

Preliminary Discussion on Brain Mechanism In Mental Arithmetic (By Image of Abacus) Process

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I. Preface

Mental arithmetic by image of abacus as internal sublimation of Chinese Zhusuan has caught attention of education workers at home and abroad, and has been applied for brains cultivation in a large scope in recent years. According to President Zhu Xi'an in the Chinese Zhusuan Association, the number of children in abacus and mental arithmetic education has reached 3 million so far. According to massive abacus and mental education research reports in various areas, mental arithmetic by image of abacus may improve students' calculation speed clearly and effectively, and play an active role in promoting cognition quality. We note that the past research on abacus and mental arithmetic always focused on education observation, led to non-experimental statistics comparison and narrative results, and lacked discussions on brain mechanism and cognition mental tests through strict supervised condition, especially the nerve psychological experiment research pertaining to brain functions. Accordingly, cognition nerve psychological tests should be conducted in line with characteristics of mental arithmetic by image of abacus. Under this important education condition, it is a must to carry out scientific practical experiments on abacus and mental arithmetic. Based on this, its course value and talents training value should require further discussion.

Whether mental arithmetic by image of abacus training can become a brain-friendly activity, a key problem is whether it has the function of transition; that is to say, mental arithmetic by image of abacus not only functions as a calculation instrument to improve students' calculation speed but also plays a benign role in cognition activities, such as in attention progress, sensibility and thinking progress. Though the function of transition has been reported in people's experiments and observation, it needs stricter scientific validation. Therefore, we carry out experiment research on mental arithmetic by image of abacus. To our special gratitude, the research has got supports from the Chinese Zhusuan Association, and got supports and coordination from the Cognition Nerve Mentality Lab of Psychology Research Institute of Chinese Academy of Science and the Cognition Psychology Lab of Beijing Normal University.

II. Experiment Aims

There are two basic aims for this experiment:

1. Are there clear differences on cognition activities between the students who have received mental arithmetic by image of abacus training and those who have not?
2. Are there clear differences on brain function polarization between the students who have received mental arithmetic by image of abacus training and those who have not?

This experiment is the first laboratory research on brain mechanism of mental arithmetic by image of abacus. Mental arithmetic by image of abacus is a complicated mental movement, involving various contents. As it is the first research, many problems are yet to solve. Therefore,

in order to carry it out comprehensively and systematically, this experiment is conducted on several main cognition aspects in close connection with mental arithmetic by image of abacus; in other words, comparison research on training effects is carried out in terms of the basic cognition mechanism, such as vision scan, perception, picture and word memory, instant memory space and data abstraction. Meanwhile, this research also solves the problem whether mental arithmetic by image of abacus training bears the brain-friendly function of transition.

According to common experiment experience, children are the mainstream of mental arithmetic by image of abacus, for the age phase from 3 to 13 years old is a period for brain function polarization. Therefore, this experiment also goes around brain function polarization to explain whether mental arithmetic by image of abacus is beneficial to brain development.

III. Experiment Methods

This experiment presents comparison research on the children who have received mental arithmetic by image of abacus training and those who have not. In this experiments, two groups of children are tested on several cognition basic functions as follows:

1. Number space memory test, a general index for instant memory.
2. Attention test through deleting given objects. This test can reflect students' attention quality, including selectivity and broadness of attention, through deleting special letters within limited time.
3. Several contents in YWG nerve psychology lab software. Detailed as: memory level of Chinese characters, picture memory level and comparative trend of brain polarization. The Chinese characters memory level focuses on student's memory ability on Chinese characters. The picture memory level tests students' memory ability on non-word pictures. The testing principle of brain polarization is that: Students are quickly given words and pictures by the computer to the left eyeshot and the right eyeshot alternatively, in a speed lower than eyeball-moving speed. The students' reflection will objectively test their cognition ability of the left brain and the right brain: the former plays a leading role in words and the latter in pictures. The index based on the error rate and reflection time shows the extent of the brain function polarization of the left and the right. Nerve psychologists think this extent reflects the brain development degree.
4. Eye-moving instrument. This records students' eye-moving modes in specific operations and eye-moving condition in object seeking. Testees in the experiment are subject to all tests according to situation.

