

CONCENTRATION IMPROVEMENT TEST FOR ATHLETES IN ARCHERY TRAINING



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TESTE DE MELHORIA DE CONCENTRAÇÃO PARA ATLETAS EM TREINO DE TIRO COM ARCO

PRUEBA DE MEJORA DE LA CONCENTRACIÓN PARA DEPORTISTAS EN EL ENTRENAMIENTO DE TIRO CON ARCO

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ABSTRACT

Introduction: There is a correlation between competition performance with a concentration in competitive archery athletes. It is an essential theme in academia to improve the performance of archers, the belief that this goal can be achieved by increasing their concentration. Studies on concentration and relaxation in archery training have shown effective indicators to evaluate training intensity and athlete cognition, but there is still no scientific consensus. **Objective:** This study aims to analyze the impact of concentration on traditional archery and athlete performance during competition. **Methods:** Twenty traditional archers were selected as research volunteers. They underwent a battery of biometric tests, including an EEG system to perform group tests. A chi-square test was performed on concentration and relaxation data. The results were analyzed according to the influence of the above two factors on the athletes' performance. In parallel, this paper analyzed the relationship between the degree of relaxation and the archers' performance. **Results:** There was a positive correlation between concentration and performance. More focused athletes perform better. The data were statistically significant ($P < 0.05$). There is a positive correlation between relaxation and performance. The data were statistically significant ($P < 0.05$). **Conclusion:** The results of this article provide evidence that both concentration and relaxation can help improve archer performance. **Level of evidence II; Therapeutic studies - investigation of treatment outcomes.**

Keywords: Athletes; Sports; Attention.

RESUMO

Introdução: Há uma correlação entre o desempenho na competição com a concentração nos atletas arqueiros competidores. É um tema essencial na academia para melhorar o desempenho dos arqueiros a crença de que esse objetivo pode ser alcançado aumentando a sua concentração. Estudos sobre a concentração e o relaxamento no treinamento de arco e flecha mostraram indicadores eficazes para avaliar a intensidade do treinamento e a cognição do atleta, porém ainda não há um consenso científico. **Objetivo:** Este estudo tem como objetivo analisar o impacto da concentração sobre o esporte de arco e flecha tradicional e o desempenho do atleta durante a competição. **Métodos:** Foram selecionados 20 arqueiros tradicionais como voluntários de pesquisa. Estes foram submetidos a uma bateria de testes biométricos, incluindo um sistema EEG para realizar testes em grupo. Realizou-se um teste qui-quadrado sobre os dados de concentração e relaxamento. Os resultados foram analisados segundo a influência dos dois fatores acima no desempenho dos atletas. Paralelamente, este artigo analisou a relação entre o grau de relaxamento e o desempenho dos arqueiros. **Resultados:** Houve correlação positiva entre a concentração e o desempenho. Atletas mais focados realmente têm melhor desempenho. Os dados foram estatisticamente significativos ($P < 0,05$). Há uma correlação positiva entre relaxamento e desempenho. Os dados foram estatisticamente significativos ($P < 0,05$). **Conclusão:** Os resultados deste artigo evidenciam que tanto a concentração quanto o relaxamento podem ajudar a melhorar o desempenho dos arqueiros. **Nível de evidência II; Estudos terapêuticos - investigação dos resultados do tratamento.**

Descritores: Atletas; Esportes; Atenção.

RESUMEN

Introducción: Existe una correlación entre el rendimiento en la competición y la concentración en los atletas de tiro con arco de competición. Es un tema esencial en la academia para mejorar el rendimiento de los arqueros la creencia de que este objetivo se puede lograr mediante el aumento de su concentración. Los estudios sobre la concentración y la relajación en el entrenamiento de tiro con arco han mostrado indicadores eficaces para evaluar la intensidad del entrenamiento y la cognición del deportista, pero aún no hay consenso científico. **Objetivo:** Este estudio pretende analizar el impacto de la concentración en el deporte del tiro con arco tradicional y el rendimiento del atleta durante la competición. **Métodos:** Se seleccionaron veinte arqueros tradicionales como voluntarios para la investigación. Estos fueron sometidos a una batería de pruebas biométricas, incluyendo un sistema de EEG para realizar pruebas de grupo. Se realizó una prueba de chi-cuadrado con los datos de concentración y relajación. Los resultados se analizaron en función de la influencia de los dos factores mencionados en el rendimiento de los atletas. Paralelamente, este artículo analizó la relación entre el grado de relajación y el



rendimiento de los arqueros. Resultados: Hubo una correlación positiva entre la concentración y el rendimiento. Los atletas más concentrados rinden más. Los datos fueron estadísticamente significativos ($P < 0,05$). Existe una correlación positiva entre la relajación y el rendimiento. Los datos fueron estadísticamente significativos ($P < 0,05$). Conclusión: Los resultados de este artículo demuestran que tanto la concentración como la relajación pueden ayudar a mejorar el rendimiento de los arqueros. **Nivel de evidencia II; Estudios terapéuticos - investigación de los resultados del tratamiento.**

Descriptor: Atletas; Deportes; Atención.

