Educational Equity Based on Brain Cognitive Behavior Science

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ABSTRACT

Since the reform and opening up, the level of education in China has been improving continuously. However, there is still a widening gap in some respects. In the academic community, the definition of the concept of education equity is different. Considering the opinions of many scholars, the author believes that education equity can be roughly divided into three forms: the first is the equality at the starting point of education, which includes the equality of the right to education and conditions for schooling; the second is the equality in educational process, which includes the equality of educational content and teacher-student relationship; the third is the equality of educational results, which includes the equality of ultimate achievement in academic achievement and the impact of academic qualifications and education they receive on their future social life. This paper uses the theory of brain cognitive behavior to conduct an EEG experiment to study the issue of education equity in China from these three perspectives. It simulates the generation process by which everyone views the scientific equality of education from these three perspectives, analyzes the scientific equality of education, and proposes ways to solve the problems of education equality, providing reference for relevant researchers.

Key Words: Education Equity, Brain Cognition, EEG Experiment

DOI Number: 10.14704/nq.2018.16.5.1378 **NeuroQuantology 2018; 16(5):523-529**

Introduction

What is education equality? The education equality refers to the fair and reasonable distribution of limited educational resources among different educators, which includes three different levels: the equality at the starting point of education, the equality in educational process and the equality of educational results:

The equality at the starting point of education refers to the fact that each person can enjoy equal educational opportunities regardless of the gender, race, birth and living environment (Shipley *et al*., 2013). At present, the inequalities in China at this level include the difference between urban and rural areas in the quality and quantity of nine-year compulsory education, the differences among various regions in the enrolment of these college entrance examination and the serious infringement of the right to education of females.

The equality of the educational process refers to the fact that each one is treated equally in the education in both the subjective and objective aspects, which is mainly reflected in the aspects of education quality, teacher-student relationship, and students' attention. At present, the inequalities in China at this level include the differences in the conditions for school operation among different regions, differences between key schools and general schools, gaps of teachers in various schools, and differences in teachers' attention to students.

The equality of education results, namely the equality of education quality, refers to the fact that education allows everyone to obtain reasonable academic performance and equal

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
Received: 8 April 2018; **Accepted:** 7 May 2018

education has an equal impact on the opportunities of social work life in the future. In real life, this inequality is reflected in the differences of probability of success for different family background and stratum, differences of further education and employment for males and females and the diploma discrimination against graduates from non-key schools.

At present, the issue of education equity is no longer just a cliché in the field of education research, but also a core value orientation of contemporary social development. The Third Plenary Session of the 18th CPC Central Committee adopted the "Decision of the CPC Central Committee on Several Major Issues Concerning Comprehensively Deepening the Reform." The following instructions were made in terms of educational equity: "effectively promoting education equity and gradually narrowing the gap between regions, urban and rural areas, and schools. In the report on the government work of the two associations in March 2018, the topic of education equality was mentioned again. In the report, Premier Li Keqiang of the Chinese State Council mentioned the development of equal and quality education. The integration of compulsory education in urban and rural areas should be promoted and education investment should continue to tilt toward difficult areas and weak links. At the national level, more and more attention is paid to education equity and the government proposes to continue to give more support for areas with backward infrastructure (Koutsouki and Asonitou, 2015).

In order to display the issue of education equality more clearly and intuitively, constantly mine new perspectives on the study of education equity and explore new directions for the study of educational equity, this paper uses the theory of brain cognitive behavior to study the problem of education equality in China from these three perspectives through EEG experiment. At present, there is almost no study in this area in China and the number of foreign studies is scarce. countries. The national conditions in foreign countries are still different from those in China. The author has reviewed large amount of information in this regard. In the past, scholars studied the issue of education equity more from a theoretical perspective. Most scholars analyze and study the theory and case of education equity, but they do not conduct in-depth research on the behavior of a specific group.

In the introductory part of this paper, the research background and significance of the issue of education equity have also been specifically described and the research question has been raised. Some basic hypotheses have been made to tackle this research question, and the EGG experiment is used to study this problem. The process and data results of the EGG experiment will be elaborated.

Research Hypothesis

This experiment takes the education equality based on brain cognitive behavioral science as the research question and three hypotheses are proposed based on this research topic.

Hypothesis 1: Assume that everyone will be affected by conditions such as gender, race, origin and living environment, which means that the starting point of education is unfair.

