Survival Processing Improves Memory of minority primary students
A Research Based on the Unconscious Learning Paradigm and Variance Analysis Methods

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Abstract: This electronic document is a “live” template. The various components of your paper [title, text, heads, etc.] are already defined on the style sheet, as illustrated by the portions given in this document. It is believed that humans tend to have better memory performance under survival conditions, and this survival advantage effect of memory should be beneficial to human survival and reproduction according to evolutionary psychology. In this research, primary school students from the Han ethnic group and special “the directly-entering-socialism ethnic groups” were used as participants, and vocabularies and pictures were used as learning materials. Using the unconscious learning research paradigm and variance analysis methods, the research found that the pupils of the Nu ethnic minority and the Drung ethnic minority, like those of the Han ethnic group, had better memory performance in survival condition than other condition. That is, there was a memory survival advantage effect. In addition, the memory performance of the pupils of the Nu ethnic minority was better than that of the pupils of the Drung ethnic minority and the Han ethnic group on the whole. The participants' memory performance of the picture material was better than that of the vocabulary material.

1. INTRODUCTION

From the perspective of evolutionary psychology, human memory is the product of natural selection and has evolutionary adaptability. Memory is chosen naturally because it produces adaptive behaviors that increase fitness for survival[1]. In other words, the pressure in the evolution process has shaped the relevant characteristics of memory. As the most important pressure in the human evolution process, survival may be the most important factor affecting the characteristics of human memory. The survival advantage effect of memory is the phenomenon that people have better memory performance under survival conditions, which is found in many studies[2]. Survival condition refers to the survival-related scenarios similar to the humans in the main adaptive environment (such as the African savannah) during the evolutionary process, which is set up in experiments. Memory survival advantage effect is an important manifestation of memory adaptability.

At present, the studies of survival advantage of memory used the study - distraction - recall three stages of indirect learning paradigm basically. Without telling participants that they then had memory test, the participants were arranged to study the experiment project (such as word) according to different experimental conditions, then to complete distraction task, finally to recognize or recall projects that they had studied before. In the learning stage, the subjects were asked to evaluate the related degree between experimental items and certain experimental conditions. In different studies [3][4][5][6][7][8][9][10][11][12][13], there were many kinds of experiment conditions specified in the learning phase, including survival situation, the valence judgments, self-reference, moving scene, vacation scene, robbery scene, the urban survival situation, treasure hunt game, hunting game, word classification, activation of vivid stereotype, sleeping out condition, the forgotten condition, etc. In addition, Sandry, Trafimow, Marks and Rice also compared other possible adaptive conditions with survival scenarios, the adaptive conditions including fear, mate selection, close relatives avoidance, fraud awareness, jealousy, adultery, and status acquisition (or maintenance)[14]. Among them, survival scenario referred to asking subjects to imagine that they were trapped in a foreign prairie, in which they needed to find food and water and avoided wild animals to survive. The task of the subjects was to evaluate the correlation between the things referred to the experimental project and survival in this scenario. The process of asking subjects to evaluate words in survival situations was
called survival processing. It was found that the participants had better memory performance in the survival scenario, regardless of whether the control conditions were processing conditions that had been proven to promote memory (such as self-reference) or processing conditions matching the survival scenario in many aspects (such as robbery scenario, mate selection). In other words, it was survival processing that produced a stable memory advantage.

The survival advantage effect of memory is a relatively new field of memory research. Although researchers have made some valuable research results, the research in this field is still in its infancy and many questions need to be studied further. For example, in terms of experimental materials, most of the researches used vocabulary materials, with few pictures of researches, and video materials had not been reported yet. From the perspective of the scope of subjects, the existing studies focused on adults in modern mainstream society and culture, with few studies on subjects of other ages (such as infants, children and the elderly). And there is almost no research specifically on subjects (such as ethnic minorities) in non-mainstream cultures. Moreover, most of the current studies were conducted in the United States, with little cross-cultural verification. Therefore, the cross-cultural stability of the survival advantage effect of memory has not been demonstrated fully.

