Research on the Effect of Exercise Load on Orienteering Map Reading Ability Based on Computer Software Analysis

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Abstract. Orienteering is a combination of physical and intellectual sports, and the combination of physiology and psychology in experimental research on orienteering is in line with the needs of the development of orienteering itself. The study of orienteering is to examine the brain's ability to recognize maps under different exercise loads, to control the running speed, to maximize the brain's ability to recognize maps, and to provide a reference basis for athletes, coaches, and amateur participants in orienteering to understand the relationship between running and maps. In addition, if the experimental data is collected from professional athletes, a database of physiological and biochemical indicators of our orienteering athletes can be established to improve the data reference for our orienteering training and competition. Based on this, this paper explores the effect of exercise load on orienteering map recognition ability.

Keywords: Computer Software, Sports Load, Orienteering Cross-country, Ability to Map, Influence

1. Introduction

With the continuous development and popularization of orienteering in China, and the continuous improvement of our country's orienteering performance, more and more coaches and athletes began to pay attention to the relationship between psychology and physiology in the process of orienteering, but so far, our country's orienteering research scholars have focused on the research of orienteering training competition from a single perspective of physiology or psychology. Some scholars in Europe, where the development of international orienteering is better, have begun to use the relevant experimental equipment in indoor laboratories to conduct experimental research. However, we have not found any information and data on the combination of physiological and psychological aspects of orienteering from consulting experts and international websites. However, with the development needs of orienteering and the special nature of orienteering itself, it is an inevitable trend to combine psychology and physiology to study orienteering in the process of theoretical exploration and experimental research of orienteering in the future.

2. Research objects and methods
2.1. **Subject investigated**

To 2006 social sports students, selected 15 people.

2.2. **Research technique**

The research methods used in this paper are: teaching experiment method, experimental test method, mathematical statistics method.

**Teaching experiment method:** 15 people are selected from Jilin University College of Physical Education orienteering elective course, the selected students for 3 months of theoretical and practical teaching, preliminary grasp of the basic skills of orienteering cross-country, have a basic understanding of orienteering map, and can independently complete the campus orientation, field orientation of the search route.

**Experimental test method:** the selected 15 students completed the E-prime software and professional map design on the power bicycle, monitored the heart rate changes during the experiment, and measured the flicker value.

**Mathematical statistics method:** the reliability of experimental results is tested by correlation analysis method to investigate the reliability of experimental results. For the experimental data, the statistical software is used to SPSS 16.0 the quantitative processing and analysis.

3. **Experimental Object and Design**

3.1. **Experimental subject**

Fifteen students majoring in social sports were taught 72 hours of compulsory orienteering courses. Through the initial understanding of orienteering, combined with campus orienteering, 100-meter orienteering, campus orienteering with Jilin University South Campus, Jilin University South Lake Campus, Chaoyang Campus and other campuses to master basic orienteering knowledge and rules, and then park and field orienteering, successively with South Lake Park, Culture Square, Jingyue Park, field orienteering teaching, so that students basically master the orienteering map reading skills, and can complete the point finding independently.

3.2. **Experimental design (see table 1)**

A running exercise model for orienteering was developed using a power bicycle with a 3-minute interval incremental load exercise scheme. The flicker value is an index to evaluate the excitation level of brain function, and there are more and more studies on flicker value in sports. In the experiment, the state of central nervous system was inferred from the changes of flicker value and heart rate at different exercise intensities, and the graph recognition model of orienteering was established with the mental brain cognitive graph experiment to analyze the recognition of graph by the brain at different intensities, and the speed of graph recognition and The results were analyzed in terms of the speed of recognition and the accuracy of recognition, and were combined with the heart rate and flicker values at the corresponding intensity.

The subjects were exercised on a power bicycle (Dutch LODE) with an incremental load of 0 watt for the first 3 min, 50 watt for the first 3 min, and 30 watt increments every 3 min, and were required to maintain the bicycle speed at about 60 rpm at all times. During the test, a heart rate telemetry meter (Finnish polar meter) was worn by the subject and simultaneously displayed and saved on the computer connected to it, while scintillation values were measured 40s after the start of each load level and E-prime recognition testing was started 1 min after the start of each load level.
Table 1. Experimental Design of Power Bicycle with Incremental Load Movement

| Charge   | Time interval | Watt | Blink value | Heart rate |
|----------|---------------|------|-------------|------------|
| Charge1  | 3 min         | 0    | N1          | M1         |
| Charge2  | 3 min         | 50   | N2          | M2         |
| Charge3  | 3 min         | 80   | N3          | M3         |
| Charge4  | 3 min         | 110  | N4          | M4         |
| Charge5  | 3 min         | 140  | N5          | M5         |
| Charge6  | 3 min         | 170  | N6          | M6         |
| Charge7  | 3 min         | 200  | N7          | M7         |
| Charge8  | 3 min         | 0    | N8          | M8         |