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INTRODUCTION

Archery is a sport dominated by mental skills. It requires exceptionally high technical precision and stability. Studies have shown that the project has accurate, fast, and consistent characteristic performance. The role of an athlete's mental ability in sports competition is prominent.¹ Our mental training for archers can go a long way in helping them perform well in the competition. A good shooter must have good concentration, relaxation, judgmental thinking, and anti-interference ability.

In this study, a single-lead EEG acquisition system was used. This paper calculates the subjects' concentration and relaxation through the special software of Neurosky Company.² Concentration and relaxation in archery training are effective indicators to evaluate training intensity and athlete's cognition. Concentration and relaxation are a combination of various brain waves.

METHOD

Research objects

This article selects 30 outstanding male archery athletes.³ We divide the collected data into excellent performance group, average performance group, and off-target group according to different training situations.

Research equipment

This paper adopts the Cirlet single-lead EEG system produced by NeuroSky Company in the United States. We read brain waves from 2 o'clock in the middle of the forehead and the earlobe.⁴ This article transmits data via Bluetooth. The data acquisition and storage device is an IBM-X200 portable computer. In this paper, the concentration and relaxation level data are collected and calculated by this software.

Evaluation indicators

Evaluation indicators include concentration and relaxation.⁵ The data range is 0~100. The general population is generally between 40 and 60.

Archery training target vector function model

Several independent factors of the target position vector $\vec{s} = (x, y)^T$ are represented by a vector $\vec{u} = (u_1, u_2, \dots, u_n)$, if it is differentiable in $\vec{u}_0 = (u_{10}, u_{20}, \dots, u_{n0})$, then

$$\vec{s} = \vec{f}(\vec{u}) = \vec{f}(\vec{u}_0) + H \overline{\Delta u}^T + R \approx \vec{f}(\vec{u}_0) + H \overline{\Delta u}^T \quad (1)$$

Where $\vec{f} = (f_x, f_y)^T$, $\overline{\Delta u} = (\Delta u_1, \Delta u_2, \dots, \Delta u_n)$ is a tiny deviation vector over \vec{u}_0 . R is a higher-order small quantity. H is the derivative matrix of the vector function. Its expression is as follows

$$H = \frac{\partial \vec{f}(\vec{u}_0)}{\partial \vec{u}} = \begin{bmatrix} \frac{\partial f_x}{\partial u_{10}} & \frac{\partial f_x}{\partial u_{20}} & \dots & \frac{\partial f_x}{\partial u_{n0}} \\ \frac{\partial f_y}{\partial u_{10}} & \frac{\partial f_y}{\partial u_{20}} & \dots & \frac{\partial f_y}{\partial u_{n0}} \end{bmatrix} \quad (2)$$

When there is a slight deviation of \vec{u} , the deviation vector of the target position is

$$\overline{\Delta s} \approx H \overline{\Delta u}^T = \begin{bmatrix} \frac{\partial f_x}{\partial u_{10}} & \frac{\partial f_x}{\partial u_{20}} & \dots & \frac{\partial f_x}{\partial u_{n0}} \\ \frac{\partial f_y}{\partial u_{10}} & \frac{\partial f_y}{\partial u_{20}} & \dots & \frac{\partial f_y}{\partial u_{n0}} \end{bmatrix} \overline{\Delta u}^T \quad (3)$$

The target position deviation vector is not only related to the significant fluctuation $\overline{\Delta u} = (\Delta u_1, \Delta u_2, \dots, \Delta u_n)$ of the influencing factor vector.⁶ It is also related to the derivative matrix H of the vector function $\vec{f} = (f_x, f_y)^T$. The component of the target position deviation vector is a linear combination of the coefficients of $\overline{\Delta u} = (\Delta u_1, \Delta u_2, \dots, \Delta u_n)$ corresponding to the row elements of H . The larger the coefficient, the more significant the impact.

