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One-way analysis of variance-based table tennis special athlete psychological quality difference study

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ABSTRACT

Table tennis event is a mass event that suitable for all ages, in the main background of present national fitness, look for events benefits from traditional sports events is one of important ways to propel to national fitness progress. Physical exercises generate lots of impacts on sportsmen psychology; it can let sportsmen to keep physical and psychological health state, which is also the purpose of the paper's studies. The paper explores table tennis event promotion efficiency on exercisers' psychological quality's attention characteristics, with an aim to analyze the event promotion efficiency in attention characteristics four dimensions levels, in the paper, it applies experiment comparison, mathematical statistics and other methods, gets one-way analysis of variance that based on totality, grouping, genders, training years and attention characteristics dimensions, gets attention characteristics differences in different conditions, it verifies that subjects of experimental group that takes table tennis exercises have superior efficiency in attention characteristics upgrading by comparing to subjects of control group that takes other special events exercises.

KEYWORDS

Attention characteristics; One-way analysis of variance; Dimension level; Grouping experiment; Significant difference.



INTRODUCTION

Table tennis as Chinese “national ball”, it is widely spread in the folks, the event not only can promote learners’ interests in sports event, but also can strengthen physique, promote body function, have remarkable efficiency in cultivating exercisers’ psychological quality aspect, from which its promotion efficiency in sportsmen attention characteristics are more remarkable, the paper is researching on table tennis event psychological quality upgrading efficiency, in the research, it makes fully use of documents literature, experiment designing method, mathematical statistics and logic comparison method, with an aim to make contributions to popularize table tennis event.

For researches on table tennis promotion to exercisers’ psychological quality, lots of people have made efforts, just their efforts, let “national ball” such event sports value to be taken to extreme that made utmost contributions to make national fitness progress. Among them, Pu Xi-an etc. (2013) by consulting psychology, sports training theories and table tennis relative knowledge literatures, compiled initial scale, applied difference test, factor analysis and internal consistency test to test scale reliability and validity, and got relative scientific scale^[1]; Pang Li (2013) proposed when coaches manage players, they should possess corresponding qualities, according to table tennis athletes’ essential diversity, hierarchical attribute and developmental features, overcome prestigious opinions of focusing on starting from thoughts and ignoring starting from demands, correctly handle with table tennis event personal demand and social demand dialectical relationship, and cultivate table tennis players into compound talents that met social demands^[2]; Yang Dong-Hua etc. (2013) mainly adopted psychological test method and mathematical statistical method to carry on comparative analysis of different genders athletes’ psychological qualities respectively from different perspectives, and got corresponding conclusions^[3].

On the basis of formers research, the paper discusses table tennis event promotion efficiency on exercisers’ attention characteristics in totality, groups, genders, training years and attention characteristics four dimensions levels, with an aim to build basis for Chinese national fitness effective propelling, and meanwhile it also provides theoretical references for table tennis event scientific training and targeted training.

SUMMARY OF TABLE TENNIS BENEFITS ON STUDENTS’ PSYCHOLOGICAL QUALITY

Yao Jia-Xin (1994) pointed out that table tennis event was net separated small ball event that had both interests and competitiveness, it had profound history and widely mass base in China, development of the event up to now, its competitions not only limited in contesting among athletes techniques, tactics, physical quality and styles, but also paid more attentions to athletes’ psychological consciousness contesting^[4].

In athletics psychology, attention characteristics refer to sportsman orientation and concentration on one specified object that people’s mental activity and awareness move towards one direction, make further processing with partial information that is selected sensory input, and attention objects may be constantly changing so that will stimulate people to turns to new and different stimulation, people intentionally control the changes, which makes utmost contributions to build people psychological quality. Table tennis event needs athletes to well grasp techniques of steady, accurate, exact attack, change, fast and rotate in stroking, the key to these techniques grasping adept extent is that athlete should exclude external interference, be more concentrated, make rapidly judgment according to incoming balls at times, and then move steps to swing racket and stroke, so table tennis is helpful for promoting sportsman attention characteristics.

