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The Influence of Self-Creation of Situation on Scientific Problems Solving

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Abstract: *This study focuses on whether self-creation of situation will have an impact on scientific problems solving. We selected 10 scientific invention problems (including two samples) as the experiment materials and adopted the three － stage experimental paradigm "self-creation of situations of scientific problems - analogy Association (activation of prototype) - scientific questions solving. Through manipulating the self-creation of situations (without self-creation of situations， self-creation of situations) before scientific questions solving, we investigated the influence of self-creation of situation of scientific problems on the scientific questions solving correct rate and reaction time to solve scientific problems. The results of our study are as follows: (1) Self-creation of situation of scientific problems have significant effects on the correct rate to solve scientific problems, and the correct rate to solve scientific problems with self-creation of situations was significantly higher than that in without self-creation of situations. (2) Self-creation of situation of scientific problems have significant effects on reaction time to solve scientific problems, and reaction time to solve scientific problems with self-creation of situations was significantly lower than that in without self-creation of situations. In conclusion, Self-creation of situations contributes to the activation of prototype, help to solve problems in science.*

Keywords: *self-creation of situation, scientific problems solving, prototype.*

1. INTRODUCTION

The key of science and technology innovation lies in the creative thinking. Creative thinking is the decisive factor that a scientific problem is solved and the creativity of people is made full use. Where does Creative thinking come from? Based on the in-depth study and thinking of creative thinking, it is recently proposed that there is an "activation of prototype" theory on creative problem solving. That is to say, the theory includes two stages for the key heuristic information prototype elicitation of activation of prototype and the prototype activation (Qinglin Zhang et al, 2004). This theory has been considered to be more in line with the mechanism of creative thinking in real life. Since prototype elicitation theory put forward, continuously study have achieved fruitful results, such as investigating the principle of the common words and prototype and problems in information highlighting (Dan Zhu, 2011), containing the point at objects or principle of identification (Shuai Cui, 2011), the characterization of prototype (whether there is a mark or illustrations) (Yan Tian, 2011), the position of the prototype (Haixue Zhu, 2012), redundant information of a prototype (Yanmei Zhao, 2013), personality (Dan Zhu, 2011), competition and emotions (Yadan Li, 2012; Chengchun Shen, 2012) and other aspects, and discusses the experimental paradigms (Zhenzhen Wu et al., 2009), corresponding cognitive and neural mechanism (Chunlei Liu, 2009; Dan Zhu, 2011; Jiang Qiu, 2011; Haixue Zhu, 2012; Junlong Luo, 2012).However, there has been the lack of discussion of how the long memory of the prototype is the activation. In addition, the most previous studies have used two stage learning-testing experimental paradigms for discussion of prototype elicitation theory. But in real life, the individual is often puzzle on scientific problems, and generally do not have been learning, the prototype of inspiring thinking are normally stored in long-term memory. But recently the situation education theory thought that creating a good situation has help with inspiring thinking. Learning relevant samples of problem solving in science field, will effectively promote the individual's the level of creativity in the field, and promote problem solving (Yi Xinfa et al., 2013; Hattori et al, 2013). Based on this, this study intends to use the "science problem situation self-creation - analogy Association (activation of prototype) - science problem test" three stage of experimental paradigm. And inserting sample excitation before self-creating situation, the study explores impact of situation self-creation of science problem on the accuracy of science problem solving and response time of scientific problem solving.

The experimental hypothesis are: (1) Situation self-creation of science problem has significant effects on the correct rate to solving scientific problems, and the correct rate of scientific problem solving with situation self-creation was significantly higher than that in non creation of the science problem situation; (2) Situation self-creation of science problem has significant effects on the reaction time to solving scientific problems, and the reaction time of scientific problem solving with situation self-creation was significantly lower than that in non creation of the science problem situation.

2. METHOD

2.1. Objective

The study investigates the effect of situation self-creation of science problem on solving scientific problems in order to test the hypothesis 1 and hypothesis 2.

2.2. Participants

A total of 60 students 20–23 years of age were recruited from a domestic undergraduate university in Nantong, China. With vision or corrected visual acuity of the normal, all students have a preliminary computer operation skill, and were not involved in scientific issues test. The 60 subjects were randomly divided into 2 groups, each group of 30 people, were randomly assigned to a situational treatment and non situational treatment. The subjects finished the experiment after getting the proper reward.

2.3. Material

10 scientific problems of "scientific invention experimental problems of material library" are selected as materials for study. Each test subject includes two parts: prototype and problems. There are 2 samples of 10 test questions as follows.