The relationship between the mean square error of each component of $\overline{\Delta s}$ and the mean square error of each component of \vec{u} is:

$$\begin{pmatrix} \sigma_x^2 \\ \sigma_y^2 \end{pmatrix} = \begin{bmatrix} \sum_{i=1}^n \left(\frac{\partial f_x}{\partial u_{i0}} \right)^2 \sigma_{u_i}^2 \\ \sum_{i=1}^n \left(\frac{\partial f_y}{\partial u_{i0}} \right)^2 \sigma_{u_i}^2 \end{bmatrix} = \sum_{i=1}^n \begin{bmatrix} \left(\frac{\partial f_x}{\partial u_{i0}} \right)^2 \sigma_{u_i}^2 \\ \left(\frac{\partial f_y}{\partial u_{i0}} \right)^2 \sigma_{u_i}^2 \end{bmatrix} \quad (4)$$

The mean square error and variance of the target position deviation are not only related to the fluctuation of each influencing factor but also related to the derivative matrix H of the vector function $\vec{f} = (f_x, f_y)^T$. $\mu_{xi0} = \frac{\partial f_x}{\partial u_{i0}}$ and $\mu_{yi0} = \frac{\partial f_y}{\partial u_{i0}}$ are respectively the influence rate of the i factor on the lateral deviation x and lateral deviation y of the mid-target position. $\vec{\mu}_{i0} = (\mu_{xi0}, \mu_{yi0})^T$ is the influence rate vector of the i factor in $\vec{u}_0 = (u_{10}, u_{20}, \dots, u_{n0})$ on the target position deviation vector. $N_0 = (\mu_{10}, \mu_{20}, \dots, \mu_{n0})$ is the influence matrix of $\vec{u} = (u_1, u_2, \dots, u_n)$ at $\vec{u}_0 = (u_{10}, u_{20}, \dots, u_{n0})$. but

$$\overline{\Delta s} \approx N_0 \overline{\Delta u}^T = (\mu_{10}, \mu_{20}, \dots, \mu_{n0}) \overline{\Delta u}^T = \begin{pmatrix} \mu_{x10} & \mu_{x20} & \dots & \mu_{xn0} \\ \mu_{y10} & \mu_{y20} & \dots & \mu_{yn0} \end{pmatrix} \overline{\Delta u}^T \quad (5)$$

$$\begin{pmatrix} \sigma_x^2 \\ \sigma_y^2 \end{pmatrix} = \sum_{i=1}^n \begin{pmatrix} \mu_{xi}^2 \sigma_{u_i}^2 \\ \mu_{yi}^2 \sigma_{u_i}^2 \end{pmatrix} \quad (6)$$

Data Statistics and Processing

Test data results are expressed as mean \pm standard deviation.⁷ In this paper, a one-way analysis of variance was used to compare the differences between groups, and the level of significant difference was $P < 0.05$.

There is no need for a code of ethics for this type of study.

RESULTS

Comparison of concentration results at different ring value levels in training

There was no significant difference in the mean concentration of athletes in the excellent performance group and the average performance group in the training state ($P>0.05$). The off-target group was significantly higher than the excellent and average groups.⁸ The difference between the excellent grade group and the average grade group at <40 was statistically significant ($P<0.05$). The difference between the level of 60 and 79 was also statistically significant ($P<0.01$). Between 40 and 59> The difference at the level of 80 was not statistically significant ($P>0.05$). There was no statistically significant difference between the excellent performance group and the off-target group in each concentration level. The difference between the average performance group and the off-target group at the level of <40 was statistically significant ($P<0.05$), and the difference at the level of 60-79 There was statistical significance ($P<0.01$). (Table 1)

Comparison of relaxation results at different ring value levels during training

The difference between the excellent grade group and the off-target group, and the average grade group was statistically significant ($P<0.01$). The difference between the average grade and off-target groups was not statistically significant.⁹ The score of 60-79 between the excellent and off-target groups was higher than that of the off-target group, and the difference was statistically significant ($P<0.05$). There was no difference in other levels ($P>0.05$). Except for the score >80 , there was no significant difference between the excellent grades group and the average grades group, and the rest of the relaxation levels were significantly different ($P<0.05$). Among them, the difference at the level of 40-59 was very significant ($P<0.01$). There were statistically significant differences between the average score group and the off-target group at the score level of <40 and 40-592 ($P<0.05$). (Table 2)

Comparison of the level of concentration and relaxation when hitting 10th level and below 7th level

The evaluation focus level of hitting the 10th ring is 44.23 ± 12.84 , and the relaxation degree is 58.16 ± 19.82 . Compared with the level of hitting the 7th ring, the difference in concentration was not statistically significant, but the difference in relaxation was statistically significant ($P<0.05$). (Table 3)

Table 1. Comparison of concentration results at different ring value levels.

	Outstanding Achievement Group	General grade group	Off-target group
n	10	10	10
Mean	43.34 ± 8.25	40.28 ± 10.08	48.81 ± 8.48
<40	0.42 ± 0.18	0.33 ± 0.12	0.26 ± 0.13
40~59	0.43 ± 0.11	0.44 ± 0.08	0.38 ± 0.06
60~79	0.12 ± 0.10	0.31 ± 0.14	0.27 ± 0.10
>80	0.07 ± 0.06	0.06 ± 0.05	0.08 ± 0.07

Table 2. Comparison of relaxation results at different ring value levels.

