THE INFLUENCE OF SCHEMA ACTIVATION IN RECALL OF MEMORIES IN ADOLESCENTS: AN EXPERIMENTAL PSYCHOLOGICAL INVESTIGATION

XinYi Huang

Guangdong Country Garden School, Foshan 528300, Guangdong, China.
Corresponding Email: xinyihuang2023@163.com

Abstract: Schema attracts increasing highlights among scholars due to its impacts on memories in adolescents. This study aims to examine the accuracy of short-term memory of Chinese adolescents and whether students receiving an activation of the schema and students without activation have similar performance in recalling a story. With a series of objective test items in the psychological experiment of schema activation, it is found that visual aids display strongly positive influence on the recall although its effectiveness is not totally acceptable. This research contributes to the improvement of memorization methods and accuracy of adolescents.
Keywords: Schema; Adolescent; Recall of short-term memory; Experimental psychology

1 INTRODUCTION

Schema refers human mental categorization of information due to previous experience, which can be can be used to deal with the present situation [1]. Specifically, schema helps people explain the new information on the basis of existing knowledge; it also implies the mechanism of how stereotype affects people's behavior; additionally, schema explains what people are likely to recall or forget in daily issues [2].

Schema can be activated by connecting old mental representation to new information which facilitates to effectively deal with the upcoming tasks. Research has found that once the schema is activated, humans are more likely to recall the consistent information [3].

In the previous study, four different experiments were completed from different gender to try to demonstrate which factors (e.g. context, repetition, topics) affected people's encoding and recall of memory [4]. They listed about three to five possible factors and created different conditions and grouping for each test, resulting in ranking of degree of impact for each study [4]. The first experiment tested for two items: comprehension rating and recall. Divided to 5 groups, 50 participants of male and female from high school were asked to retell a story recorded in a radio after listening in 5 unique conditions and their extent of recalling accurately would be calculated. Two groups just simply heard the story; one was given a contextual picture before hearing and one given after; and the other was given only part of the context [4]. Based on these data, they got the results: firstly, comparing to given no context, receiving partial context before and context after and hearing the story for two times had weeny effect recall of the story; secondly, context before group do work as a medium that helps association and stimulation, leading to easier and more accurate recalling for participants [4]. In this experiment, gender shows little difference in results of recall of story.

Related to the study above, the contextual picture can be seen as a schema activation that might still be a reinforcement of memory. The original study of Bransford and Johnson was completed in 1972, which is about 50 years now. It means that the results are too outdated and might give out a distinct result in modern days even with the same procedure. Thus, the current research would like to replicate Bransford's study on modern youths and trying to figure out the relationship between activation of schema and memory. Moreover, many other confounding variables might also exist nowadays, such as gender and environment. In the past, it was hypothesized that students receiving an activation of the schema perform better in recalling the story (memorize more details and more accurately) than students without activation. Currently, the hypothesis in this study is that students receiving an activation of the schema and students without activation have similar performance in recalling the story (material).

2 METHODOLOGY

An experiment was conducted in this study. The researcher used independent measures design which meant that each group of participants only underwent the experiment once with different conditions. To be specific, the participants were divided into two different conditions, one with and one without activation before the story, and each group of participants only completed the task once. The researcher also tried to reduce the participants variability between the two conditions to try to avoid fatigue. Under this research design, the practice effect could be avoided, meaning that the participants became familiar of a certain task by repeating and therefore did better in the task. After the getting enough participants from the population, participants were allocated into two different conditions by drawing the lots. One condition is that participants were showed a picture about the story as an activation before listening to the recording of the story, and the other condition was participants without the activation.

This experiment employed volunteer sampling which means that all participants volunteer to attend in the experiment. The researcher made posters about the experiment and showed them on school walls or public bulletin board. Moreover, the researcher assigned a letter to invite participants and sent it to social network in school and group chats. The participants might spread in the social network of existed participants. Thus, the progress would be simple and convenient, leading to a relatively large number of participants.