First, flicker value measurement experiment. Flicker value is the lowest flash fusion frequency that can cause continuous light perception, and what it indicates is the degree of excitation of the entire optic nervous system from the retina to the visual center, which can be used as an indicator of the level of excitation of brain function. It is a quantitative physiological indicator to determine the level of excitation of brain function and fatigue, which is felt as flash under normal conditions and continuous light perception after the occurrence of fatigue [4].

In this experiment, the TKK fatigue tester was used to measure the flicker value of the subject at 40s after the start of each level of load, and the instrument was checked before the test. Eyes straight, the inspector control the adjustment of the "mathematical display" on the instrument, so that the flashing frequency from small to large, while adjusting the displayed reading, the subject sees a flashing light point that is suddenly bright and suddenly extinguished, and then the operator slowly turn the knob to adjust the flashing value clockwise. When the subject sees the flickering light point from flickering to gradually become a piece of light point, the number of flickering indicated on the knob scale, the number is the subject's retinal response to the flickering proximity fusion frequency, that is, the flickering value. The side asks the subject's reaction to the flickering light. It is a quantitative physiological indicator to determine the level of excitement and fatigue of brain function, which is felt as a flash under normal conditions and as a continuous light sensation after fatigue occurs.

This value indicates the degree of excitement of the entire visual system from the retina through the visual nerve to the visual center, and is also considered an indicator of the level of excitement of brain function. The flicker value has a certain relationship with the functional status of the athlete. During the exercise, the flicker value increases as the excitability increases, while the flicker value decreases significantly when the athlete feels very tired, as well as when muscle pain and dizziness occur. In skillful items, flicker values were measured to be higher after exercise than before exercise.

Those who are excitable generally have better motor performance, and those who are unstable or have poor motor performance, and often have fatigue, have decreased flicker values after exercise. The change in flicker value can indicate the excitation level of the visual system, and it can be used to infer the excitation of the central nervous system. Generally, as the movement begins, the flicker gaps increase for a period of time and soon begin to decrease, the greater the movement, the faster the decrease. Because the decrease of the flicker value means the decrease of the excitation level of the whole visual system, that is, the excitation level of the brain function, so according to this flicker value can basically infer the fatigue state of the central nervous system [5].

In this paper, in the study of the effect of different exercise loads on the brain literacy map of orienteering athletes, under different exercise load states, according to the changes in the flicker values of the subjects, the fatigue of the body and the degree of fatigue of the optic nerve are inferred, and the changes in the cognitive excitability of the brain are concerned, so as to explore the quantitative index of fatigue under certain load exercise and provide a physiological scientific basis for this study.

Secondly, psychological E-prime software measures reaction time and graphical cognitive experiments. e-Prime is a psychological experimental operating platform jointly developed by Carnegie-Mellon University and the University of Pittsburgh, which is an advanced graphical design
environment that provides revolutionary new tools to accelerate experimental development. e-Prime allows you to design experiments by simply selecting commonly used experimental functions E-Prime is a visual programming language platform that enables the computerization of psychological experiments, and is a suite of applications that covers experiment generation to millisecond precision data collection and analysis. Its functions are: experiment design, generation, running, data collection, editing and pre-processing of analyzed data. Used for professional psychological experiments and optimized for the temporal precision of psychological experiments. The stimulus presentation is synchronized with the screen refresh, and additionally provides detailed timing information and event details (including details of presentation time and reaction time) for further analysis, which helps to understand the timing issues of running the actual experiment [3].

Reaction ability is the basis and prerequisite for athletes to master and use sports techniques, and reaction time is an important index for studying athletes’ reaction ability. Reaction time (RT) is one of the most important indicators of response variables in psychological research, and the use of reaction time as an indicator for experimental research had played a considerable role in solving theoretical problems in psychology and practical problems in life. It mainly includes the following time periods: first, the time when the stimulus excites the receptors and their impulses are transmitted to the sensory neurons; second, the time when the nerve impulses are transmitted via sensory nerves to the sensory nerve centers and motor centers in the cerebral cortex, and from there to the effector via motor nerves; and third, the time when the effector receives the impulses and starts the effector activity [7].