Liu Hui-Jun (2003) pointed out when individual focused on understanding and grasping tasks, self-technology improvement was for success so that could be regarded as task orientations, when individual paid attention to contest and comparison with others, focused on external evaluation and ranking that belonged to self-orientation, different target orientations had different understanding on success, when individual performance was lower, individual reactions were also different^[5]. The paper studies on table tennis optional course incentive effects on athletes’ psychological qualities, and

attention characteristics is main quality promotion type in the event, so the paper focuses on carrying on attention characteristics measurement and comparison of table tennis optional course students and non-table tennis optional course students, in the hope of verifying table tennis event significances in promoting exercisers' attention characteristics.

After people's nervous system accepts nervous system fully analysis of all input information, it will enter into filter device or attenuation device, make recognition reflection on selected information, that is to say people information output frustration is not because people is unable to simultaneously process many information, but because people memory is limited that hasn't own ability of remembering all analysis results. So it needs a filter model and attenuation model combinative screening, and finally makes reaction. Here, it proposes the filter attenuation model in order to make a scientific data handling in subsequent research objects' attention characteristics indicators' handling. As Figure 1 shows, basic correlation model from people's nervous system contacting with external information to make reaction.

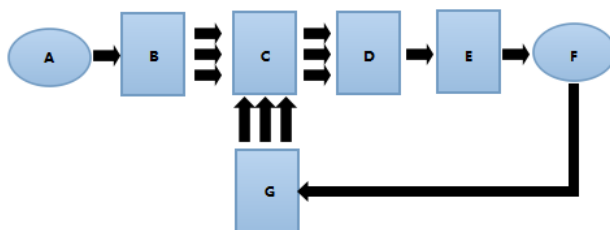


Figure 1 : Filter attenuation model schematic diagram

In Figure 1, symbol A-G definitions are respectively stimulation, sensory memory, consciousness, filter, working memory, reaction and long term memory.

In sports athletes' attention characteristics measurement research, people generally carry on indicator quantization from behavior aspect, physiology aspect and self-report three aspects, in the following; it illustrates three aspects' measurement key points, in the hope of building basis for rationalizing indicator studying.

Behavior aspect: Attention characteristics are closely linked to people reaction time, just based on such correlation compactness, athletics psychological workers adopt probe point reaction time to reflect athletes' behaviors' attention characteristics, such measurement method mainly applies in experiment, and it is used to estimate subjects occupied attention resource quantity in their main tasks.

Physiology aspect: When research objects arousal levels rise, their attention range will constantly diminish, sports researchers based on this, carry on data measurement on subjects' heart rate and brain wave as well as other physiological indicators, in the hope of providing specific information for attention changing procedures, and even there are researchers showing attention characteristics is related to left brain's α wave.

Self-report method: The method is one of main methods in psychology researches, it usually measures inclinations or features, in psychology, there are lots of attention characteristics' self-report measurement methods, from which Nideffer's attention and interpersonal relationship pattern measurement is most used that is also an effective tool to measure attentive personal characteristics.

RESEARCH OBJECTS AND RESEARCH METHODS

Research objects

The research purpose of the paper is to analyze table tennis optional course promotion effects on students' attention characteristics, in order to highlight table tennis event advantages, the paper selects 78 subjects, from which 42 people are table tennis optional course students and 36 people are non-table tennis optional course students.

Research objects basic information is as TABLE 1 shows.

TABLE 1 : Research objects basic information table

Grouping types	Training year of table tennis	Number of participants		Age	
		Schoolboys	Schoolgirls	Average value	Standard deviation
Experimental group	Within a year	5	2	20.15	2.13
	Above one year and within two years	5	3	20.94	2.51
	Above two years within three years	6	1	21.53	3.24
	Above three years within four years	5	3	22.98	3.79
	Above four years	9	3	25.36	3.18
Control group	Without	25	11	23.52	3.64

In TABLE 1, control group members are totally 36, from which 8 people are badminton optional course students, five people are tennis optional course students, six people are basketball optional course students, five people are volleyball optional course students, three people are football optional course students, six people are aerobics optional course students, and 3 people are athletics optional course students.