Hypothesis 2: Assume that everyone will be affected by factors, such as the quality of education, the teacher-student relationship and the level of attention received by students, which means that the education process is unfair.

Hypothesis 3: Assuming that education cannot enable everyone to achieve reasonable academic performance and the impact of the equivalent education on future social work life is not equal, which means that the education result is unfair.

Experiment Process and Data Results of EEG

Experimental Purposes

This paper selects and utilizes the research method of event-related potentials and truly and comprehensively simulates the generation process of cognitive behavioral of education equity from these three perspectives through the experimental paradigms related to keystroke tasks. The inherent laws and connections of the individual neural mechanisms at the level of people's perception of education fairness. In this experiment, through the start-detection experiment paradigm, 15 individuals were randomly selected among the students receiving education to conduct an experimental study and the actual assumptions of EEG were tried to verify the above hypotheses.

The inherent laws and connections of the individual neural mechanism in people's cognition towards education equality are further explored. In this experiment, through the start-detection experiment paradigm, 15 individuals are randomly selected among the students receiving

education to conduct this experimental study and the above hypotheses are verified through actual EGG experiment.

Experimental Methods

(1) Experimental Subjects

The subjects were individuals receiving education in different grades, whose age was between 12 to 18 years old. After investigation, they had no mental illnesses and were in good health without any physical discomfort. At the same time, they were in good mental state and could participate in this EGG experiment.

(2) Experimental Materials

All individuals involved in the experiment were in a quiet experimental environment and arranged in comfortable chairs. They were asked to carefully read the experimental guidance and complete the pre-test phase. First of all, the "beginning of the experiment" prompt appeared on the screen in front of the subject, indicating that the experiment has officially started and the subject will adjust his or her mental state.

Secondly, a case summary of education equality would appear on the screen. After the subject has read it carefully, a certain time was given for thinking. Finally, questions about the education equality would appear on the screen. Subjects read and thought about the questions and they responded by pressing keys.

(3) Experimental Procedure

Through literature and market research, we finally provide a summary of the newest education equity cases, which involves all aspects of education equity, and thus increase the scientificity and rationality of the cognitive research on education issues.

Before the experiment, the subjects had to read the experimental procedure and then sit in a comfortable chair. A computer was placed a 90cm in front of the subjects, and they also had to wear an electrode cap. In order to allow the subjects to participate in the experiment better, a pre-experiment needed to be conducted first before the experiment officially started to enable subjects to adapt to and become familiar with the experimental situation.

During the entire experiment, the experiment subjects needed to complete three tasks and each task took 15 minutes. Meanwhile, there would be a break between each task. When the task started, the word "beginning the experiment" would appear on the computer screen, which reminded the subjects to adjust their mindsets into the experiment and concentrate all their attention on the next experiment. Then, a brand-new case would appear on the screen and the experiment subjects were asked to use 15 minutes to read it carefully. After that, questions about this case would appear on the screen and the subjects must answer the questions after careful consideration. The subjects just needed to follow the steps, understand the case from their own perspective and answer each question carefully.

Throughout the experiment, subjects could answer questions about the cases of educational equity based on their own ideas and express their opinions and ideas through keystrokes. 1 indicated agreement and 2 indicated disagreement.

(4) EEG Data Recording

In the process of analyzing the time course of the EEG data, the measurement of data needed to be conducted 200 millisecond before the question and 800 millisecond after the question. On this basis, the 200 millisecond before the question was selected as the baseline for data analysis.

The original EEG signal would contain external equipment noise such as power frequency interference and physiological noise such as ocular artifacts and electromyographic artifacts. The amplitude of these signals was generally much larger than the truly available EEG signal so that the required EEG signals were submerged and difficult to extract for analysis. Therefore, before using EEG and ERP signals for analysis, the pre-processing needed to be conducted first to filter out various noises (Richman and Moorman, 2000).