	Outstanding Achievement Group	General grade group	Off-target group
n	10	10	10
Mean	59.39 ± 10.37	45.00 ± 9.95	52.73 ± 11.22
<40	0.23 ± 0.17	0.14 ± 0.10	0.22 ± 0.14
40~59	0.43 ± 0.13	0.24 ± 0.15	0.35 ± 0.11
60~79	0.29 ± 0.15	0.15 ± 0.11	0.21 ± 0.11
>80	0.09 ± 0.05	0.05 ± 0.05	0.11 ± 0.10

Table 3. Comparison of concentration and relaxation when hitting 10th and below 8th.

	n	Concentration	Relaxation
Hit 10 rings	51	44.23 ± 12.84	58.16 ± 19.82
Below the 7th ring	118	41.19 ± 18.60	45.42 ± 16.41

DISCUSSION

The effect of concentration on archery performance

The level of concentration of the excellent group and the average group was significantly lower than that of the off-target group ($P<0.05$). Among them, the outstanding group is 87% of the concentration level of the off-target group. The average performance group only reached about 80% of the off-target group. The technical characteristics of archery are stable movements, precise details, and decisive completion. This places high demands on the athlete's attention during the completion of technical movements. Reasonable attention distribution is one of the essential factors affecting the quality of action completion and ring value. If the athlete's concentration is excessively improved, it cannot be reasonably distributed and diverted. Increased concentration or concentration can lead to changes in the sensation of movement.¹⁰ The body's sensitivity to muscle exertion is reduced. This change will affect the completion of the movement and result in a drop in performance. Prolonged concentration can also cause early onset of central fatigue.

The effect of relaxation on archery performance

Completing the technical action of archery is a continuous and unified process. There is a time limit for completing each set of arrows in an archery competition. Athletes must properly allocate the rhythm of each arrow shot. Disruption of this rhythm can adversely affect the next arrow firing cycle. No matter what stress state the athlete is in, he should clear his mind as soon as possible and return to the state of inaction, preparation, and origin.¹¹ This also requires the athlete to relax as much as possible in a limited time, saving physical energy and restoring energy to prepare for the action cycle of the next arrow launch. The relaxation index was used to describe the relaxation level of athletes in the process of completing the movement. The results showed that the average level of relaxation in the fantastic group was significantly higher than that in the average group ($P<0.01$) and the off-target group ($P<0.05$). The high-achieving group outperformed the average-achieving group by about 23%. The outstanding group was about 9% higher than the missing group. This shows that athletes are more likely to obtain high ring values in a state of high relaxation.

From another point of view, mental relaxation can effectively reduce redundant movements, save physical strength, and improve physical coordination and movement stability. These are all necessary conditions for good grades. Athletes in good form tend to be in a moderately relaxed state. This helps them ensure clear technical lines, a good rhythm of movements, and high movement efficiency. Compared with the overall relaxation level, the fantastic group was also significantly higher than the off-target group.¹² This shows that performing well requires a more relaxed nervous system than regular training. This higher-than-usual relaxation positively affects the athlete's achievement of high ring values. Therefore, acquiring a relaxed state should be emphasized in the regular training and competition. This controlling ability can be emphasized in regular training.

The relationship between concentration and relaxation levels

An archer can't maintain the same focus and relaxation throughout the technical movement. This is a constantly fluctuating process. The distribution of good concentration and relaxation when the athlete is in good condition gradually increases during the aiming phase.¹³ The

data from this study show that there is no antagonistic relationship between relaxation and concentration levels. Elite archers show a high level of concentration and relaxation when they get a high ring value. There was no significant difference in concentration between these two states ($P>0.05$). (Table 3) But the level of relaxation when hitting the 10th ring is 125.85% ($P<0.05$) when hitting the 7th ring. This shows that relaxation is more important than concentrating on completing the launch to complete a good move. Relaxation allows for better movement. This makes the athlete's technical movements feel more precise and accurate, and the improvement of the quality of the movements will naturally have a good impact on the performance. Biofeedback training has fundamental practical significance for improving concentration. Improving the ability to relax while completing a movement is more complicated and more important than improving concentration.

Scientific observation and analysis of the change law of concentration and relaxation in training can be used to monitor training intensity and even evaluate competition status in archery.

CONCLUSION

In archery, a high level of relaxation is conducive to obtaining a high ring value, and the effect of concentration level is not apparent. The level of concentration and relaxation can be increased or decreased simultaneously. They do not necessarily have opposite trends. Target fade training can improve focus during training. This allows the athlete to focus more on the movement itself.

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