Research methods

In the paper, it adopts documents literature, psychological test method, mathematical statistical method and logic analysis method, from which the purpose of documents literature is to provide theoretical basis for the research, logic analysis is carrying on practical analysis of mathematical statistical result, the two methods will not further discuss in the section, it focuses on stating psychological test method and mathematical statistical method.

In psychological test method statement, it mainly discusses targeted at attention characteristics measurement tool, measurement methods and measurement procedures as following:

Measurement tool: The paper adopted test tool is "Athletes' competitive psychological ability and arbitrary test software" multiple items psychological test software, in test dialog box, it needs to input subject name, gender, sports item and training years and other information, and then let subjects to answer the questions according to requirements, test topics setting and operation time arrangement is as TABLE 2 shows.

TABLE 2 : Test questions and operation time arrangement table

Test type	Test method	Test purpose	Operation time
Concept formation test	Graphics distinguish test	Attention allocation	Three minutes
Attention span test	Select four rounds	Attention span	Three minutes
Attention stability test	Visual tracking	Attention stability	Two minutes
Attention shifting test	Addition and subtraction test	Attention shift	Three minutes

Adopted questionnaire is "Sports task orientation and self-orientation questionnaire", the questionnaire Cronbach coefficient is 0.8586, self-orientation Cronbach coefficient is 0.7884, task orientation questionnaire Cronbach coefficient is 0.8086, questionnaire system has higher internal consistent reliability.

Measurement method: Train examiners needs to understand test objective and significances before testing, familiar with investigation table contents opinion and instruction, have a reasonable understanding on subjects understanding word cognitive ability and physical status, carry on testing according to measurement tool software's instruction, avoid using language that may lead to hints.

Measurement procedures: Firstly, it needs subjects to make good preparation according to requirements, and examiners make test illustration to subjects, from which illustration contents are test contents, operation time and test questionnaire hand-in ways, and then let subjects to proceed with TABLE 2 showed four items attention features answering, and arrange subjects to have one minutes rest

after answering one item every time, secondly let subjects to go with target fulfillment orientation questionnaire test, finally hand in test questionnaires to examiners.

Mathematical statistics method application in the paper on one hand, it reflects in statistical variables application, on the other hand, it reflects in statistics software application, from which statistics software applies EXCEL software and SPSS statistics software, apply above statistics software to carry on independent sample test, one-way analysis of variance and data comparative analysis as well as other contents computation on experimental group and control group members' quantization indicators, in the hope of providing data basis for the paper researches, and provides theoretical references for table tennis optional course promotion superiority on optional course learners attention characteristics' verification.

In order to define scientific contents on data analysis statistical parameters, in the section mathematical statistics research method, it makes theoretical statement of one-way analysis of variance included statistics, in the hope of providing theoretical basis.

Variance analysis refers to measure significant extent of independent variables impacts on numeric type dependent variable by testing each totality average value, if variance analysis involved classified type independent variable number is one, then is called one-way analysis of variance. One-way analysis of variance research is a classified independent variable impacts on a numeric type dependent variable impact. In practical problems one-way analysis of variance, firstly it needs to put forward hypothesis, if investigation result after processing data is from s pieces of different total sample value, it needs to successive record each totality average value as $\mu_1, \mu_2, \dots, \mu_s$, according to problems analysis purpose, it can make as formula (1) showed test hypothesis

$$\begin{aligned} H_0: & \mu_1 = \mu_2 = \dots = \mu_s \\ H_1: & \forall \mu_i \neq \bar{\mu}, (i=1, 2, \dots, s); \bar{\mu} = \frac{1}{s} \sum_{i=1}^s \mu_i \end{aligned} \quad (1)$$