This research recruited a sample of 22 participants from diverse backgrounds, including individuals aged 14-18 (seen in Figure 1), with a relatively balanced representation of genders (seen in Figure 2). Participants should have no known history of memory-related disorders or significant cognitive impairments.
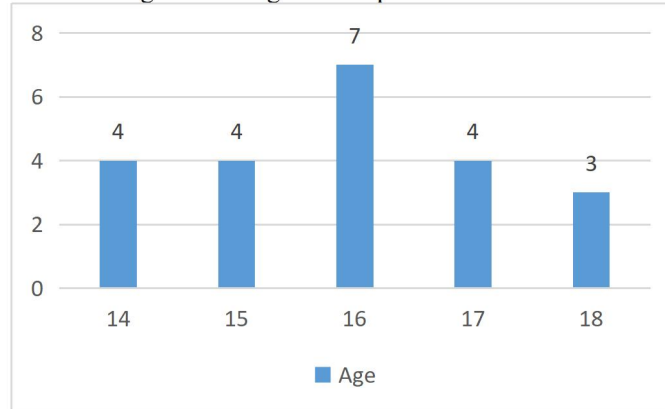
Figure 1 The age of participants
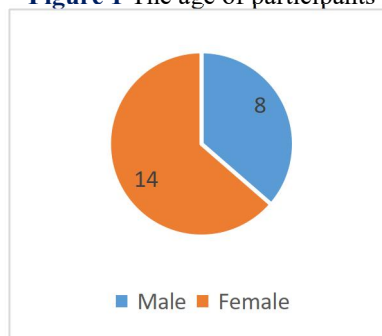
Figure 2 The gender of participants

Possible confounding variables were controlled in this experiment. To begin with, the physical environment of the experiment might influence the memory of participants. The participants in a noisy environment might do worse in memorizing and recalling the story than participants in a quite environment. Thus, the two groups of participants were arranged in two similar quiet classrooms with least distraction. Additionally, the extent of understanding the instructions may also affect their performance in memorizing. To solve this issue, the experimenter double checked with the participants whether they fully understand the instructions. Lastly, the two groups of participants were allotted to do the experiment at same time of the day to assure the similar energy level of participants.

In the study, the researcher prepared stimuli (a picture about the literal material the researcher gave to participants) that were relevant to the neutral stimuli for Group 1 which is the control group. It ensures that the stimuli were carefully designed to activate or not activate the specific schema of interest in the story. In addition, the researcher developed memory tasks that were appropriate for assessing memory accuracy and false memory creation. These tasks would only include multiple choices question and true-or-false questions that involved reconstructing events or details from the recording story. The accuracy of participants answering these questions represented the extent of recalling accuracy.

At the first states of the experiment, considering possible ethical issues, the researcher provided informed consent prior to the experiment and minimized the harm and stress that participants might receive. In the selection of activated visual materials to be used in the experiment, the researcher avoided bloody violence or material that was likely to cause participants to receive strong stimulation. Then, the participants were assigned randomly to two conditions just as described above. The experiment group (hereafter Group 2)-the group of participants that were provided an activation-were shown a picture for a few minutes. After the picture were well hidden, the same recording was played about a certain daily story. The participants received a paper including the questions then and had 8 minutes to answer all the questions. Lastly, the experimenter collected all the papers and explained the purpose of experiment to all the participants (debriefing). The same progress was done with the control group except that the participants in the control group did not have the chance to see the picture (visual activation). The researcher analyzed all results from the papers using statistics methods after the experiment.

3 RESULTS

The Group 1 mentioned below includes participants who did not see the schema picture, with 13 participants in total. Besides, the Group 2 are those who saw the schema picture and there are 9 participants in this group.