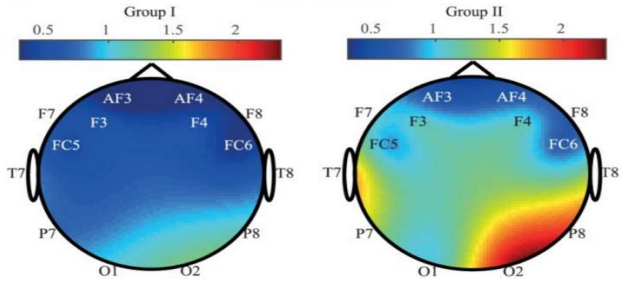

Figure 1. Original EGG and Clean EGG After Pretreatment

After the reference change, EOG removal, artifacts removal, and filtering, these three basic steps for signal preprocessing are performed in resting

state acquisition and ERP acquisition. After the fourth step of resting state data processing, a relatively clean EEG signal could be obtained. After the above pre-treatment of the EEG signal at the Fp1 electrode point, the clean EEG could be obtained, as is shown in Figure 1:

After data processing, the corresponding ERP and waveforms could be obtained and waveforms were selected for the analysis of its EEG components. The EEG component time windows were also obtained to acquire the required data.

Traditional Analytical Methods

The traditional EEG studies treat the EEG signals as linear signals and adopts linear methods to analyze signals in the time-frequency domain.

Time domain analysis theoretically means that the control system analyzes the steady-state performance of the system based on the time domain expression of the output signal under certain input signals. Since analysis of data is directly performed in the time domain, it has the advantages of intuitive and accurate (Buckner and Krienen, 2013). The time domain analysis is mainly to calculate the time domain characteristics such as mean value and standard deviation for the relatively clean EEG signals after pre-processing.

The analysis of the frequency domain characteristics is to calculate the frequency domain characteristics such as power spectrum and center-of-gravity frequency of EGG signals in different frequency bands ranging from 1 to 35 Hz (Barigye *et al*., 2013). Therefore, it is necessary to obtain the frequency band to be studied through filterers before calculating the frequency domain characteristics and then the fast Fourier transform method is used to calculate the needed frequency domain characteristics of the band.

Time domain and frequency domain analysis have their own advantages and limitations. The EEG signal is a dynamic, complex time series, so domain and frequency domain cannot provide enough information for the study of EEG signals. Therefore, it is necessary to combine time domain and frequency domain for the analysis to illustrate the characteristics of EEG signals from two aspects.

However, it is impossible to give reasonable explanation of various non-periodic phenomena in EEG activities from the perspective of time domain, frequency domain and time-frequency domain, thus demonstrating the limitations and deficiencies in the traditional linear analysis method.

Analysis of Behavioral Data

The behavioral data is an observation report on the behavior of the experimental subjects and the environment at the time of the behavior, which is, in fact, the data corresponding to the subjects' own behavior. Specifically, the recording of behavior data is the recording, measurement and assessment of the keystroke results of the experimental subjects and the reaction time when seeing a problem. Consent rate of educational inequity= times of agreement keystroke/total number of keystroke (sum of agreement keystroke and disagreement keystroke).

During the entire data processing process, the number of times when the subject did not press the button was deleted and this situation is regarded as an invalid response. The reaction time of the subject indicates the subject's cognition and understanding of this issue.

On this basis, an in-depth analysis and research is conducted to analyze the reaction time of consent rate in three aspects, which are education starting point, education process and education results. Based on the previous discussion, in the experiment, the subjects express their ideas by pressing a button, which is their recognition of education equality.

Consent rate of educational inequity= times of agreement keystroke/total number of keystroke (sum of agreement keystroke and disagreement keystroke).

Analysis of EEG Data

EEG signal is a kind of complex nonlinear signal. By studying a large number of existing literatures, the Shannon entropy and approximate entropy are selected, which are non-linear analysis methods suitable for analyzing human EGG signals. These two methods are used to study the non-linear characteristics of the EEG signals of experimental subjects' consent rate n starting point, education process and education results.

(1) Analytical Methods and Steps of EGG Data

With the aid of EEG recording and analysis system, the off-line analysis of EEG data can be achieved. The specific flow is as follows: data merging → processing and filtering out interference data → reference change → EOG removal → artifact removal → filtering →

capturing data analysis section → baseline calibration → segmentation → overlay analysis.

(2) Processing of EEG Data

After the above processing of the original EEG data, the EEG data of alpha rhythms at each of the 19 electrode points is obtained. The Shannon entropy is calculated for these data and the averaging of the characteristics of each electrode point in three aspects is obtained, as is shown in Figure 2.