1. Scientific problems: fertilizer could increase the yield of crop, so the amount of fertilizer to use is very large. But the over fertilized crops is not conducive to people's health, and damage the soil. Then how can make crops get enough fertilizer with no fertilizer?
2. Some of the planets are far away from the earth, if by a spaceship to those star, time is long (months or years). The astronauts need to consume a large amount of food in this process. Then how do we solve the problem of energy consumption in space travel?

For example, with the first scientific sample problem(shown in Fig.1(a), Fig.1(b)), firstly subjects have a careful reading of scientific problems of material, then go on self - creating a situation of "no chemical fertilizers can make crops get enough fertilizer", and thus people think of that legume do not need fertilization, nitrogen fixing bacteria legume roots can take nitrogen from the air into the nitrogen, the formation of the nodule containing nitrogen in legume roots, providing synthetic nitrogen fertilizer for leguminous plants. So will they can come up with the method for biological fertilizer when solving the problem.

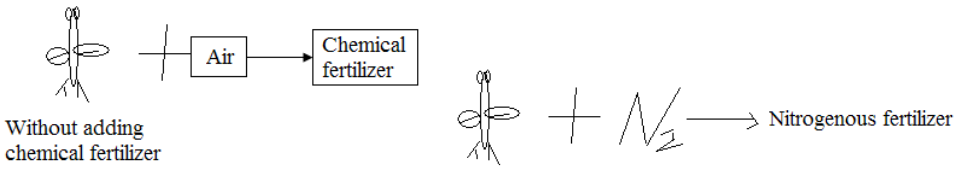

Fig1. *The first scientific sample problem*

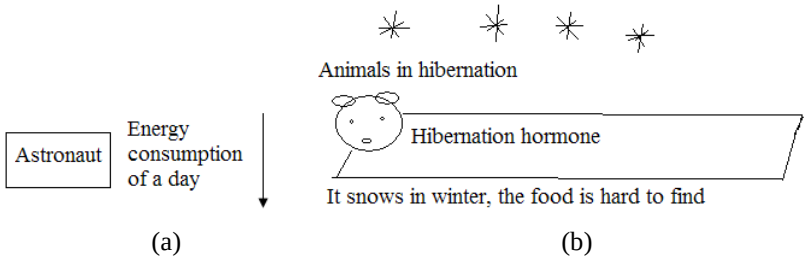

Fig2. *Another example of science problems in the sample*

Another example of science problems in the sample (shown in Fig. 2(a), Fig.2(b)), firstly subjects have a careful reading of scientific problems of material, then go on self - creating a situation of "time is long but energy consumption greatly reduced", and thus people think of that in winter, some animal solve the problem by hibernation that the food is difficult to find. They have been able to hibernate, because in their blood there is a kind of can induce hibernation hormone substance. Think of space hibernation as scientific problem solving approach.

2.4. The Experimental Design

The study was experimentally conducted as a single factor 2 levels (self creating situation: no, exist) of between-subjects design trial. The subject's task is to make self-creation situation based on as much as possible to understand scientific problems of materials, and thus have the association, activate the prototype in the long memory, finally come up with a creative solution to the problem of science.

The dependent variable 1: the correct rate of scientific problem solving, namely scientific problem solving scores of total score ratio.

The dependent variable 2: reaction time of scientific problem solving.

In the experiment, two groups of subjects were given independent variable 1 level, the 8 of 10 scientific problems as the experimental material, 2 as the sample to be trying to explain with participants.

2.5. Procedures

Participants were entered into the E-Prime laboratory; each lab is equipped with a Pentium2IV computer, monitor and chair. To Use E-Prime2.0 software program to complete the random presentation of experimental materials. Stimulus presentation process was shown in Fig.3.

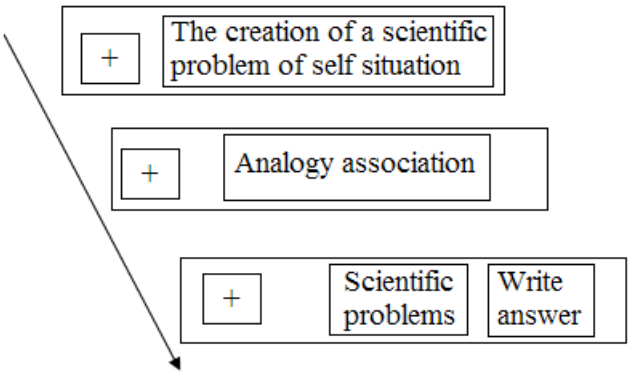

Fig3. *Stimulus presentation process in self situational creation conditions*

Before participants make situation of creating scientific problems, they firstly carry on sample priming.