And then calculate each sample average value (\bar{x}_i), whole observed value total average value ($\bar{\bar{x}}$) and each error squares sum (total squares sum SST , intergroup squares sum SSA as well as intra-group squares sum SSE), its computational method is as formula (2) show :

$$\begin{cases} \bar{x}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} x_{ij}; \bar{\bar{x}} = \frac{1}{n} \sum_{i=1}^k n_i \bar{x}_i \\ SST = \sum_{i=1}^k \sum_{j=1}^{n_i} (x_{ij} - \bar{\bar{x}})^2; SSA = \sum_{i=1}^k n_i (\bar{x}_i - \bar{\bar{x}})^2; SSE = \sum_{i=1}^k \sum_{j=1}^{n_i} (x_{ij} - \bar{x}_i)^2 \end{cases} \quad (2)$$

In formula (2), n represents number of observed value, k represents factor level number, n_i represents the i sample observed value number, three squares sum freedom degree are respectively $(n-1), (k-1), (n-k)$, variance analysis compared is difference between intra-group average square and intergroup average square, therefore total squares sum SST , intergroup squares sum SSA and intra-group squares sum SSE average squares respectively record as MST, MSA, MSE , their value computing method is squares sum and freedom degree ratio, when test hypothesis H_0 , MSA and MSE ratio conforms to numerator freedom degree as $k-1$, and denominator freedom degree as $n-k$ Chi-squared distribution, expression is as formula (3) show :

$$F = \frac{MSA}{MSE} \sim F(k-1, n-k) \quad (3)$$

Finally, according to given significance level α in Chi-squared distribution table, find out numerator freedom degree $df_1 = k-1$ and denominator freedom degree $df_2 = n-k$ corresponding critical value $F_\alpha(k-1, n-k)$, if obtained $F > F_\alpha$ then refuse original hypothesis H_0 , which shows tested

factor has significant impacts on observed value, if $F < F_{\alpha}$ and then don't refuse original hypothesis, which shows tested factor has no significant impacts on observed value.

For fully random designed single factor variance analysis, path in SPSS single factor analysis is **【Analyze】-->【Compare means】-->【One-Way ANOVA】-->【Post Hoc Multiple Comparisons】-->【Equal Variances Assumed】-->【LSD/S-N-K】**, for random unit group designed one-way analysis of variance, path in SPSS one-way analysis is **【Analyze】-->【General Linear Models】-->【Univariate】-->【Post Hoc Multiple Comparisons for Observed Means】-->【Equal Variances Assumed】-->【LSD】**.

EMPIRICAL ANALYSIS AND RESEARCH RESULT

78 research objects overall information in four attention characteristics answer sheets are as TABLE 3 shows.

TABLE 3 : Overall subjects' attention characteristics status table

Type of attention characteristics	Overall value	Type of attention characteristics	Overall value
Attention distribution	23.03 ± 4.101	Attention stability	15.02 ± 3.117
Attention span	98.27 ± 15.684	Attention shift	90.22 ± 21.274

Control group and experiment group four items attention characteristics ANOVA difference result is as TABLE 4 shows.

TABLE 4 : Control group and experimental group attention characteristics difference analysis result table

Type of attention characteristics	Control group value	Experimental group value	T test value
Attention distribution	20.99 ± 3.342	25.28 ± 3.670	60.025
Attention span	93.65 ± 14.000	94.87 ± 15.039	19.051
Attention stability	13.98 ± 2.667	16.35 ± 3.229	26.010
Attention shift	81.09 ± 21.576	88.56 ± 19.558	5.117

Note: Attention distribution significance difference probability and attention shift significance differences probability are less than 0.01, attention span and attention stability significance differences probability are more than 0.05.

By TABLE 4 data, it is clear that experimental group and control group have very significant differences in attention distribution and attention shift two qualities, and experimental group is obvious superior to control group, and it has very significant differences in attention span and attention stability two qualities. As TABLE 5 data shows, overall subjects' genders attention characteristics difference analysis.

