency coefficient of this scale was 0.76, and the test-retest reliability coefficient was 0.59 to 0.75, indicating good structural reliability and validity.

Psychological skill effect

This factor was evaluated by measuring the heart rate of athletes. Their heart rate after sitting silently for one minute was measured by placing one finger on the radial artery of the other hand.

The test was performed after the training was ended each time to guarantee the data accuracy and reliability.

Anxiety-depression scores

The anxiety-depression state of athletes was evaluated using the Self-Assessment Scale for Anxiety (SAS) and the Self-Reportation Scale for Depression (SDS), which has 20 entries, each with 10 entries scored in reverse and 10 entries scored positive according to a four-level rating method, and the sum of all positive scores, multiplied by 1.25, was converted into a standard score ranging from 25 to 100 points (21). The range of scores was 25 to 100, with moderate anxiety/depression being no less than 70, moderate anxiety/depression from 60 to 69, mild anxiety/depression from 50 to 59, and normal being less than 50. The scale retest reliability was 0.819, and the internal consistency reliability was 0.876.

Statistical Analysis

Table 1: Comparison of the Changes in the Psychological Resilience Index of Athletes Trained for Different Years before and after Intervention ($\bar{x} \pm s$)

	<i>Before intervention</i>	<i>After intervention</i>	<i>t</i>	<i>P</i>
≤3 years	2.01±0.12	4.56±0.21	115.492	<0.001
>3 years	2.21±0.07	5.87±0.32	122.39	<0.001
<i>t</i>	15.770	37.492		
<i>P</i>	<0.001	<0.001		

After the intervention, the self-efficacy, self-adjustment, and physical recovery of athletes af-

The data analysis was implemented via SPSS 22.0 (IBM Corp., Armonk, NY, USA). The measurement data following normal distribution were expressed by ($\bar{x} \pm s$), and the data comparisons were conducted through paired *t*-test (intragroup comparison) or grouped *t*-test (intergroup comparison). The enumeration data were compared using the χ^2 test. *P*<0.05 meant that the difference was significant.

Results

The psychological resilience value of athletes after the intervention was (5.36±0.26), which was higher than that (2.15±0.09) before the intervention, while the difference was significant (*t*/*P*=127.805/<0.001).

After the intervention, the psychological resilience index of athletes trained for over 3 years was higher than that of athletes trained for ≤ 3 years (*P*<0.05) (Table 1).

ter the intervention were all better than those before the intervention (*P*<0.05) (Table 2).

Table 2: Comparison of the Changes in Training State Index of Athletes before and after Intervention ($\bar{x} \pm s$)

<i>Variable</i>	<i>Before intervention</i>	<i>After intervention</i>	<i>t</i>	<i>P</i>
Emotional stress	2.49±0.87	2.36±0.74	1.247	0.107
Good feeling	2.61±0.96	2.69±1.03	0.622	0.267
Fatigue	2.63±1.08	2.45±1.16	1.244	0.107
Self-efficacy	1.59±0.95	2.81±1.26	8.469	<0.001
Self-adjustment	2.15±0.69	3.55±0.99	12.709	<0.001
Physical recovery	2.32±0.79	3.21±0.87	8.296	<0.001
Psychological exhaustion	0.79±0.15	0.69±0.16	1.104	0.135
Psychological fatigue	2.15±0.89	2.02±0.92	1.113	0.134

No significant differences between athletes trained for different years were found in the aspects of emotional stress, fatigue, psychological exhaustion, and psychological fatigue before and after the intervention ($P>0.05$). The athletes who

trained for over three years were better in the aspects of good feeling, self-efficacy, self-adjustment, and physical recovery than before the intervention ($P<0.05$) (Table 3).

Table 3: Comparison of the Changes in Training State Index of Athletes Trained for Different Years before and after Intervention ($\bar{x} \pm s$)