Currently, psychological academics more often endorse: simple reaction time and selective reaction time task theories. Simple reaction time refers to the time interval between stimulus-response when subjects are presented with a single stimulus and asked to make only a single response. Simple reaction time is relatively short, and simple reaction time has channel variability. Choice reaction time (choice reaction time) is the time required to select the response that meets the requirements and to execute the response according to the different stimuli, and among the multiple responses. Dowdus (1868) referred to the reaction time task of two stimuli corresponding to two responses as B-reaction (B-reaction), or choice reaction, and the reaction time task of one stimulus corresponding to one response as A-reaction (A-reaction), or simple response. After adjusting the B-reaction, a C-reaction, i.e., a discriminative response, can be obtained. Unlike the B-reaction, in the C-reaction task, although red and green light are also presented, the subject is only required to press the reaction button with the right hand immediately after seeing the red light, while he/she does not react after seeing the green light. Subtracting the reaction time of the A reaction from the reaction time of the C reaction gives the discrimination time, while subtracting the reaction time of the C reaction from the reaction time of the B reaction gives the selection time. The distinction between simple-complex reaction time tasks and the speed-accuracy trade-off are the two most fundamental factors affecting reaction time. Stimulus variables Among the stimulus variables, the factors that have a greater impact on reaction time are: stimulus strength.

Among the stimulus variables, those that have a greater impact on reaction time are: stimulus intensity, complexity, etc. The reaction time is affected by the stimulus intensity. When the stimulus intensity is weak, the reaction time is prolonged; while when the stimulus increases to moderate or higher intensity, the reaction time is shortened. However, the shortening of reaction time is limited by the structure of the organism and cannot exceed a certain limit. The shortening of reaction time after extensive training will encounter a "biological wall". It is evident that in experiments on reaction time, it is necessary to maintain a stable value of stimulus intensity in order to maintain a relatively stable reaction time. The cognitive graphs were designed with reference to the relevant map graphs during orienteering, and the E-prime software was used to test the graphs 1 min after the start of each level of loading. For example, the left map is a google satellite aerial map and the right map is a professional orienteering map. There are 8 groups (20 in each group) of questions and answers about orienteering and cross-country knowledge. The test result is based on the time taken by the subject to complete the selection correctly. The position of the point on the left is exactly the position of the point B on the
right, and the response time of this test is displayed from the screen to the time the subject pressed the key.

**Figure 1.** Image of E-prime software setup (orienteering map and satellite aerial photograph)

**Figure 2.** C10 of orienteering cross-country maps and satellite aerial maps

**Figure 3.** Satellite aerial photographs and orienteering maps - C02
4. Experimental Results and Analysis

Table 2. Summary of changes in accuracy, reaction time and scintillation values in the experiment

| Charge  | Correct (%) | Time reaction (s) | Blink value (Hz) |
|---------|-------------|-------------------|------------------|
| Charge 1 | 0.66±0.14   | 3268.0±500.1      | 45.57±7.97       |
| Charge 2 | 0.65±0.09   | 3204.0±627.8      | 44.52±8.11       |
| Charge 3 | 0.73±0.12   | 3158.8±546.2      | 44.29±8.80       |
| Charge 4 | 0.55±0.15   | 3247.2±484.8      | 43.23±8.90       |
| Charge 5 | 0.61±0.18   | 3305.7±612.3      | 43.90±9.36       |
| Charge 6 | 0.70±0.16   | 3287.8±531.4      | 43.44±9.25       |
| Charge 7 | 0.71±0.14   | 2820.6±526.5      | 43.19±9.58       |
| Charge 8 | 0.61±0.13   | 3084.1±480.8      | 45.08±9.67       |

4.1. Response time and correct rate of E-prime software under different motor loads
The mental state of the subjects has a certain relationship with the intensity and duration of the exercise load they are under, and the good or bad mental state also directly affects the quality of the subjects' map recognition, and relevant studies have found that in direct tests, the cognitive ability of the brain is easily affected by internal mental changes such as tension, anxiety, fatigue, etc., while under a certain exercise load, the body is stimulated by the outside world, and the mental changes will also affect the cognitive ability of the brain. Athletes under higher physiological load or physiological energy deficit, cognitive memory capacity is affected, in the participation in sports competitions to withstand a certain physiological load and psychological load, consume a lot of energy, the stability of the action and perceptual perception are affected to a certain extent, the extraction of action skills decline.