TABLE 5 : Overall subjects' gender-based attention characteristics difference result table

	df	MS	F	Man	Woman	T test value
Type of attention characteristics	1	124.433	1.454	23.42 ± 4.841	22.28 ± 3.197	-1.454
Attention span	1	246.862	5.979	98.25 ± 14.665	92.18 ± 16.108	-2.979
Attention stability	1	119.779	21.207	/	/	/
Attention shift	1	279.931	0.612	88.69 ± 2.937	92.29 ± 3.195	1.207

Note: F value test result is significant differences existing in attention distribution quality, very significant difference existing in attention span and attention shift, non-significant difference existing in attention stability ;T value test result shows it has significant difference in attention distribution, and has very significant differences in attention span and attention shift.

By TABLE 5 data, it is clear that on a whole, women are obviously superior to men in attention shift quality and have very significant differences, and men are obviously superior to women in attention

span and have very significant differences. As TABLE 6 shows table tennis specialized students and non-table tennis specialized students totally three dimensions' attention characteristics differences in genders beyond attention stability.

TABLE 6 : Control group and experimental group respectively gender-based difference test result table

Type of attention characteristics Attention distribution	Control group			Experimental group		
	Men	Women	F value	Men	Women	F value
Attention span	21.02 ± 3.270	20.93 ± 3.545	4.013	25.46 ± 3.819	25.13 ± 2.778	2.107
Type of attention characteristics	102.54 ± 13.2	95.03 ± 15.88	2.294	103.87 ± 10.3	92.98 ± 17.12	12.926
Attention shift	88.03 ± 2.882	92.19 ± 3.544	6.080	89.23 ± 3.111	93.86 ± 2.199	0.002

Note: Control group F test value has very significant differences in attention distribution, and has significant differences in attention span and attention shift; Similarly experimental group F test value has very significant differences in attention distribution, and has significant differences in attention span and attention shift.

By TABLE 6, it is clear that experimental group subjects men and women's attention distribution quality level is obviously higher than that of control group in numerical values, all women are superior to men in attention shift quality, overall men are superior to women in attention span quality. Training years-based experimental group subjects' attention characteristics attention distribution, attention span, attention stability and attention shift totally four dimensions' difference test result is as TABLE 7 shows.

TABLE 7 : Training years-based experimental group's attention characteristics four dimensions difference test result

Type of attention characteristics	Within one year	Above one year and within two years	Above two years within three years	Above three years within four years	Above four years	F value
Attention distribution	18.17 ± 1.54	20.54 ± 1.20	21.44 ± 3.47	23.27 ± 3.31	26.39 ± 4.61	25.2
Attention span	93.38 ± 15.1	90.28 ± 13.7	90.06 ± 12.5	95.5 ± 19.01	96.61 ± 19.6	5.07
Attention stability	13.94 ± 1.43	18.67 ± 2.96	15.96 ± 1.87	20.36 ± 2.87	19.22 ± 3.18	10.8
Attention shift	85.89 ± 21.5	80.83 ± 17.7	82.64 ± 20.6	96.36 ± 24.2	106.26 ± 20	4.14

Note : F value test result is it has very significant differences in attention distribution quality and attention shift quality among training years, has significant differences in attention stability quality among training years, and has insignificant differences in attention span among training years.

TABLE 7 is training years-based overall difference, in order to more clearly differences in training years, it provides TABLE 8 showed training years-based respectively four dimensions difference test result.

As Figure 2 shows, different training years' experimental group subjects respectively four dimensions' average value comparison status.

In Figure 2 A represents attention distribution dimension, B represents attention span dimension, C represents attention stability dimension, D represents attention shift dimension. By TABLE 8 and Figure 2, it is clear that in attention distribution dimension, subjects that training years being within one year have significant difference with that of above three years within four years, and it has very significant differences with training years being above four years, while training years being above one year below two years have significant differences with that being above two years and below three years, and attention distribution in training years tendency graph has rising trends following by years increasing, and after training years being above two years and below three years, it shows obviously rising trend; in attention span dimension, different training years subjects have insignificant differences, the dimension level has certain fluctuation with years increasing, overall is in rising trend, it drops off per year during the phase from one year to above two years within three years, but it increases per year

from above two years with three years to above four years; in attention stability dimension, except for subjects with one year and above four training years have significant differences, other training years have insignificant differences, in view of different years' attention stability average values tendency, it has certain fluctuation but not so big; in attention shift dimension, subjects with one year and above four training years have significant differences, subjects with above one year within two years and that with above three training years have significant differences, subjects training years being above two years with three years and that with above four years have significant differences, in view of different years' attention shift average value tendency, from subjects with one training year to that with three training years, there is no bigger fluctuation, above three training years' subjects attention shift average value has strengthening trends.