3.1 Directions in Space

The study's spatial recall component focused on three questions (Q1, Q5, and Q10) that required participants to recall directions within the described space. For Q1, which asked about the location of the Smith family's house, Group 1 had a 54% accuracy rate, with 7 out of 13 participants providing the correct answer. In contrast, Group 2 demonstrated a significantly higher accuracy rate of 89%, with 8 out of 9 participants correctly identifying the house's location.
The next question (Q5) in this category inquired about the position of the street relative to the living room. Group 1's accuracy rate was markedly lower at 18%, with only 2 out of 13 participants answering correctly. Group 2, however, showed a substantial improvement, with 67% accuracy (6 out of 9 participants).
The final spatial recall question (Q10) was a multiple-choice question about who usually occupies the left corner of the living room. Group 1's accuracy rate was 18%, with 2 out of 13 participants providing the complete correct answer. Group 2 again outperformed, with 56% accuracy (5 out of 9 participants).
These results suggest that the presence of a schema picture enhances participants' ability to recall spatial directions significantly and consistently, as evidenced by the higher accuracy rates in Group 2.

3.2 Numerical Recall

The numerical recall component of the study included questions that tested participants' ability to extract and recall numerical information from the narrative. In brief, this experiment designed seven items (Q3, Q6, Q7, Q12, Q13, Q14 and Q15) to test the effects on the numerical recall.
Based on the data of four items, Group 2 performs better than Group 1 more or less. For Q3, which asked about the number of people in the family portrait, Group 1 had a 62% accuracy rate (8 out of 13 participants), while Group 2 had a 67% accuracy rate (6 out of 9 participants). Q6, which inquired about the position of the study room on the second floor, saw Group 1 with a 54% accuracy rate (7 out of 13 participants) and Group 2 with a 67% accuracy rate (6 out of 9 participants). Q7 and Q13, which tested participants' recall of specific details about the living room's ceiling height and the floor number of the Smiths' bedroom, respectively, showed Group 1 with accuracy rates of 85% and 38%, while Group 2 had rates of 89% and 67%. These results indicate that Group 2 participants were generally more accurate in recalling numerical details.
However, when it comes to a true/false question about the number of guest rooms (Q12), it resulted in a 92% accuracy rate for Group 1 (12 out of 13 participants) and a 67% accuracy rate for Group 2 (6 out of 9 participants). The sharp gap is found and Group 2 becomes worse than Group 1.
Furthermore, Q14 and 15, which involved more complex recall and summarization of numerical information about the number of tables and chairs in the living room, saw Group 1 with accuracy rates of 69% and 77%, respectively. However, Group 2 had a higher rate at 78% (Q14) but much lower accuracy at 44% (Q15). The result of both groups in these questions suggests that the complexity of summarizing and recalling numerical details presented a challenge, and even with the aid of a schema picture, the improvement is not stable.
In numerical recall, Group 2 generally outperformed Group 1, indicating that schema pictures aid in the recall of numerical information. However, the effectiveness varied with the complexity of the task, although the differences were less pronounced than in the spatial recall category.

3.3 Adjectives

The study also examined the recall of descriptive adjectives via the test of three questions, namely Q2, Q18 and Q21.
For Q2, which asked about the material of the coffee table in the Smith family's living room, both Group 1 and Group 2 achieved a 100% accuracy rate, indicating that this detail was easily recalled regardless of the schema picture.
Q18, which inquired about the type of staircase leading to the second floor, had Group 1 with a 77% accuracy rate (10 out of 13 participants) and Group 2 with a perfect score. This indicates that the schema picture provided a clear visual cue, enhancing memory recall.
Q21, concerning the short or long length of the corridor leading to the kitchen, saw Group 1 with a 54% accuracy rate (7 out of 13 participants) and Group 2 with a 33% accuracy rate (3 out of 9 participants). This suggests that the absence of a schema picture may have hindered participants' ability to recall this specific detail.
To sum up, the positive impacts of a schema is not very obvious in terms of descriptive adjectives. The possible explanation is adjectives are not explicit in the schema picture and the young reader are not skilled at receiving this implicit information.