Providing sample priming of scientific problems can effectively improved people to create correct situation.

The whole process includes three stages: the creation of a scientific problem of self situation, analogy association and scientific problems of testing.

The self-creation stage of a scientific problem situation: firstly in the middle of the screen shows the fixation point "+", black bottom and mispronounced character, duration time is 1s; then it presents a scientific problem, within the prescribed limit time the subjects understand the scientific problem and press the spacebar to enter the following two stages, if up to the highest limit participants has not understood problems, then automatically enter into the next step, later appears the second scientific problem, repeat the previous steps, until the present round 8 scientific problems so far.

Analogy Association stage: participants understand the scientific problem that press the spacebar to enter the analogy Association stage, firstly showing the fixation point "+" in the middle of the screen with no time limit, they write on answer sheet with associative knowledge. After writing press the space key to enter the next stage.

Scientific problems of testing phase: the screen appears tip for testing to begin (1s); again showing the scientific invention problem, duration time is 1990s. If the participants think the answer within the 90s,

press the "1 key", " program jumps to writing answer" prompt, subjects write down the answer on the answer sheet, write the answer without time limit, if during the 90s subjects failed to come up with the answer, the program will automatically move to the next stage. Later appears second scientific invention problem, repeat the previous steps, until the finished testing the wheel of all the science invention problems. Subjects were asked to think of the answer and immediately pressed button, and then write down the answers. Subjects were asked to write the answer "to specify what to do to solve the problem when writing the answer".

Analysis of the system is described in section 4, followed by the conclusion.

3. Statistics and Analysis Results

Removing the experiment data of subjects with failing to complete the experiment during the course of experiments, other experiment data is analyzed. On the basis of "scientific invention and creation provides experimental materials library" of the reference answer, the answers to scientific invention problem are scored. Scientific problem solving scores use four point scoring, 0-3,0 said there is no answer or solution answer or is not entirely correct; 1 said that the subjects answer a bit closer to the correct answer; 2 said that the subjects answer relatively close to the correct answer; 3 said that the subjects answer completely consistent with the correct answer. The correct rate of scientific problem solving is equal to the ratio of the scores of scientific problem solving and the total scores of scientific problem solving multiplied by 100%. Scientific problem solving reaction time with E-Prime2.0 software of the recorded data shall prevail.

Using SPSS18.0 for statistical analysis, under the conditions of different the correct rate and reaction time of subjects problem solving are showed in Table 1.

Table1. *Mean and standard deviation of the reaction time and correct rate of no or self situational problem solving*

Statistical index		N	M	SD
reaction time	no	30	7872.70	3700.45
	have	30	3322.17	1102.56
	total	60	5597.43	3548.62
correct rate	no	30	.17	.06
	have	30	.40	.11
	total	60	.28	.15

From results showed in the answer sheet, in the group with the self creation situation all subjects that can answer scientific questions were able to activate the life prototype, and “reference prototype provided by inventive scientific experiment materials library" is very close to the answers by them. Self situational creation contributes to activate the prototype.

Table2. *Analysis of problem solving reaction time and average correct rate variance*

Statistical index		df	Mean square	F	Sig.
reaction time	Between subjects	1	3.11	41.67	.000***
	Within subjects	58	7454482.42		
	Total	59			
correct rate	Between subjects	1	.788	98.78	.000***
	Within subjects	58	.008		
	Total	59			

*** *The mean difference is significant at the .001 level.*

Under different experimental conditions variance analysis results of correct rate for problem solving show:

There is significant main effect of self situation creating: $F(1, 58) = 98.78$, $P<0.001$, the correct rate of problem solving with self creating situation group was significantly larger than the group without creating self situation; analysis results of variance of the reaction time in different experimental conditions showed: there is significant main effect of self situation creating: $F(1, 58) = 41.67$, $P<0.001$, the reaction time of problem solving with self creating situation group was significantly larger than the group without creating self situation; So two experimental conditions groups of main effects were significant (Table 2, Fig.4 and Fig. 5). The results showed significant differences between groups.

