

Study on the Method of Scientific Measurement of Sensitive Quality

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Abstract

Taking 67 college students as research subjects, this paper makes experimental research on reliability of several agility measurements which included in National Exercise Standard of Ordinary Multitude. By using the method of mathematical statistics, the repeatedly measured data was analyzed in one-way variance. The reliability of these measurements was calculated, and the degree of correlation between each measurement was discussed. The results are pointed out that the reliability coefficients of 5m side slide test and '8' route changing direction run are relative higher (is 0.8721 and 0.9100 respectively), which show fine consistency of the repeated measurement of these two tests; however, the reliability coefficients of quadrant jump ($r=0.8096$) and left-right span test ($r=.7644$) are relative lower. The degree of correlative between these measurements is low, which explain that each measurement incarnate different aspect of agility.

Keywords: *Agility measurement, reliability, comparative research*

I. Introduction

Sensitive quality refers to the ability of human body to change body posture, movement direction and adaptability quickly, accurately and harmoniously under various complex conditions[1]. Sensitive quality is a comprehensive quality, which is closely related to strength, speed, flexibility and coordination. It is the comprehensive performance of the coordination of various organ systems, various physical qualities and sports skills in the process of human activities. American training experts K. A. Jason and A. GA. Fischer also discussed the sensitive quality in detail in the book "scientific basis of athletes' physical training", and pointed out that the sensitive quality is to quickly change the movement direction of the body or a part of the body, and it is the combination of several sports qualities, including strength, reaction time, speed and coordination[2]. This is of great significance for daily life, labor and sports training. Therefore, it is very necessary to analyze and discuss the sensitive quality test methods.

A test method with high reliability and effectiveness can ensure the accuracy of test results, and then accurate and valuable conclusions and information can be obtained through analysis, so as to further guide and improve the test method. At present, the analysis and discussion of sensitive quality test methods are still rare. According to the physical exercise standard for ordinary people issued by the State General Administration of sports[3], this paper selects four test methods: quadrant jump, left and right crossing, two-point sideslip and eight character directional running to measure the subjects repeatedly, and analyzes the reliability and the degree of consistency between the test methods, in order to provide reference for the correct and reasonable selection of sensitive quality test methods.

II. Research Objects and Methods

2.1 Research object

There are 67 college students aged 20-22.

2.2 Research methods

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2.2.1 Sensitivity test method

Quadrant jump (Fig 1): Draw two equal and perpendicular straight lines on a flat field, divide the test ground into four quadrants, and mark the numbers 1, 2, 3 and 4 respectively. During the test, the subjects stood in quadrant "1" with their feet close together and their knees slightly bent. After hearing the start signal, keep your feet together and jump in the order of 1 → 2 → 3 → 4 → 1. Count once for each quadrant, jump repeatedly for 10 times according to this method, and record the time taken to complete. It is required that both feet must take off and land at the same time when jumping. The number of times of stepping on the wrong quadrant or jumping in the wrong quadrant shall not be counted. Repeat the measurement three times.

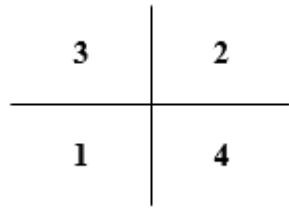


Fig 1: Quadrant jump

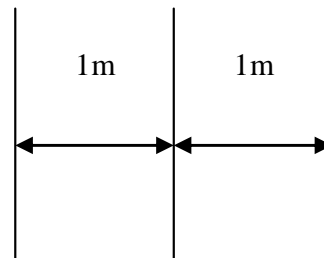


Fig 2: Left and right spans

Cross left and right (Fig 2): Draw three parallel lines on a flat site, with a distance of 1m between each line. During the test, the subjects separated their feet on both sides of the midline, slightly bent their knees, stepped left or right after hearing the start signal, so that their feet straddled both ends of the end line, and then returned to the midline; Step to the other end of the line with the same action, and then return to the center line. Count one step at a time, jump back and forth for 10 times, and record the time taken to complete. If both feet are not standing at both ends of the line or stepping on the line, they will not be counted. Repeat the measurement three times.

Two point sideslip (Fig 3): Draw two parallel lines 5m apart on a flat site. During the test, the subject stood laterally on one side of the sideline. After hearing the signal, he quickly slipped to the other side of the sideline. When his foot touched the sideline, he slipped back immediately. When he returned to the starting sideline, he completed a sideslip. Make 10 round trips and record the completion time. Repeat the measurement three times.