3.4 Inclusion of Details

The study looked at the recall of included details through two multiple-choice questions.
The first one is Q8, which asked about the contents of the basement, none of the participants in Group 1 answered fully correctly, while 44.4% (4 out of 9 participants) in Group 2 did. This significant difference highlights the beneficial effect of schema pictures in recalling a comprehensive list of items.

The other one is Q9, concerning potential food items on the coffee table, saw 15.4% (2 out of 13 participants) in Group 1 and 44.4% (4 out of 9 participants) in Group 2 answer fully correctly. The higher rate in Group 2 suggests that schema pictures can aid in recalling a variety of detailed items.

Hence, it can be seen that the image schema helps the young remember inclusion of details a lot. The stable progress in recalling in the two items above approves the employment of schema in the young people's learning.

3.5 Personal Preferences

The study also examined the recall of preferences via the test of several questions (Q4, 11, 16, 17, 19, 20, 22, 23, 24, 25).

For question 11, which asked about Mr. Smith's preference for tea, Group 1 had a 61.5% accuracy rate (8 out of 13 participants) and Group 2 had a 55.6% accuracy rate (5 out of 9 participants). The complexity of the information and susceptibility to interference seem to have led to a lack of attention to detail in checking.

Question 17, inquiring about Sarah's love for listening to pure music and doing homework, saw Group 1 with a 69.2% accuracy rate (9 out of 13 participants) and Group 2 with a significantly lower 33.3% accuracy rate (3 out of 9 participants). This suggests that the schema picture may have helped Group 1 to a slight extent.

For question 19, regarding the youngest daughter's love for economic magazines, Group 1 had a 61.5% accuracy rate (8 out of 13 participants) and Group 2 had a slightly higher 66.7% accuracy rate (6 out of 9 participants). Question 20, about the children's preference for staying home, saw Group 1 with a 53.8% accuracy rate (7 out of 13 participants) and Group 2 with a 55.6% accuracy rate (5 out of 9 participants). Question 23, concerning Mrs. Smith watching sunsets, had Group 1 with a 30.8% accuracy rate (4 out of 13 participants) and Group 2 with a 33.3% accuracy rate (3 out of 9 participants). These results indicate a slightly better performance for Group 2, suggesting that the schema picture provided some assistance.

In stark contrast, question 4, a single-choice question about who likes playing the piano the most, had Group 1 with a 69.2% accuracy rate (4 out of 13 participants) and Group 2 with an impressive 88.9% accuracy rate (only 1 out of 9 participants made an error). Question 16, about Mrs. Smith's liking for makeup, saw Group 1 with a 76.9% accuracy rate (10 out of 13 participants) and Group 2 with a perfect score. Question 22, inquiring about Mr. Smith's preference for sitting in an armchair and reading newspapers, had Group 1 with a 76.9% accuracy rate (10 out of 13 participants) and Group 2 with an 88.9% accuracy rate (1 was wrong). Question 24, concerning Timmy's fondness for watching documentaries, saw Group 1 with a 69.2% accuracy rate (9 out of 13 participants) and Group 2 with a 77.8% accuracy rate (7 out of 9 participants). Lastly, question 25, about the youngest daughter reading novels in the study room, had Group 1 with a 53.8% accuracy rate (7 out of 13 participants) and Group 2 with a significantly higher 77.8% accuracy rate (7 out of 9 participants).

In summary, the schema appears to have a positive impact on the recall of preferences, particularly when the information is reinforced by visual cues in the schema picture. The length of the sentence seems to interfere with memory, but overall, the schema picture aids in enhancing memory recall.

4 DISCUSSION

The study's findings underscore the significant role of schema pictures in enhancing memory recall, particularly in spatial directions and numerical details. Group 2, exposed to schema pictures, performed better than Group 1 across most questions, suggesting that the schema (visual aids) substantially improve recall accuracy. This finding is consistent with a previous study which found that schema is helpful in memorizing complex information's details and accuracy [5]. Similarly, another empirical research also approved the effectiveness of schema in memory [6].

