THE REACTION SPEED OF SPORTS ATHLETES IN DIFFERENT STATE LEVELS

COMPARAÇÃO DA VELOCIDADE DE REAÇÃO DOS ESPORTISTAS NA PARTIDA DA CORRIDA DE CEM METROS

COMPARACIÓN DE LA VELOCIDAD DE REACCIÓN DE LOS DEPORTISTAS EN LA PARTIDA DE LA CORRIDA DE CIEN METROS

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ABSTRACT

Introduction: The start of a sprint race is one of its most important stages. The reaction time at the start lays a psychological foundation for normal performance and performance improvement in its next three stages. Objective: To research the reaction time of athletes in the starting stage of the 100-meters sprint race. This helps analyze the internal reaction mechanism of the body, which receives signals and responds to actions. Methods: We use a bibliographical research, experimental comparison, and mathematical statistics to study the starting reaction time of sprinters. Results: The starting reaction time of male and female sprinters was basically at the same level. Conclusion: The starting time of Chinese sprinters needs to be improved. 400-m sprinters, especially, should devote more training to their starting reaction time. ***Level of evidence II; Therapeutic studies - investigation of treatment results.***

Keywords: Sports; Sprint Interval Training; Reaction Times.

RESUMO

Introdução: A partida é uma etapa importante na corrida de cem metros. A velocidade de reação no início estabelece a base psicológica para o desempenho normal e a melhoria do desempenho nas três fases seguintes. Objetivo: Investigar o tempo de reação de atletas no estágio inicial da corrida de 100 metros rasos. Isso ajudará a analisar o mecanismo de resposta interno do corpo, que recebe sinais e responde a ações. Métodos: Pesquisa bibliográfica com comparação experimental e estatísticas matemáticas para estudar o tempo de reação inicial de corredores. Resultados: O tempo de reação inicial de corredores do sexo feminino ou masculino foi basicamente o mesmo. Conclusões: O tempo de reação inicial dos corredores chineses precisa ser melhorado. Corredores dos 400 metros, especialmente, devem dedicar mais tempo de treinamento ao tempo de reação inicial. ***Nível de evidência II; Estudos terapêuticos – investigação de resultados de tratamento.***

Descritores: *Esportes; Treinamento Intervalado de Arranque; Tempo de Reação.*

RESUMEN

Introducción: La partida es una etapa importante en la corrida de cien metros. La velocidad de reacción en el inicio establece la base psicológica para el desempeño normal y la mejoría del desempeño en las tres fases siguientes. Objetivo: Investigar el tiempo de reacción de atletas en la etapa inicial de la corrida de 100 metros. Esto ayudará a analizar el mecanismo de respuesta interno del cuerpo, que recibe señales y responde a acciones. Métodos: Investigación bibliográfica con comparación experimental y estadísticas matemáticas para estudiar el tiempo de reacción inicial de corredores. Resultados: El tiempo de reacción inicial de corredores del sexo femenino o masculino fue básicamente el mismo. Conclusiones: El tiempo de reacción inicial de los corredores chinos necesita ser mejorado. Corredores de 400 metros, especialmente, deben dedicar más tiempo de entrenamiento al tiempo de reacción inicial. **Nivel de evidencia II; Estudios terapéuticos – investigación de resultados de tratamiento.**

Descriptores: *Deportes; Entrenamiento de Intervalos de Alta Intensidad; Tiempo de Reacción.*

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INTRODUCTION

As the level of world track and field sports continues to improve, sprint competitions have become increasingly fierce. Starting has become a technology with considerable potential to be tapped. In a race where the winner is determined by 1/100s, the starting reaction speed of the athletes directly affects the starting speed. This has a certain impact on athletes' psychology.[1] There is still a big gap between China's sprint level and the world's advanced level. Studying the reaction speed of Chinese athletes has important practical significance for improving the level of Chinese sprinting.

METHOD

Research object

572 male and female athletes participated in the track and field sprint competition in the final stage of the National Games.[2] The content of the competition includes the all-around sprint event and the reaction speed of the 4×100m, 4×400m relay first rod.