Zigzag running (Fig 4): Draw a 12m long straight line on the flat ground. The starting point of the straight line is point A, the ending point is point E, and the midpoint is point C. draw four symmetrical points (D, F, G, B) on both sides 3M away from the straight line. The connecting lines of the two symmetrical points pass 3M away from the upper and lower points of the straight line. During the test, the subjects took a standing starting position at point A. after hearing the start signal, they immediately ran to point B, then turned to point C → point D → point E → point F → point C → point G, and finally ran over point A. Record the time of running the whole course and repeat the measurement three times.

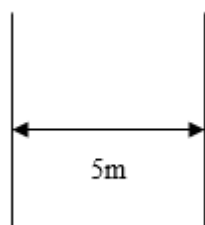


Fig 3: Two point sideslip

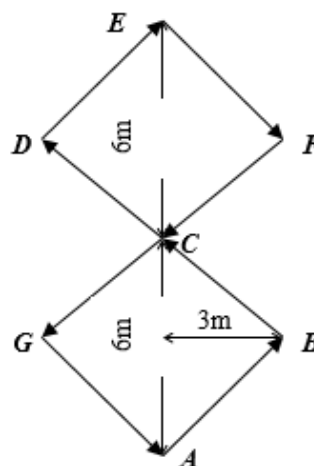


Fig 4: Zigzag running

In order to ensure the authenticity and reliability of the measured data, each student shall first carry out appropriate exercises according to the requirements of the test method. Conduct formal testing after being familiar with the test method.

2.2.2 Mathematical statistics

The experimental data were statistically processed by SPSS statistical software. The mean value and standard deviation of each test method were obtained by one-way ANOVA. The reliability of each test method was statistically analyzed and compared. The correlation of the four test methods is analyzed.

III. Results and Analysis

3.1 Analysis on influencing factors of reliability coefficient of four test indexes

The factors affecting the reliability of measurement include measurement error, individual differences of subjects, repeated measurement interval, measurement length and so on[4]. Among them, the measurement error is the most important factor affecting the measurement reliability. The change of measurement error caused by the change of any condition will cause the change of reliability. The essence of reliability is to describe the size of measurement error.

The reliability coefficients of the four test indexes are shown in Table 1. Among them, the reliability of repeated measurement of two-point side slip ($r = 0.8721$) and eight character direction change run ($r = 0.9100$) is high, while the reliability of quadrant jump ($r = 0.8096$) and left-right Cross ($r = 0.7644$) is relatively low. We believe that this reliability difference is related to the action structure and complexity of sensitivity test. The posture of quadrant jump and repeated cross action changes quickly, and the distance of displacement is short, which mainly emphasizes the speed of action frequency. Therefore, the random error of quadrant jump and repeated cross measurement results is greater than that of two-point side slip and eight character direction change run, which reduces the reliability.

Repeated measurement interval is also one of the factors affecting reliability. However, in the test, each subject completed three consecutive repeated tests when testing various indicators, and the repeated test interval is short, which meets the requirements of sensitivity quality test. Therefore, the impact of repetition interval on the reliability of this experiment can be ignored.

The main reason affecting the reliability of sensitivity measurement results is random error[5]. According to Spearman Brown formula, the reliability of measurement can be improved by appropriately increasing the length

of measurement. The value selection method also has a certain impact on the reliability. Sensitivity is a kind of maximum ability test. Therefore, taking the maximum value of repeated measurement results can also improve the reliability. Therefore, each of the four test indicators was tested three times, and then repeated three times the next day. We take the best result of each person's three measurements, and use the product moment correlation method to calculate the reliability. The results show that (see Table 2): the reliability of the four tests is significantly improved. Therefore, it is suggested to adopt the method of repeated measurement for three consecutive times to obtain the best score in the sensitivity test.

3.2 Correlation analysis of four test indicators

3.2.1 Analysis of factors affecting the correlation degree of the four test indicators

Take the average values of the four test indicators respectively, and then use Excel software to analyze their correlation. The results are shown in Table 3. The correlation coefficients between the four test indexes are low, and the correlation coefficients of quadrant jump and left-right span are the highest, only 0.4388, which shows that although these four test methods are indicators for measuring sensitivity, their respective emphases are different. In the quadrant jump and left-right cross test, the body displacement is relatively small, mainly emphasizing the speed of action frequency, which is closely related to the balance and sensitivity of cerebral cortical neural process, as well as the feeling and accurate judgment ability of space and time. Therefore, they mainly measure the ability of subjects to dominate muscle movement and overcome body inertia in the process of rapid jumping. But the correlation coefficient between them is only 0.4388. Since the reliability of these two test indicators is relatively low (Table 1), this may be the reason for their low correlation coefficient.