TABLE 8 : Training years-based respectively four dimensions difference analysis result table

Training years	Within one year	Above one year and within two years	Above two years within three years	Above three years within four years	Above four years
Within one year	-	[-2.72] <-0.94>	[-1.62] <-12.75>	[-3.42] <-1.47>	[-4.28*] <-12.37*>
Above one year and within two years	【-2.38】(-5.10)	-	[1.11] <-11.80>	[-0.70] <-0.53*>	[-1.55] <-11.43*>
Above two years within three years	【3.27】(-5.20)	【-6.07】(-0.11)	-	[1.80] <11.28>	[-2.66] <0.38*>
Above three years within four years	【-5.11*】(-6.22)	【-2.73】(-1.13)	【-1.83】(-1.02)	-	[-0.86] <-10.90>
Above four years	【-7.22**】(-14.33)	【-4.85*】(-9.24)	【-3.95*】(-9.13)	【-2.12】(-8.11)	-

Note: Data in 【】 is attention distribution dimension T test value, data in () is attention span dimension T test value, data in [] is attention stability dimension T test value, data in <> is attention shift dimension T test value, from which behind data, there is no “*” or “**” shows test value corresponding probability is above 0.05, represents insignificant differences exist in data, behind data, there is a “*”, it shows test value corresponding probability is less than 0.05but more than 0.01, represents significant difference exists in data, behind data, there is a “**” it shows test value corresponding probability is less than 0.01, represents very significant difference exists in data.

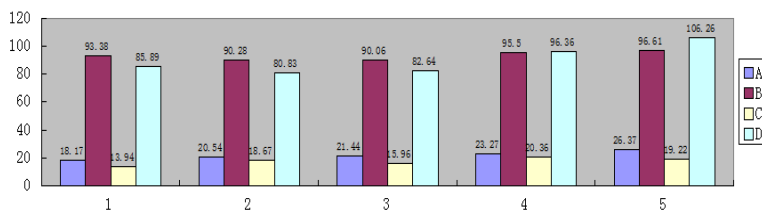


Figure 2 : Different training years' experimental group subjects' four dimensions attention characteristics average value comparison statistical graph

CONCLUSION

For table tennis promotion to exercisers' psychological quality, it makes summary, proposes that table tennis has relative superior promotion efficiency in psychological quality's attention characteristics, and provides people nervous system's information filter attenuation model that judges input information till makes reaction, which builds basis for table tennis event measurement on exercisers' attention characteristics. In order to verify table tennis event superiority in exercisers' attention characteristics promotion, it summarizes research objects' grouping status and partial research methods, focuses on stating measurement tools, measurement methods, measurement extents and one-way analysis of variance theories, which builds basis for scientific data collection and correct theory application. For 78 research objects' overall attention characteristics' differences, control group and experimental group's attention characteristics differences, gender-based overall attention characteristics

respectively four dimensions differences, training years-based attention characteristics four dimensions differences and training years-based each training year's each attention characteristic differences, it presents result and makes result analysis.

Research result shows that control group and experimental group have significant differences in attention characteristics' four dimensions except for attention stability dimension, from which in attention distribution dimension, they have very significant differences, and in view of numeric values, experimental group each dimension level is higher than control group. In overall subjects' respectively attention characteristics four dimensions gender grouping level data, in the aspect of attention shift dimension, women are superior to men and have very significant differences, while in attention span dimension, men are obviously superior to women and have very significant differences, control group's men and women as well as experimental group's men and women keep same differences as totality. Training years-based experimental group entirely have very significant differences in attention distribution dimension and attention shift dimension, it has significant differences in attention stability dimension, and has insignificant differences in attention span.

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