Research methods

We use the Swiss OF02-ATΩ starting foul monitor to monitor and record the reaction time of all sprinters at the start. At the same time, we perform statistical processing on the data obtained.[3] The article uses physiological and logical reasoning methods to analyze the factors that affect the starting reaction.

Decomposition of human motion force behavior

In this paper, the adaptive radio frequency technology RFID missing data probability functional method is used to realize the improvement of the decomposition algorithm and model of the human motion characteristic behavior. The key technologies to improve the algorithm and model design are described below.[4] After data preprocessing and feature selection, the feature vector O is obtained. Judging whether there is any abnormality, the coordinates of the joints that the human body exerts and receives are relatively fixed. At the same time we get a V type joint and a P type joint as:

$$a_a = r_\omega - p_4 / \| r_\omega - p_4 \|, r_\omega = p - l_h n \quad (1)$$

$$o_a = a_4 \times (r_s - p_4) / \| a_4 \times (r_s - p_4) \|, n_4 = o_4 \times a_4 \quad (2)$$

We use the method of quantitative recursive analysis to recursively calculate the probability of missing data.[5] The article performs trend probability functional processing to calculate the remaining feature formation vector $\hat{O}$ of the human body motion force model. If the remaining feature vector $\hat{O}$ has missing data, we calculate the target probability $P\ (O\lambda)$ according to the first forward algorithm to obtain the decomposition result of human motion force behavior as:

$$\begin{aligned}
\hat{a}_t(j) &= P(o_{1:t-1}, o_t^{\bar{m}}, q_t = S_j \mid \lambda) \\
&= \sum_i P(\hat{o}_{1:t-1}, o_t^{\bar{m}}, q_{t-1} = S_i, q_t = S_j \mid \lambda) \\
&= \sum_i P(\hat{o}_{1:t-1}, q_{t-1} = S_i \mid \lambda) P(o_t^{\bar{m}}, q_t = S_j \mid q_{t-1} = S_i \mid \lambda) \\
&= \sum_i \hat{a}_{t-1} P(q_t = S_j \mid q_{t-1} = S_i \mid \lambda) P(o_t^{\bar{m}} \mid q_t^{\bar{m}} = S_{jm}^{\bar{m}}, \lambda) \\
&= \sum_i \hat{a}_{t-1}(i) a_{i,j} b_{jm}^{\bar{m}}(o_t^{\bar{m}})
\end{aligned} \quad (3)$$

We use the above method to implement probabilistic functional analysis of RFID missing data and modify the original forward variables.[6] In this way, the algorithm improves the performance of decomposing the force behavior of human motion. This improves the recognition performance of human motion behavior. The algorithm realization flow chart is shown as in Figure 1.

RESULTS

We conducted a T test comparative analysis on the starting reaction time of the men's and women's similar events. The results showed that the men's 110m hurdles and the women's 100m hurdles had a significant difference in starting reaction time ($P<0.05$), and there was no significant difference in other events. Does this mean that the starting reaction speed of Chinese male and female sprinters is basically at the same level? The difference between male and female sprint performance is not directly related to the starting reaction speed. We believe that the reaction speed of male athletes is faster than that of female athletes.[7] The response time of the Chinese male and female sprinters monitored and calculated does not match the starting reaction time. And the research also found that the fastest starting reaction in track and field competition is a female athlete.

According to statistics, the average number of women's quicker reactions at the start of the finals accounted for 3 events, and men's faster events accounted for 4 events. Our study on the difference in the starting reaction time between male and female sprinters in the three competitions found that there was no significant difference in the starting reaction time of male athletes in each competition.[8] This shows that the starting reaction speed of male athletes is at the same level in each race and the reaction speed is relatively stable. Female athletes have significant differences in starting reaction time between each competition in 3 events. There is a very significant difference between the 100m preliminaries and the final start reaction time. The reason for this difference may be the large difference in the strength of female sprinters. Some athletes did not do their best in the preliminaries. Whether it can explain the unstable starting reaction speed of female athletes needs further research to prove.