"The Directly-entering-socialism ethnic groups" refers to the nation that has directly transformed from primitive society to socialist society without democratic reform after the founding of new China. The Nu nationality and the Drung nationality are typical directly-entering-socialism ethnic groups, living mainly in Nuijiang prefecture, Yunnan province. Since ancient times, the people of the two ethnic groups have lived in the mountains, where traffic was blocked and productivity was low. Before and after the founding of the People's Republic of China, they still retained the remnants of the primitive commune system, and its economy was dominated by extensive agriculture based on slash-and-burn farming. Without nationality characters, the Nu nationality and the Drung nationality both have their own unique languages. People of both communities retain many features of the primitive society in their way of life, division of labor and social culture. The people of the major ethnic groups in China (such as the Han nationality) experienced about 4000 years of slave society and feudal society from the primitive society to the new China. The evolutionary view holds that survival is the primary problem facing humans during evolution, and that survival pressures may have shaped the relevant features of memory. Then, people of the Nu and Drung nationality, who have been living in the primitive society, may have experienced different survival pressures in the evolutionary process from the main ethnic groups in China. Could this 4,000-year-old difference directly affect the memory function of the two groups, leading to different memory mechanisms? At present, researches on the survival advantage effect of memory tended to use subjects from mainstream social cultures, verifying the promoting effect of survival processing on memory [15][16][17]. The core issue of this research is whether survival processing could have a similar effect on the memory of the subjects of "the directly-entering-socialism ethnic groups" and the subjects of the main ethnic group (the Han nationality) in China.

In addition, from the perspective of individual development, children can reflect more natural attributes in cognition than adults, less affected by the acquired society and culture. For the survival advantage effect of memory engraved into human genes from evolutionary pressure, it should be an innate memory characteristic, emphasizing the natural nature of cognition, so children are more suitable subjects than adults. Most of the related researches used adults as subjects, and children were rarely been involved. Using Chinese Nu, Drung and Han elementary school students as subjects, this research intends to examine whether survival processing can bring similar memory advantages to them.

Besides, most of researches in this field used words as experimental materials. However, in the course of human evolution, characters appeared later and were less relevant to the theme of survival. This study intends to add picture as experimental material. On one hand, it can improve the ecological validity of the study to a certain extent. On the other hand, it is more suitable for the subjects of the Nu and the Drung without their own characters.

2. RESEARCH METHODS

2.1. Participants

Due to the particularity of the subject group, this research was conducted in a township primary school in the Drung Nu Autonomous County, Gongshan, Nuijiang Prefecture, Yunnan Province, China. A total of 117 participants participated in the experiment. Among them, there were 42 pupils of the Nu ethnic group (21 boys and 21 girls, M=11.5, SD=1.11), 40 pupils of the Drung ethnic group (20 boys and 20 girls, M = 11.3, SD=1.305), and 35 pupils of the Han nationality (19 boys and 16 girls, M=11.17, SD=0.923). All subjects had basic Mandarin communication skills and simple Chinese character recognition. Each subject was tested separately and obtained a gift after the experiment.

2.2. Materials

The experimental materials included vocabularies and pictures. Selected from "Common Words and Phrases in Modern Chinese" (draft), 100 vocabulary materials were common two-word words, whose nature was material noun (such as corn). There were 100 picture materials, which were one-to-one correspondence with the content of these words. The pictures were selected from the Internet and processed uniformly. All the pictures were de-background and the same in size and shade. Before the official experiment, with the help of the Chinese teacher at the school, about six 9-10 years-old pupils (about 3 each from the Nu and Drung races) with poor Chinese scores screened the experimental materials. About 100 vocabularies and pictures prepared in advance...
were shown to them. They were asked to judge whether they knew and understood these words and pictures. During the screening process, once a primary school student indicated that he couldn't understand or was in doubt about a certain word (or picture), the word (or picture) and the corresponding picture (or word) were deleted. After screening, the number of selected vocabularies and corresponding pictures were 42, of which 2 were used as exercises and 40 were used as formal experimental materials.