<i>Variable</i>		<i>Before intervention</i>	<i>After intervention</i>	<i>t</i>	<i>P</i>
Emotional stress	≤3 years	2.69±1.53	2.58±1.49	0.564	0.286
	>3 years	2.56±1.11	2.45±1.15	0.754	0.226
Good feeling	≤3 years	2.07±1.12	2.18±1.15	0.751	0.227
	>3 years	2.89±1.06	3.86±1.15	6.794	<0.001
Fatigue	≤3 years	2.66±0.29	2.61±0.25	1.431	0.067
	>3 years	2.54±1.02	2.48±0.96	0.469	0.320
Self-efficacy	≤3 years	1.87±0.69	1.95±0.74	0.866	0.194
	>3 years	1.74±0.71	2.39±0.75	5.940	<0.001
Self-adjustment	≤3 years	2.15±0.52	2.23±0.49	1.227	0.111
	>3 years	2.29±0.89	3.95±0.96	13.891	<0.001
Physical recovery	≤3 years	2.21±0.78	2.31±0.76	1.006	0.158
	>3 years	2.25±0.96	3.14±1.02	6.960	<0.001
Psychological exhaustion	≤3 years	0.69±0.15	0.71±0.17	0.966	0.167
	>3 years	0.85±0.13	0.82±0.18	1.480	0.070
Psychological fatigue	≤3 years	1.43±0.32	1.48±0.29	1.268	0.103
	>3 years	2.32±0.51	2.29±0.43	0.493	0.311

The concentration and cognitive regulation status of athletes after the intervention were better than those before the intervention ($P<0.05$) (Table 4). No differences in athletes trained for different years were observed in the aspects of self-confidence, coordination ability, and motive be-

fore and after the intervention ($P>0.05$). The concentration and cognitive regulation of athletes who trained for over three years after the intervention was better than those before the intervention ($P<0.05$) (Table 5).

Table 4: Comparison of the Changes in Psychological Skill Index of Athletes before and after Intervention

<i>Variable</i>	<i>Before intervention</i>	<i>After intervention</i>	<i>t</i>	<i>P</i>
Self-confidence	3.39±0.51	3.48±0.49	1.394	0.082
Coordination ability	3.89±0.41	3.95±0.45	1.080	0.141
Motive	3.43±0.29	3.49±0.38	1.375	0.085
Concentration	3.07±0.32	3.85±0.39	16.937	<0.001
Cognitive regulation	3.42±0.48	4.21±0.29	15.431	<0.001

Table 5: Comparison of the Changes in Psychological Skill Index of Athletes Trained for Different Years before and after Intervention ($\bar{x} \pm s$)

<i>Variable</i>		<i>Before intervention</i>	<i>After intervention</i>	<i>t</i>	<i>P</i>
Self-confidence	≤3 years	3.22±0.35	3.29±0.41	1.422	0.078
	>3 years	3.41±0.52	3.48±0.49	1.073	0.142
Coordination ability	≤3 years	4.11±0.33	4.16±0.36	1.122	0.132
	>3 years	3.96±0.28	4.02±0.32	1.546	0.062
Motive	≤3 years	3.38±0.29	3.41±0.31	0.774	0.220
	>3 years	3.61±0.35	3.68±0.36	1.527	0.064
Concentration	≤3 years	3.18±0.25	3.23±0.26	1.519	0.065
	>3 years	3.21±0.22	3.75±0.54	10.145	<0.001
Cognitive regulation	≤3 years	3.32±0.48	3.38±0.35	1.106	0.135
	>3 years	3.26±0.41	3.89±0.25	14.371	<0.001

Through imagery intervention training, the pulse rate of athletes presented a declining trend, with 68 beats/min before the intervention, declining to 63 beats/min at five weeks after the interven-

tion, in which the imagery intervention could gradually lower the heart rate of athletes (Table 6).

Table 6: Changes in Pulse Rate per Min of Athletes before and after Intervention

<i>Group</i>	<i>Psychological skill effect (beats/min)</i>
Before intervention	68
1w after intervention	66
2w after intervention	65
3w after intervention	64
4w after intervention	63
5w after intervention	62

Table 7 shows that the SDS and SAS scores of the athletes after the intervention were signifi-

cantly lower than those before the intervention ($P<0.05$).

Table 7: Anxiety and depression of athletes before and after the intervention

	<i>Before inter- vention</i>	<i>After interven- tion</i>	<i>t</i>	<i>P</i>
SDS	63.39±5.51	43.48±4.49	30.685	<0.001
SAS	63.89±5.41	43.95±3.45	34.043	<0.001

In terms of SDS and SAS scores, the differences between athletes with various training years before and after the intervention were insignificant. Athletes with >3 years of training had significant-

ly lower SDS and SAS scores after the intervention than before the intervention ($P<0.05$) (Table 8).