Table 1 measurement reliability of four sensitive qualities (repeated measurement times are 3 times)

Test method	Difference source	Sum of difference squares (SS)	freedom(df)	mean square(MS)	Reliability coefficient(r)
Quadrant jump	Between groups	71.30887	66	1.080437	0.809
	Within group	27.57053	134	0.20575	
left and right spans	Between groups	46.50937	66	0.704687	0.764
	Within group	22.24907	134	0.166038	
point sideslip	Between groups	108.5548	66	1.64477	0.872
	Within group	28.19973	134	0.210446	
zigzag running	Between groups	202.5232	66	3.068534	0.910
	Within group	37.001	134	0.276127	

Table 2 Measurement reliability of four sensitive qualities

Test method	Reliability
Quadrant jump	0.851
Straddle left and right	0.823
Two point sideslip	0.914
zigzag running	0.935

Table 3 Correlation Analysis of four test indexes (average value of repeated test)

	Quadrant jump	Straddle left and right	Two point sideslip	zigzag running
Quadrant jump	1			
Straddle left and right	0.438825	1		
Two point sideslip	0.098222	0.347727	1	
zigzag running	0.177393	0.026177	0.182921	1

Two point sideslip and eight character directional change run have a relatively long distance, and more emphasis on the speed of movement, which is related to the strength and contraction speed of muscles. They mainly measure the ability of subjects to change direction and move quickly. Although the reliability of the two test indexes is high, the correlation coefficient between them is very low. This may be due to the longer distance of eight character directional change running and the lack of body directional change speed, which can be compensated by the speed of running on the way[6]. Therefore, the difference of measurement results is mainly reflected in the difference of speed; The movement distance of two-point sideslip is relatively short, and the speed of body direction change will have a significant impact on the measurement results. Therefore, two-point sideslip can better reflect the subject's ability of rapid direction change movement.

Because of the close relationship between eight character directional change running and sports speed, its correlation coefficient with the other three test indexes is very low; The motion modes of two-point sideslip and left-right cross are similar, so the correlation coefficient between them is also relatively high.

3.2.2 Influence of different value taking methods on correlation coefficient

Take the maximum of the repeated measurement results of the four test indicators respectively, and then use Excel software to analyze their correlation. The results are shown in Table 4.

Comparing the results in Table 2, taking the maximum value for correlation analysis does not increase the correlation coefficient between the four test indexes, but significantly reduce the correlation coefficient between them. This shows that taking the maximum value reflects the different emphases of the four test indexes in measuring sensitivity.

Table 4 Correlation Analysis of four test indexes (the best score is obtained by repeated test)

	Quadrant jump	Straddle left and right	Two point sideslip	zigzag running
Quadrant jump	1			
Straddle left and right	0.27459	1		
Two point sideslip	0.019209	0.341524	1	
zigzag running	0.032237	0.162132	0.199641	1

IV. Conclusions and Suggestions

4.1 The reliability coefficient of quadrant jump and left-right span is relatively low.

The reliability of measurement can be improved by using the method of three consecutive repeated measurements to obtain the best results; The reliability coefficient of two-point sideslip is high, and it mainly reflects the subject's ability to change direction and move quickly, so it can better reflect the sensitivity quality; Although the reliability coefficient of eight character directional change running is very high, it is more closely related to speed quality, so it needs to be corrected to better reflect the sensitivity quality.

4.2 Sensitivity test subject's subjective factors have a great influence.

Therefore, before the test, the subject can do appropriate exercises and be familiar with the measurement methods to improve the reliability of the measurement.

4.3 The attributes of sensitivity are complex. The correlation of the four test indexes is analyzed through different value taking methods.

The results show that the correlation of the four test indexes is very low. It shows that the effectiveness of these four sensitive quality measurements is very low. The quality attributes measured by different test methods are not exactly the same. It is suggested that when we choose the sensitivity measurement method, we should correctly select the sensitivity measurement method according to the purpose of the test.

Acknowledgements

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