2.3. Experimental design

In this research, the control condition which compared with the survival processing condition was moving condition, which was used in the classic study of the survival advantage effect of memory commonly. The variable of processing conditions adopted within-subjects design. The living conditions and moving conditions of the two experimental scenarios were set in the same experimental program. Nationality and material were both within-subject variables. That is, a mixed design of 2 (processing condition: survival condition, moving condition) ×2 (experimental material: vocabulary, picture) ×3 (ethnic: Drung, Nu, Han) was adopted in this research. Subjects of different nationalities were randomly assigned to two material programs. Among the 42 Nu subjects, 22 were given the vocabulary program and 20 were given the picture program. Among the 40 Drung subjects, 20 were given the vocabulary program and 20 were given the picture program. Among the 35 Han subjects, 17 were given the vocabulary program and 18 were given the picture program.

2.4. Procedure

The experimental program was compiled by E-prime 2.0 Professional, which was divided into vocabulary program and picture program. The experimental program under each condition included three steps: learning (practice and formal learning), distraction and recall. In order to simplify the operation of the subjects, the results were collected by pen and paper. As mentioned above, processing conditions were within-subject variable, so the learning stage in the experimental procedure was divided into two parts: survival conditions and moving conditions, achieved with different instructions.

At the learning stage, the subjects were first presented with survival (or moving) situation instructions, and then presented with vocabulary (or picture). The presentation time of each word (or picture) was 3000ms. In order to eliminate the order effect of experimental conditions, both the vocabulary program and the picture program presented the survival scenario first to half of the subjects and then presented the moving scenario, and the other half subjects were presented the moving scenario first and then presented the survival scenario. In order to eliminate the sequence effect of experimental material, 40 objects were randomly presented in 20 of the two experimental scenarios under the two experimental procedures.

Considering the understanding degree of the subjects, the instructions presented to the subjects at the learning stage in this research were simplified based on the instructions of survival and moving conditions under the classical research paradigm, making it more suitable for the students. Survival condition: please imagine this scenario - You live on a pristine prairie and have nothing on you. You need to find ways to get food, find water, and escape predators to survive on the prairie. Next, some words (pictures) will appear on the screen. You need to judge whether you need these things in order to survive on the primordial prairie. If you think you need it to survive on the prairie, write "✓" on the paper. If you don't think you need it to survive on the prairie, write the"×" on the paper. Moving condition: please imagine this scenario - You will move to a strange place and have nothing on you. To move and move on, you need to make some preparations. Next, some words (pictures) will appear on the screen. You need to judge whether you need these things when you move out of town. If you think you need it to move out of town, write "✓" on the paper. If you don't think you'll need it when you move out of town, write "×" on the paper.

The distracting task of this study was to ask subjects to write the multiplication table on paper by hand for three minutes. Then the subjects were asked to recall the words or pictures presented on a computer screen and write them down on a piece of paper. In the vocabulary program, the subjects are asked to write the vocabulary directly. In the picture program, the subjects are asked to write down the contents of the picture. Both programs reminded subjects that if they cannot write characters, it can be replaced by pinyin.

The main experimental flow of vocabulary program in this study is shown in figure 1, and the picture program was similar to it.

![Figure 1: Vocabulary program experiment flow chart](image)

3. RESEARCH RESULTS

The dependent variables examined in this study were the memory scores of the subjects. The test of the subjects' memory performance under the vocabulary program was subject to the unchanged core meaning of the vocabulary. For example, the word "axe" was recalled as "hatchet", ...
which was also regarded as correct answer. The test of the subjects' memory performance under the picture program was subject to the unchanged core meaning of the picture. Take the picture "comb" as an example. The subjects' answer was "comb "or" wooden comb", all of which were regarded as correct answer. The number of items that subjects recalled correctly was the memory score presented in the results.