Similarly, the approximate entropy of the alpha rhythm at each of 19 electrode point is calculated and then the mean and standard deviation of the three aspects at each electrode point are calculated. The results are shown in Figure 3:

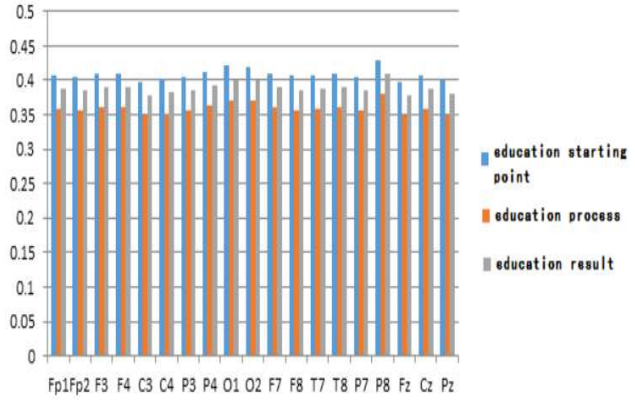

Figure 2. Average Shannon Entropy for Each Lead in alpha Rhythm (M±SD)

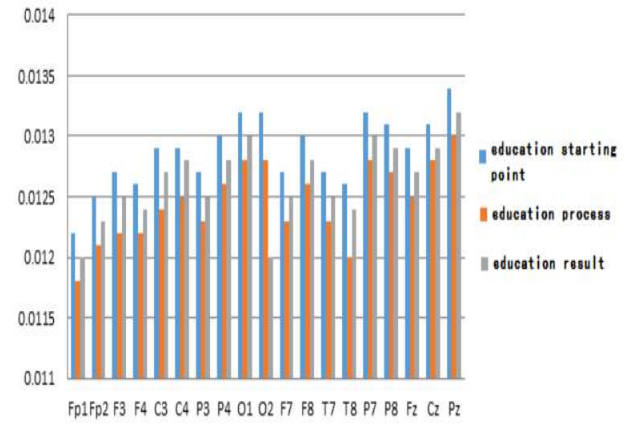

Figure 3. Average Approximate Entropy for Each Lead in alpha Rhythm (M±SD)

According to the independent sample T test, in the Shannon entropy, the education starting point, education process, and education results are significantly different in most of the electrode sites (except FP1 and T8), p1<0.05, p2<0.05, p3. <0.05; and at the electrode points Fp2, F4, C3, C4, P3, P4, O1, O2, F7, F8, T7, P8, Fz, Cz, Pz, p1 <0.01, p2 <0.01, p3 <0.01. For the approximate entropy, these three aspects have significant differences at all electrode points, p1<0.05, p2<0.05, p3<0.05, of which Fp1, Fp2, F3, F4, C3, C4, P3, P4, O1 , F7, F8, T7, T8, P8, Fz, Cz, Pz, p1<0.01, p2<0.01, p3<0.01.

From the results of these data, it can be clearly seen that subjects' consent rate for the equality of education starting point, education process and education results are all different and there are significant differences.

(3) Analysis of EEG Data

In the experiment, two entropy methods are used to analyze the characteristics of the alpha rhythms of EEG signals in the three aspects of education starting point, education process and education results to explore the differences of EEG signals in alpha rhythm and effect of non-linear EEG characteristics in the recognition study in the experiment.

By using Shannon entropy and approximate entropy, it can be clearly seen from Figure 2 and Figure 3 that the Shannon entropy and the approximate entropy of education starting point in the alpha band are greater than the other two. Through independent samples T-test, it is found that the Shannon entropy and approximate entropy of education starting point in the alpha rhythm are relatively similar to the data of education results. The Shannon entropy is often used in the study of various EEG signals, and its value can be used as an indicator of the disorder degree of the signal. The smaller the value of the Shannon entropy, the more ordered the signal; the larger the value of the Shannon entropy, the more disordered the signal (Brummelman *et al*., 2012).

In the experiment, the Shannon entropy and the approximate entropy of education starting point are greater than the other two and there are significant differences. Combined with the characteristics of Shannon entropy and the processing results of the data, it can be found that people's recognition for the inequality of education starting point is higher, as is shown in Figure 4.