1. Result of number space test and attention test: Unit: number

| Testees | Number space (in common order) | Number space (in reverse order) | Attention test |
|-----------|-----------------------------------|------------------------------------|----------------|
| Trained | 7.90 (0.99) | 6.80 (1.40) | 45.30 (17.42) |
| Untrained | 7.08 (0.79) | 4.50 (0.67) | 31.92 (9.15) |
| Disparity | 0.82 | 2.30* | 13.38* |

2. Result of YWG nerve psychology experiment

- 1) Reflection time Unit: ms

| Testees | Picture memory Level 1 | Picture memory Level 2 | Chinese characters Memory Level 1 | Chinese characters Memory Level 2 | Single part of the brain |
|-----------|-------------------------------|------------------------------|-----------------------------------|-----------------------------------|------------------------------|
| Trained | 532 (103.32) 9S _S | 422 (78.31) 8S _S | 366 (52.47) 9S _S | 359 (43.14) 8S _S | 422 (64.78) 9S _S |
| Untrained | 530 (143.82) 12S _S | 442 (72.28) 12S _S | 361 (33.21) 12S _S | 380 (59.19) 12S _S | 500 (129.11) 8S _S |
| Disparity | 2 | -20 | 5 | -21 | -78* |

2) Mistake rate

| Testees | Picture memory Level 1 | Picture Memory Level 2 | Chinese characters Memory Level 1 | Chinese characters Memory Level 2 | Single part of the brain |
|-----------|------------------------------|------------------------------|-----------------------------------|-----------------------------------|-----------------------------|
| Trained | 0.08 (0.03) 9S _S | 0.23 (0.06) 8S _S | 0.11 (0.05) 9S _S | 0.21 (0.05) 8S _S | 0.13 (0.07) 9S _S |
| Untrained | 0.08 (0.03) 12S _S | 0.17 (0.08) 12S _S | 0.08 (0.04) 12S _S | 0.22 (0.09) 12S _S | 0.29 (0.27) 8S _S |
| Disparity | 0 | 0.04 | 0.03 | -0.01 | -0.16* |

3) Analysis of objects seeking Unit : ms

| Testees | Total focus time for numbers seeking | Total focus time for numbers seeking | Total focus time for Chinese characters seeking | Total focus time for Chinese characters seeking |
|-----------|--------------------------------------|--------------------------------------|---|---|
| Trained | 2.112 (246.53) | 9.8 (2.24) | 413.5 (946.82) | 18.96 (4.08) |
| Untrained | 3086 (1038.73) | 13.69 (3.79) | 4475 (681.71) | 21.16 (4.15) |
| Disparity | -974* | -3.89 | -340 | -2.20 |

(Tick mark* means significant disparity.)

IV. Testees Condition

Testees in this experiment are 43 students in Grade3 in Beijing Shilour Primary School, altogether. Among them, 21 students have received mental arithmetic by image of abacus training for three years, and 22 have not. All of them have normal vision.

V. Experiment Result

According to differences on the eye-moving mode of testees in addition operations, 10 children with typical horizontal eye-moving mode are selected from the trained group and 12 with typical upright eye-moving mode. Divide the 22 children into two groups: the trained and the untrained to analyze the result.

V. Conclusion

After the above analysis of experiment results, several conclusions can be reached:

1. In the test of single part of the brain, the trained group has a significant disparity with the untrained group on reflection time and mistake rate. The average RT of the trained group is 422ms. And the untrained is 50ms; the mistake rate of the former is 0.13, and the latter is 0.29. Obviously, the trained group is better than the untrained, showing a higher degree of brain polarization. Nerve psychologists think relative specification and coordination of the two parts of

the brain compose the trend of brain evolution; the specification is under slow way while the coordination is in advancement. The high degree of the latter also requires the high degree of the former; both are in dialectic combination is the development of people's brain functions. This indicates the trained group has a better condition of brain function development.

2. The result of the attention test indicates that there is a great disparity between the two groups: The mean score of the trained group is 45.30 while that of the untrained group is 31.92. This clear disparity shows the former group is better than the latter on both attention degree and flexibility of choices.

3. The number space test indicates that a clear disparity also exists between the two groups: The average digit in reverse order of the trained group is 6.80 while that of the untrained group is 4.50. Therefore, the former has the better reverse digit space than the latter, hence suggesting its better information abstraction ability than the latter.

4. The eye-moving test indicates that a significant disparity lies between the two groups on total focus time in seeking certain numbers: The average total focus time cost by the trained group is 2112ms while that by the untrained is 3085ms. Therefore, the former group appears faster than the latter. Whereas, there is no clear difference between them on seeking Chinese characters. This indicates mental arithmetic by image of abacus training doesn't expand vision scan activity into various tasks; mental arithmetic by image of abacus is an internalized mental activity, and it exercises its transition functions in the core process instead of the external.

Courtesy:

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