Since most previous related studies used a single type of experimental material (vocabulary was the majority) to verify the survival advantage effect, the results of the two experimental programs in this research also were presented separately in order to discover whether survival processing had different effects on lexical materials and picture materials.

Table 1 showed the memory performance of subjects from different nationalities under two procedures of vocabulary and picture and the two conditions of survival and moving processing.

**3.1. Vocabulary program results**

The statistical analysis of the results of the experimental program using vocabulary materials showed that the main effect of processing conditions was significant, F(1, 56) = 12.37, p<0.01, ηp2=0.184, and the picture memory results of the subjects under the survival conditions were overall better than moving conditions. The national main effect was significant, F(2, 55) = 19.96, p<0.001, ηp2=0.256. For subjects of the Han nationality, the picture memory performance under survival conditions was significantly better than the moving condition, F(1, 55) = 19.96, p<0.001, ηp2=0.256. For subjects of the Han nationality, the picture memory performance under survival conditions was also significantly better than the moving condition, F(1, 55) = 7.08, p<0.05, ηp2=0.114. See Figure 3.

A simple effect analysis of the results showed that for Drung subjects, there was no significant difference in picture memory scores between survival conditions and moving conditions, F(1, 55) = 1.14, p=0.29. For subjects of the Nu nationality, the picture memory performance under survival conditions was significantly better than the moving condition, F(1, 55) = 12.37, p<0.01, ηp2=0.242. The interaction between processing conditions and nationalities was significant, F(2, 55) = 12.37, p<0.001, ηp2=0.394. According to the post-hoc test results, subjects of the Han nationality had significantly better picture memory performance than subjects of the Drung nationality (MD=3.13, p<0.001). While subjects of the Han nationality and subjects of the Drung nationality showed no significant differences in picture memory scores (p=0.208). The interaction between processing conditions and nationalities was significant, F(2, 55) = 12.37, p<0.001, ηp2=0.242. The post-hoc test results showed that slightly better than subjects of the Han nationality (MD=1.81, p =0.058), subjects of the Nu nationality had significantly better picture memory performance than subjects of the Drung nationality (MD=3.13, p<0.001).

### Table 1. Correct Recall of Experimental Materials Under Survival and Moving Conditions [M(SD)]

<table>
<thead>
<tr>
<th>Material</th>
<th>Nation</th>
<th>Survival</th>
<th>Moving</th>
</tr>
</thead>
<tbody>
<tr>
<td>vocabulary</td>
<td>Dulong</td>
<td>7.2(3.79)</td>
<td>4.35(2.30)</td>
</tr>
<tr>
<td></td>
<td>Nu</td>
<td>8.55(1.56)</td>
<td>6.41(2.54)</td>
</tr>
<tr>
<td></td>
<td>Han</td>
<td>8.00(2.35)</td>
<td>6.18(2.30)</td>
</tr>
<tr>
<td>picture</td>
<td>Dulong</td>
<td>5.85(3.40)</td>
<td>6.40(3.02)</td>
</tr>
<tr>
<td></td>
<td>Nu</td>
<td>10.4(2.23)</td>
<td>8.10(2.10)</td>
</tr>
<tr>
<td></td>
<td>Han</td>
<td>8.17(2.28)</td>
<td>6.72(2.47)</td>
</tr>
</tbody>
</table>