However, the effectiveness of schema pictures was less consistent in recalling descriptive adjectives and personal preferences, indicating that the complexity and nature of information impact the utility of visual cues. This limitation of effectiveness is also reflected in the processing social information is easy to be disturbed in memory although the visual aid exists [7]. This result also testifies the argument that personally relevant descriptive information is not always enhanced by schema in memory [8].

Specifically, in this study, Group 2's performance declined in questions requiring complex numerical counting and operating, highlighting the need for further exploration into how schema pictures can be optimized for various types of memory tasks. This result is in line with the research which suggests the impact of schema on memory for non-schematic information in the young is variable and depends on the specific category of test items [9]. Moreover, the narrative language, driven by ID3 algorithm and node optimization, becomes crucial in recalling the information [10]. Generally, the memory behaviour is positively related to schema [11]. In brief, this study suggests that schema pictures are a valuable tool in memory enhancement but their impact varies with the intricacy of the information being recalled.

5 CONCLUSION

This empirical research carried out an experiment to test the instant recall performance of Chinese adolescents in memorizing the detailed description of the home scenario with the help of static schema. Based on the participants' data, this research quantitatively analyzed five types of memory information, including space directions, numbers, adjectives, inclusion of details and each individuals' interests. To be conclude, the hypothesis mentioned in the introduction is supported. The schema is obviously beneficial in the young's memory, and improves the accuracy of some details.

This research is limited in the scope of sample size due to the time limit and location. However, the findings provide insights into the psychological studies and adolescent development with the first-hand data. For future work, it is recommended to conduct more exact experiments with dynamic images and continue to explore the long-term memory performance.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

REFERENCES

[1] Bern S L. Gender Schema Theory and Its Implications for Child Development: Raising Gender-Aschematic Children in a Gender-Schematic Society. Signs, 1983, 8(4): 598-616.

[2] Armbruster B. Schema Theory and the design of content-area textbooks. Educational Psychologist, 1996, 21: 253-276.

[3] Tse D, Rosamund F, Langston, MK, et al. Schemas and memory consolidation. Science, 2007, 316(5821): 76-82.

[4] Bransford J D, Johnson, M K. Contextual prerequisites for understanding: Some investigations of comprehension and recall. Journal of verbal learning and verbal behavior, 1972, 11(6): 717-726.

[5] Brady T F, Konkle T, Alvarez, G A. A review of visual memory capacity: Beyond individual items and toward structured representations. Journal of vision, 2011, 11(5): 4.

[6] Hastie R. Schematic principles in human memory. In E. Tory Higgins, C. Peter Herman, Mark P. Zanna (eds.), Social cognition, Routledge, 2022, 39-88.

[7] Lord C G. Schemas and images as memory aids: Two modes of processing social information. Journal of Personality and Social Psychology, 1980, 38(2): 257-269. DOI: https://doi.org/10.1037/0022-3514.38.2.257.

[8] Ferguson T J, Rule B G, Carlson D. Memory for personally relevant information. Journal of Personality and Social Psychology, 1983, 44(2): 251-261. DOI: https://doi.org/10.1037/0022-3514.44.2.251.

[9] Webb C E, Dennis N A. Memory for the usual: the influence of schemas on memory for non-schematic information in younger and older adults. Cognitive Neuropsychology, 2020, 37(1-2): 58-74.

[10] Jiang Wangmeng, Ma Qiang. English teaching system design based on ID3 algorithm and node optimization. PeerJ Computer Science. 2023, 9: e1486. DOI: https://doi.org/10.7717/peerj-cs.1486.

[11] Cockcroft J P, Berens S C, Gaskell M G, et al. Schematic information influences memory and generalisation behaviour for schema-relevant and-irrelevant information. Cognition, 2022, 227: 105203.