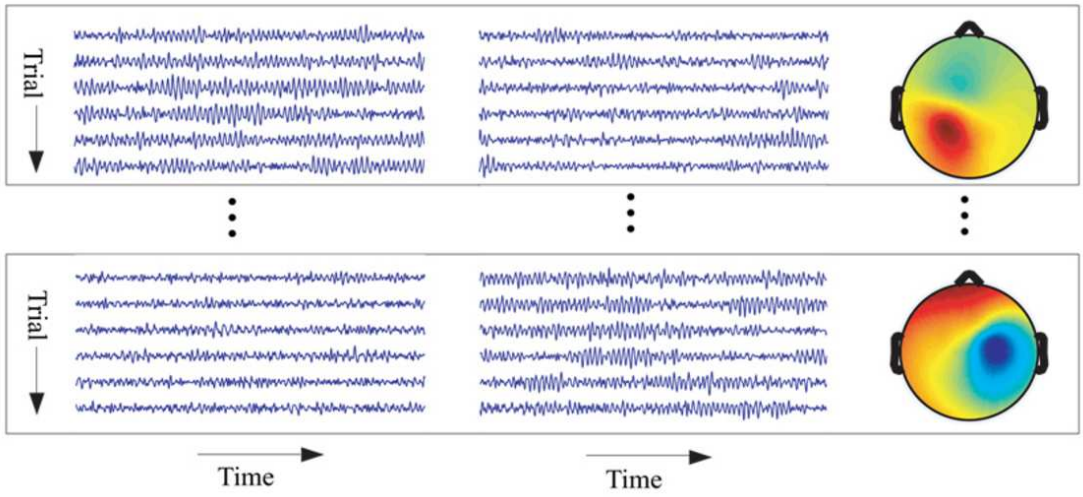

Figure 4. EGG Stimulus Diagram of Shannon Entropy and Approximate Entropy of Education Starting Point

Methods to Solve the Problems of Educational Equity

By reviewing a large number of documents and summarizing the above experimental results, several suggestions are put forward from the three aspects of education equity, namely education starting point, education process and education results.

First of all, this paper points that the inequality of education starting point is the most severe in the problems of education equity:

(1) Firstly, we must uphold basic rights and equal educational resources. Especially in the compulsory education stage, it is not only necessary for everyone to receive compulsory education, but the quality of compulsory education is very important. Every student must receive a nine-year compulsory education and each of them enjoys equal basic educational opportunities (Meyers, 1998; Kim, 2015).

(2) It is necessary to develop education adapting to local conditions and promote the "localization" of education. We should not always compare the differences between urban and rural areas and boost the development of rural education closer urban standard so as to realize the "great unification" model. Such an idea is wrong and we should correct the erroneous tendency of highly concentration and urbanization and achieve the diversification of educational models. Each region has its own characteristics and advantages and we should give full play to its strengths and make up for its shortcomings so that we can better narrow the regional gap and urban-rural gap (Ward, 2009).

(3) For some vulnerable groups, it is necessary to give support and attention, including some weak schools in remote cities, weak schools in urban-rural continuum, schools in remote rural areas, education for girls in impoverished areas, education for children with disabilities, education for children of migrant population and education for children and adolescents in ethnic minority areas. All of these should be given support and attention, especially in the era of the Internet, we can encourage more people to pay attention to this phenomenon and use the collective strength to give them support. As for the education process, local governments must fully coordinate the development of regional education (Jirsa and Muller, 2013).

Under the guidance of the country's macro-policy and based on the development status of educational equality in various regions, the local education administrative department can analyze the causes of imbalanced education among regions, and adopt measures such as balanced allocation of educational resources, flow of high-quality teachers and upgrading of educational modernization, thus promoting the sharing of high-quality resources between schools and orderly and effectively narrowing the inequality of inter-school education within the same region. The government should make up for the insufficiency of educational funds for weak schools and equalize the educational hardware of these schools. Secondly, teachers and management personnel should be rationally allocated so that the teachers' level and management level of each school are roughly balanced.

As for education results, after the problems of education starting point and education process are resolved, the result will change naturally. Some well-known companies and big corporations place a higher value on the 985, 211 students, which is the criteria for recruitment. This is also because the elite students from 985 and 211 are recognized for their learning ability. After all, it is very difficult to win the admission into these elite schools, and it is also a market selection.

Conclusions

This paper analyzes behavioral data and EEG data, and further explores the issues of educational equity in the three aspects, namely the education starting point, education process and education results. Through the EEG data, the above three aspects can be can be judged the above three aspects and everyone's recognition of the unequal phenomenon in the above three aspects can be obtained. The above-mention hypotheses can also be verified.

The issue of education equity is a social issue, which is directly related to the coordinated development of our society and economy. In the new era, we must further enhance the awareness of the development of education equality, take effective measures against the current situation, gradually narrow the educational gap and gradually promote the development of education equality.

Acknowledgments

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