### 3.2. Picture program results

The statistical analysis of the results of the experimental program using picture materials showed that the main effect of processing conditions was significant, F(1, 56) = 7.08, p<0.05, ηp2 =0.226. The interaction between processing conditions and nationalities was significant, F(2, 55) = 12.37, p<0.001, ηp2=0.242. The post-hoc test results showed that subjects of the Han nationality (MD=1.81, p =0.058), subjects of the Nu nationality had significantly better picture memory performance than subjects of the Drung nationality (MD=3.13, p<0.001). While subjects of the Han nationality and subjects of the Drung nationality showed no significant differences in picture memory scores (p=0.208). The interaction between processing conditions and nationalities was significant, F(2, 55) = 12.37, p<0.001, ηp2=0.242. The post-hoc test results showed that slightly better than subjects of the Han nationality (MD=1.81, p =0.058), subjects of the Nu nationality had significantly better picture memory performance than subjects of the Drung nationality (MD=3.13, p<0.001). While subjects of the Han nationality and subjects of the Drung nationality showed no significant differences in picture memory scores (p=0.208). The interaction between processing conditions and nationalities was significant, F(2, 55) = 12.37, p<0.001, ηp2=0.242.

![Figure 2](https://doi.org/10.1051/shsconf/202317101001) The number of words correctly recalled by pupils of the three ethnic groups under the vocabulary program

![Figure 3](https://doi.org/10.1051/shsconf/202317101001) The number of pictures correctly recalled by pupils of the three ethnic groups under the picture program
3.3. Overall results

In general, the average correct rate of recalling the two experimental materials by different nationalities were between 21% and 52%, and the overall memory performance was not particularly good.

The experimental results were analyzed by a 2 (processing conditions: survival conditions, moving conditions) × 2 (experimental materials: vocabulary, picture) × 3 (nations: Drung, Nu, Han) repeated measurement variance analysis. The main effect analysis results were as follows: The main effect of processing conditions was significant, F (1,111) = 47.61, p < 0.001, ηp² = 0.3. The vocabulary memory performance of the subjects under survival condition was better than that of moving condition. The national main effect was significant, F (1,111) =11.85, p<0.001, ηp² =0.176. The results of post-hoc test showed that the memory performance of the Nu subjects was significantly better than that of the Drung subjects (MD = 2.38, p < 0.001) and the Han subjects (MD=1.06, p < 0.05), and the memory performance of the Han subjects was significantly better than that of Drung subjects (MD=0.32, p < 0.05). The main effect of the experimental materials was marginally significant, F (1,111) =3.94, p =0.05, ηp²=0.034, and the subjects' memory performance of the picture materials was slightly better than that of the vocabulary materials.

The results of the interaction analysis were as follows: The interaction between processing conditions and nationalities was not significant, F (2,111) =1.73, p =0.182. The interaction between processing conditions and experimental materials was significant, F (1,111) =6.22, p<0.05, ηp²=0.053. The interaction between ethnic and experimental materials was not significant, F (2,111) =1.34, p =0.27. The interaction of processing conditions, nationalities and experimental materials was significant, F (2,111) =5.44, p =0.01, ηp² = 0.089.

Further simple effects analysis showed that: In the vocabulary program, the Drung subjects had better memory performance in the survival condition than the moving condition, F (1,111) =23.94, p<0.001, ηp² =0.177. And in the picture program, there was no significant difference in memory scores between survival conditions and moving conditions, F (1,111) =0.89, p =0.347. In the vocabulary and picture program, subjects of the Nu nationality had better memory performance in the survival condition than the moving condition, with the results F (1,111) =14.80, p<0.001, ηp² =0.118 and F (1,111) =15.59, p<0.001, ηp² =0.123 respectively. In the vocabulary program and the picture program, subjects of the Han nationality had better memory performance in the survival condition than the moving condition, with the results F (1,111) =8.33, p<0.001, ηp² =0.070 and F (1,111) =5.53, p<0.05, ηp² =0.047 respectively.