Table 8: Changes in anxiety and depression in athletes with different training years before and after intervention

<i>Variable</i>		<i>Before interven- tion</i>	<i>After inter- vention</i>	<i>t</i>	<i>P</i>
SDS	≤3 years	63.22±5.35	43.29±4.41	31.489	<0.001
	>3 years	63.41±5.52	38.48±3.49	41.817	<0.001
SAS	≤3 years	64.11±5.33	44.16±4.36	31.737	<0.001
	>3 years	63.96±5.28	39.02±3.32	43.803	<0.001

Discussion

From the results in Table 1, the psychological resilience index of athletes after the intervention was higher than that before the intervention, while the psychological resilience index of athletes who trained for over three years was higher than that of athletes who trained for less than 3 years after the intervention, indicating that the PETTLEP-based imagery intervention could improve the psychological resilience of athletes, especially the athletes who trained for over 3 years, and this result was similar to the report of Lin (22). A possible reason is that the PETTLEP-based imagery intervention can enhance the psychological and behavioral control of athletes in the sports process and enhance their concentration on the target task. This positive effect can help athletes overcome challenges and difficulties, temper their willpower, strengthen their self-confidence, and improve their psychological resilience in such a process (23). Imagery training, a training pillar in sport psychology, has a significant effect on improving athletes' sports performance. Imagery scripts have developed from the initial image and audio into the current individualized customization, with more complete functions. The PETTLEP-based imagery does not have any inherent pattern, in which it is necessary to set different script contents and scenarios according to the intervention goal and related needs, aiming at stress management, skill learning, damage recovery, self-confidence enhancement, performance review, and preview (24). In this study, the intervention contents used included athletes' psychological skills and psychological resilience, in which a fierce competition back-

ground was added to the PETTLEP-based imagery scripts to enhance their self-confidence and sense of achievement and temper their psychological resilience.

Tables 2 and 3 have shown that after the intervention, the training state indicators of athletes' self-efficacy, self-adjustment, and physical recovery were higher than those before the intervention, where the athletes trained for over three years had higher values of the aforementioned indicators than those trained for less than 3 years, manifesting that the PETTLEP-based imagery intervention could better improve their training state. By executing the designed script intervention, related memory was saved in the brain of athletes, and plenty of evidence also supported the sharing structure between sports imagery and sports, indicating that psychologists should attach importance to all kinds of responses of athletes' physical skills in the script design, and clinically oriented individualized imagery intervention should be conducted for athletes, instead of traditional stereotyped imagery intervention (25). Only in this way can their psychological resilience and training state be improved. Proprioception is a kind of physical calm turntable reached by the corresponding relaxation training before the imagery training (26). However, the relationship between imagery intervention and relaxation training has not been clearly described in previous studies. In the PETTLEP-based imagery intervention, imagery behaviors are driven by functional equivalence, needing the proprioception in the script to draw the closest to the execution and preparation states of sports (27). Thus, in the PETTLEP-based imagery intervention in this study, the wet hairs adhered to the forehead of

the respondent who was sweaty all over experienced the physical confrontation and felt the ball catching and shooting movements. This reflected that the designed script could arouse the athletes' sports state very well, along with all kinds of movements, which improved their training state. Meanwhile, this also verified that the PETTLEP-based imagery intervention could improve the athletes' psychological resilience and training state from the level of psychoneuromuscular theory.

Results in Tables 4-8 show that the mental skill indicators such as focused attention and cognitive regulation were significantly higher after the intervention than before the intervention, thus indicating that the PETTLEP phenotype-based intervention can improve the mental skills and anxiety-depression status of athletes better. This result accorded with the findings of Zandi et al. (28). In this study, the environmental factors and tasks involved in the designed script highlighted the individualized imagery intervention pattern customized according to the features of different athletes and intervention objects, in which the respondents should be encouraged to participate in it with multiple sense organs. As for the time, if the execution state, sports preparation, and sports imagery could stimulate the athletes' cerebral nervous activities, they were consistent in the time feature. In terms of learning, as the correlated responses and imagery would vary with learning, the corresponding adjustment was needed in the script design. In this imagery intervention process, the coaches regularly interview the athlete respondents, understood the whole learning process, and adjusted the script contents according to the learning progress to realize the functional equivalence. Emotion has always been considered a missing link in the sports process. In this study, the PETTLEP-based imagery intervention pattern integrated seven-aspect content, with an emphasis on the detailed physical sensations and movements of the athletes. The imagery of the cognitive functional type was used to help the athletes in controlling their anxiety in the match, lowering the degree of arousal, keep-

ing their self-confidence, and improving their psychological skills.

Conclusion

The PETTLEP-based imagery intervention can effectively improve the athletes' psychological skills, relieve anxiety and depression, and enhance their psychological resilience. This study provides a novel idea for sports psychologists to investigate the imagery intervention, and provides a reference for improving athletes' mental health.

Journalism Ethics considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

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Conflict of Interest

The authors declare that there is no conflict of interests.

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