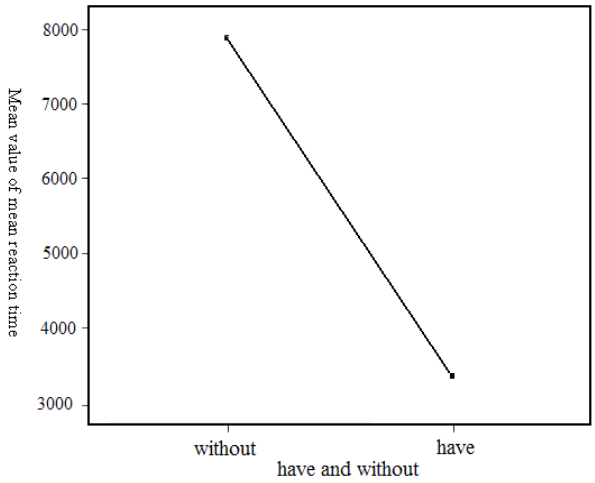

Fig4. *Reaction time of problem solving*

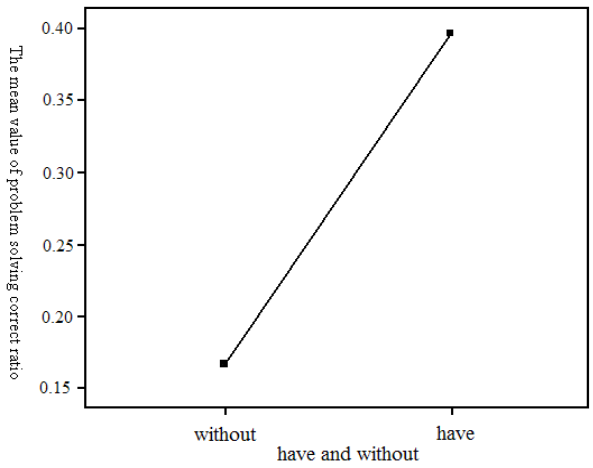

Fig5. *Correct rate of problem solving*

Analysis of the system is described in section 4, followed by the conclusion.

4. DISCUSSIONS

4.1. Self-Creating Situation and Scientific Invention Creative Problem Solving

The experimental results show that, under the experimental conditions of self creating situation, the subjects activate more prototypes, and correct rate of scientific problem solving is higher, therefore, self creating situation contributes to activating prototypes. Statistical results show that two kinds of experimental conditions have a significant difference in the correct rate of problem solving; the correct rate of problem solving was significantly lower than that of self creation of situation group. Creative problem solving is to inspire the thinking. The solution to these problems is not abstract obtained, but only according to the target, the context understanding (heuristic understanding), and the creation of an effective self situation, problem solver are leaded to give up error problem representation and obtain the correct problem representation (Macchi & Bagassi, 2014). That self creating situation helps scientific invention creative problem solving. Therefore, the self creating situation helps to solve scientific problems in the generation process of inspiration thinking. The results show the situation education theory point of view of teacher Li Jilin.

4.2. Self Creating Situation of Scientific Problem Solving and Sample Excitation

Sample excitation is an effective mode of the general problem solving and learning, individuals understand internal structure of problems through mastering the way of common problems solving, this problem solving approach can migrate to similar problems solving, and hints promote problem solving, it shortens the problem solving time (Yi Xinfa et al., 2013; Hattori et al, 2013). To illustrate before creating self situation in scientific problems sample excitation help the subjects to produce analogical transfer mode of thinking and correct problem representation. In other words, the sample stimulation helps participants with effective self creation of situation.

4.3. The Activation Process of Prototype in Scientific Problem Solving

The experimental results show that, by comparison, the reaction time to solve science problem in the condition of self situation creation is shorter than that of no self situation creation. Perhaps once again shows that the activation of prototype is the first stage of prototype enlightenment.

Under the experimental conditions of self creating situation the subjects activated prototype in the previous stage, so reaction time of scientific problem solving will be shorter. Associative ability is the core of creativity, the ability of producing semantic relations content through association is considered to be an important factor with affecting the difference of individual creativity. Creative cognition can be evaluated reliably effective from association behavior (Prabhakaran et al, 2013; Beaty et al, 2014). In this study, based on the situation of analogy Association, subjects activate prototypes. Analogy association may be an important thinking approach to context activation of prototype.

5. CONCLUSION

(1)Scientific problems of self creation of situation have significant effects on the correct rate of solving scientific problems, and correct rate of a scientific problem solving with scientific problems of self situation creation was significantly higher than that in non scientific problem situation creation;

(2)To solve scientific problems, self creating situation of scientific problems has a significant impact on reaction time, and the response time of a scientific problem solving with scientific problems of self situation creation was significantly lower than that of non scientific problem situation creation; the research results show that, the self situation creating contributes to the prototype activation, also helps to solve science problems.

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