4. DISCUSSION

4.1. Memory Advantages of Survival Processing

The results showed that the main effect of processing conditions was significant. The overall memory performance of the subjects was better in survival conditions than the moving condition, which proved that survival processing brought memory advantages. That is, the existence of memory survival advantage effects was verified. This result was consistent with the results of many studies [18]. This showed that although the "the directly-entering-socialism ethnic groups" had been quite different from the Han nationality in the process of social development for more than 4,000 years, they still had similar performance with the Han nationality in the cognitive mechanism. From an evolutionary perspective, cognitive shaping may take longer, and differences in survival over thousands of years were not enough to alter memory mechanisms. The results of this research further proved the universality of the memory survival advantage effect. In other words, whether it is "the directly-entering-socialism ethnic groups" or other nations, we are still thinking about the current problem with the brains shaped in the primitive times.

Specifically, the subjects of the Nu and Han nationalities, regardless of the memory of vocabulary materials or the memory of picture materials, showed the memory advantage brought by survival processing. However, subjects of the Drung nationality only showed the survival advantage effect of memory in the memory of vocabulary materials, without showing this advantage in picture memory. The differences in vocabulary and picture materials among subjects of the Drung nationality might be related to the picture recall method used in this research. In this research, the memory effect was examined using recall scores. Recalling pictures required subjects to convert the picture content into vocabulary. Did this memory conversion affect the internal mechanism of memory to some extent, leading to deviations in memory results? At present, there are few studies on the conversion of memorization materials and memory test methods, and the specific mechanism of action is unclear.

4.2. Ethnic differences

In terms of the memory performance of the three ethnic groups, the main effect of nationality was significant. The memory performance of the Nu nationality was better than that of the Drung nationality and the Han nationality, while the Han nationality was slightly better than that of the Drung nationality. This may be related to two reasons: The first reason is the deviation of sample. This research was conducted in a township primary school in Gongshan Drung Nu autonomous county, Nujiang prefecture, China. The students of this school belonged to a large ethnic group. Accounting for more than 40% of the total number of students, the students of the Nu nationality were the mainstream ethnic group in the school in terms of number,
while both Drung students and Han students were less than 5%. In this context, the students of the Nu nationality might have a dominant advantage in communication and mutual assistance with other ethnic groups. Therefore, students of the Nu nationality in this school may be better than students of the Drung nationality and the Han nationality in cognitive development to some extent, which led to the fact that students of the Nu nationality in this research generally had better memory performance than students of the Drung nationality and the Han nationality. The second reason is the ethnic differences in social development. Although Nu nationality and Drung nationality are both “the directly-entering-socialism ethnic groups”, Drung nationality is relatively backward in economic and cultural development and population scale. Lagging in the process of historical development of productive forces relatively will lead to the relatively backward cultural development. The experimental procedure and the way of memory test which this research adopted were presented both in mandarin and Chinese characters. For subjects of the Drung nationality, understanding these contents may occupy more cognitive resources, resulting in less cognitive resources for memory. It could be most important reason for students of the Drung nationality who were weak in memory in this research.

4.3. Advantages of Picture Memory

In terms of the memory performance of different experimental materials, the main effect of experimental materials was marginally significant, and the subjects' memory performance of picture materials was slightly better than that of vocabulary materials. This result was consistent with the picture-superiority effect in memory research[19]. In this research, subjects of the Nu nationality and the Drung nationality showed an advantage in memory of picture materials, which may be due to the fact that the two ethnic groups have no written language in their long national development and only have a short history of using character for several decades. Therefore, the subjects were better at cognitive processing of picture materials and thus had a better memory performance.

5. CONCLUSION

Survival processing of experimental materials can produce better memory results than other processing conditions. The survival advantage effect of memory had been verified in primary school students of the Han nationality and" the directly-entering-socialism ethnic groups", reflecting that people of the "the Directly-entering-socialism ethnic groups" and people of the Han nationality had similar performances in the cognitive mechanism, which further proved the universality of the memory survival advantage effect. In addition, the memory performance of the pupils of the Nu nationality was better than that of the Drung and the Han nationality, and the three subjects had better memory of the picture material than the vocabulary material on the whole.

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