It can be concluded that in the first test (0-3min), the subject was only faced with the stimulus of the diagram, there was no load, from zero load to 50watt load (3-6min), the correct rate was reduced, but the reaction time was shortened instead. In the second test (3-6 min), the body received a motor load stimulus, which caused a temporary discomfort of the body, thus affecting the recognition of the diagram, and the correct rate decreased; while in the third test 80watt load (6-9 min), because the body was subjected to a relatively low load stimulus, the heart rate accelerated and the excitability of the brain increased, resulting in The brain on the cognitive ability to improve, thus appearing to know the map of the correct rate is higher, and complete a certain number of map test with less time, at this time the heart rate is roughly 120 times / min above and below; With the increasing exercise load, the body gradually fatigue, physical fatigue, affecting the cognitive ability of the brain, resulting in the correct rate of map and response time changes, in the fourth test 110watt load (9-12min), the correct rate of knowledge map was the lowest, and the time spent was also more, and the heart rate at this time was about 135 times/min or less; from the fifth test 140watt load (12-15min), the body was further faced with increasing load, and the correct rate of knowledge map was improved, but the time spent on knowledge map continued to increase until the most, and the heart rate at this time was 145 times/min or less; at the sixth test, the body was gradually fatigued, and the body was fatigued, which affected the cognitive ability of the brain, resulting in changes in the correct rate and reaction time of knowledge map. In the sixth test with 170 watt load (15-18 min), the correct rate of map recognition and response time were basically the same as the fifth test, and the heart rate continued to rise (155 beats/min); in the seventh test with 200 watt load (18-21 min), the correct rate of map recognition was once again the climax, basically the same as the correct rate of map recognition in the third test, but the response time appeared to be the same. In the eighth test (21-24 min), the power bicycle load was zero, and the correct rate decreased and the time spent in response increased.

4.2. Changes of scintillation values under different exercise loads
In this paper, in the study of the effect of different exercise loads on orienteering athletes' brain map recognition, the subjects' flicker values were inconsistent under different exercise load states. The flicker values decreased significantly when the athletes felt very tired, and when muscle pain and dizziness occurred. It was found that the flicker gaps generally increased for a period of time with the onset of exercise and began to decrease soon after, with the greater the amount of exercise, the faster the decrease. The decrease in flicker value means that the level of excitation of the entire visual system, i.e. the level of excitation of brain functions, is reduced, so that the fatigue of the central nervous system can basically be inferred from this flicker value.

5. Summing-up

5.1. The heart rate corresponding to the optimal recognition point
Subjects generally have a better map state is the average heart rate at 120 times / min or 170 times / min, and for the heart rate at 120 times / min, the subject's response time is longer than the heart rate at 170 times / min, combined with the analysis of the heart rate change curve of a national team and club members of European orienteering players can be obtained, good orienteers, to maintain a good map
state, the heart rate is generally maintained at 170 times / min, while the heart rate at 170 / min, but the body is prone to fatigue. The heart rate is generally kept at 170 times/min, while the heart rate at 170/min, but the body is prone to fatigue, to demand a better state of knowledge, we must have a good physical fitness to do rely on, improve the body's ability to resist fatigue.

5.2. Excellent orienteering athletes' heart rate changes fluctuate less

For this experiment, the heart rate change curve of the better and worse orienteering class and the heart rate curve change of foreign scholars for a national team and club members in Europe can be analyzed, the heart rate change of excellent orienteering athletes fluctuates less, whether it is the body load or the influence caused by the map, the heart rate change and fluctuation of excellent players is low, while for general participants, under the influence of the double load of running load and map stimulation, the heart rate change fluctuates greatly. This can be used as a basis for selection and training, and provide a basis for selecting excellent orienteering athletes.

6. Conclusion

The fluctuation of heart rate change of excellent orienteering athletes is small, whether it is the effect caused by the body load or the knowledge map, the change and fluctuation of heart rate of excellent runners is low, while for general participants, under the influence of the double load of running load and knowledge map stimulation, the fluctuation of heart rate change is large. This can be used as a basis for selection and training, and provide a basis for selecting excellent orienteering athletes.

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