Further research on the difference in the starting reaction speed of each race found that the starting reaction speed of Chinese sprinters tended to be faster in the latter race than in the previous race.[9] The semifinals are faster than the preliminary rounds, and the finals are faster than the semifinals. Among the 12 races in the statistics, 11 of the starting reaction time averages were the shortest in the finals. The fastest reaction speeds of the top 3 individuals in the men's and women's 100 meters all appeared in the finals. This may be related to the athlete's emphasis on the competition and the start.

The reaction time of Chinese sprinters from the sprint race (100m, 100m hurdles, etc.) to longer distances (400m, 400m hurdles, etc.) is gradually extending. The shortest average starting reaction time was the women's 100m hurdle final (0.163s) (Table 1). The longest average

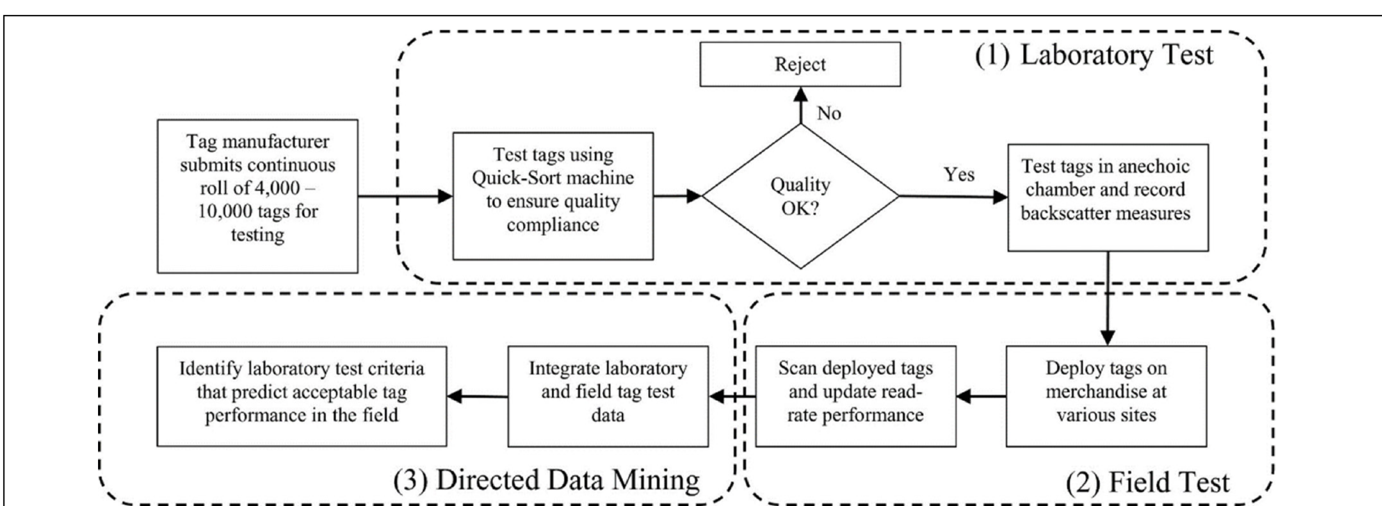

Figure 1. Implementation process of force behavior decomposition based on probability functional of RFID missing data.

Table 1. Table of average starting reaction time for each item.

Project	Preliminaries		Rematch		Finals	
	Average	Quantity	Average	Quantity (16)	Average	Quantity (8)
Male 100m	0.1815	28	0.1782		0.1705	
Female 100m	0.1832	29	0.1755		0.1631	
Male 200m	0.2105	28	0.1963		0.1938	
Female 200m	0.2022	25	0.1909		0.1973	
Male 400m	0.2692	27	0.2543		0.2539	
Female 400m	0.2525	16	0.2048			
400 hurdles for men	0.2667	20	0.2536			
400 hurdles for women	0.2898	17	0.2766			
Male 4×100	0.2381	14	0.2349			
Female 4×100	0.2418	9	0.2456			
110 hurdles for men	0.1767	12	0.1763			
Women's 100 hurdles	0.1945	19	0.163			

start reaction time is the women's 400m hurdle preliminaries (0.2898s). Further analysis of variance for male and female items found that each item has extremely significant differences.[10] By comparing the average number of men's starting reactions, it was found that there were significant differences between 100m and 400m, between the 400m hurdles, and between the 110m hurdles and the 400m hurdles. The comparison of the average response time of women in each item found that there are significant differences between the 100m column and the 4×100m, 4×400m, 400m column, 100m and 4×100m, 4×400m, 400m column, 200m, 400m and 400m column. This shows that Chinese sprinters have different starting reaction speeds due to different special events. The reason for this difference is related to the importance the athletes place on the start. The shorter the distance, the higher the number of matches, the fiercer the competition and the faster the reaction speed. This proves this inference. In addition, the amount of starting training performed by athletes of different sports also has a certain impact on the starting reaction.

The starting reaction time of athlete A in the women's 100m hurdles final was 0.114s. The slowest starting reaction speed appeared in the men's 400m hurdles with a reaction time of 0.422s. The difference between the two is 0.308s. Such a big difference in starting reaction is abnormal. It is incredible that the starting reaction time exceeds 0.4s. After years of research, the manufacturer of the starting foul monitor has determined that if the starting reaction time is shorter than 0.1s, the possibility of a starting foul is very high.

DISCUSSION

Psychological influence

Provinces and cities have attached unprecedented importance to the National Games, which has caused some athletes to feel pressured. In particular, some young athletes think too much about their rankings and results before the competition and are therefore overly nervous.[11] Observed on the spot, some athletes tremble involuntarily in their calf muscles due to tension after the athletes have done the "each in position" posture. Individual athletes even experienced whole body tremors. In this state, the human nervous system is not in the best working condition. Excessive tension may cause inhibition and affect the starting reaction speed. According to the backward reading of the on-site reaction to the over-stressed athletes, the reaction speed of these athletes is relatively slow.

The influence of the surrounding environment

The track and field competitions of the National Games changed the situation where there were no spectators in track and field competitions in the past. The crowds in the stands were crowded with horns, gongs and drums, and slogans one after another. Such an environment is easy to excite athletes and is conducive to creating good results. But for Chinese track and field athletes who are used to competing in a quiet environment, some people may experience excessive excitement.[12] The central nervous system can increase the reaction speed under moderately excited conditions. However, if the excitement is excessive, it may cause the excitement to spread and slow down the reaction speed. In addition, excessive excitement will reduce the athlete's resolution and sensitivity to gunfire in a noisy environment, thereby affecting the speed of reaction.

The impact of starting gunfire

The starting bullet of the Omega-type starting gun is used in the track and field competitions of the National Games. There are obvious differences in volume and sound quality between this product and the domestic starting gun. The volume is greater than that of domestic guns and bullets, and the sound quality is relatively dull. These changes are analyzed physiologically as changes in stimulation intensity (volume) and stimulation signal (sound quality). These changes may have an impact on the starting reaction speed of sprinters. Before the start of the game, only a few athletes took the initiative to find the starter to be familiar with and adapt to the start and gunfire. This is in sharp contrast with the Asian Games and the East Asian Games, many foreign athletes voluntarily asked to adapt to the starter's commands and gunshots.[13] This may be related to the athlete's belief that there is no language barrier in domestic competitions. However, the obvious difference in volume and sound quality between domestic bullets and bullets used in international competitions should arouse our attention. Domestically-made starting bullets should be in line with international standards to lay a solid foundation for improving athletes' reaction speed in major competitions.

CONCLUSION

In the 11th Asian Games, the East Asian Games, the 8th National Games and other major events, the threshold for fouls in the start and run is set to 0.1s. However, in this competition, Chinese athletes rarely approached this value in their starting reaction. Only 5 people had a reaction time shorter than 0.15s, accounting for 4.54% of the statistics. And this reaction all appeared in the men's and women's 400m and 400m hurdles. This shows that the starting speed of Chinese sprinters needs to be further improved. Especially 400m hurdle athletes should pay more attention to and strengthen the starting training.

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