The Effects of Different Positions of Visual Aids on Memorization

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Abstract: As scientists researched how to improve people's memory, they found that visuals stick in people's brains stronger than words do. Nevertheless, the question is how can we arrange the visual aids so the position of the visual aids is effective in improving memory. An experiment is conducted using Psychopy. The participants are going to memorize words and do a simple recognition task. The different position of visual aid is the altered variable between the 3 experiment groups. The results show a strong correlation between visual and linguistic perception. In the future, this experiment can be taken further deeper into this topic, or people can apply the results in real life.

Keywords: Memory, Visual Aids, Visual Memory, Short-Term Memory

1.   Introduction

Three core notions that should be introduced for this study need to be defined for a clearer representation of the final research paper. Short-term memory (or "primary" or "active memory") is the capacity for holding, but not manipulating, a small amount of information in the mind in an active, readily available state for a short period [1]. Visual aid is an item of illustrative matter, such as a film, slide, or model, designed to supplement written or spoken information so that it can be understood more easily [2, 3]. Attention is used to describe the mental faculty of considering or taking notice of someone or something [4, 5].

This article chooses to do this research because it is very commonly seen in real life, and I would like to know the scientific principles behind it. By doing this research and experiment, we can know the most effective way of utilizing visual aids to help with short-term memory. Therefore, we can improve our memory and increase our working or studying efficiency. Furthermore, this experiment can be set as a foundation for many experiments that digs deeper into this topic. Most importantly, this experiment is very easy to set up and does not require a lot of time for the participants to finish.

Before people study how visual aids help with memory, we need to know how visual memory is formed. First, the stimuli hit the eye as a form of light. Then, the retina in the back of an eye detects the stimuli as a form of neurochemical event. Next, the transducers on the retina transferred these neurochemical stimuli into impulses. Rods and cones are examples of transducers in the eyes. Rods are sensitive to low light while cones are sensitive to color. The impulses were sent to the brain for decoding information. When visual information is processed in the brain, there are two streams of a working unit. The dorsal stream decodes the position of the stimuli. The ventral stream decodes the

characteristics of the stimuli. The two streams work parallelly, so one stream does not have to wait on the other stream to decode information [6].

Visual memory is supported by a feeling of seeing this memory, but the memory is represented by a visual in the brain [7]. That is part of the reason why visual memory is more powerful than only memorizing words—it contains a type of feeling! The visual memory is not only a visual, it also contains the context in which the memory is formed.

For better efficiency when working and studying, scientists have long been trying to find methods to improve people's memory. By conducting experiments, they found that people memorize concepts better when studying with a visual aid. For example, the teachers in schools teach with PPT slides. Visual aids are used in lots of situations to aid in studying and delivering information [8]. According to research, "Adding an illustration or graphic to the mix enhances retention by 20 percent while adding graphics and illustrations and reinforcing them with an activity can improve memory by 32 percent over the baseline" [9]. This data shows how visual aids can improve memory retention significantly.

Scientists have also investigated the development of the attention system and working memory. They have studied the early development of the human attention system—the attention system of infants. They stated how the sensation process of the infant works, which "infants will continue to look at a stimulus until it is fully encoded, at which point attention will be shifted toward novel information in the surrounding environment" [10]. The time they take to encode information would decrease when they get old. They have found that the brain trains the eyes to remember how to control the eyes for attention, rather than by directly controlling them itself, which means that eye fixation is an involuntary action. Therefore, eye fixation and attention are very important in the encoding of information and improving short-term memory.

In this study, I have also investigated the concept of the dominant eye. Because the layout of the picture will be taken into consideration for the accuracy of memory, the meaning of the position of the pictures relative to the participants' eyes will be very important. The dominant eye is defined as the eye which takes the major role in the performance of seeing. It usually affects the visual consciousness more than the other eye. According to studies, "Your chosen eye for these and other monocular (one-eyed) tasks is typically the dominant one. Eye dominance usually matches handedness—that is, you are more likely right-eye dominant if you are right-handed, for example" (Porter). Since all of the participants of my experiment are right-handed, they are more likely to have their right eye as the dominant eye. In the second experiment group, I designed to put the image on the right side of the word, which is the side with their dominant eye. We will see if this plays a role in the results of the experiment.

Generally, the literature view on this topic remains consistent, and they all agree that visual aids can help with memory. By using this principle as the foundation of their studies, many scientists conduct experiments that dig deeper and more specifically into the area. For example, people researched the help of visual aids in different application situations. Based on these previous papers, I get background information for my topic, helping me to form my predicted results. Next, I will investigate three papers in depth and analyze how they contribute to my study.

2. Literature Reviews

2.1. Visual-spatial Attention Aids the Maintenance of Object Representations in Visual Working Memory

This article analyzes the spatial rehearsal mechanism in the brain for visual short-term memory. Williams and his coworkers designed 3 experiments to analyze the relationship between them. The first one is to track the participants' eye movements when remembering objects. The results they

found were that the participants still look at the position where the object was during the recall section. They developed two important findings in their result, "First, the participants were better at detecting changes in the colors of memoranda when they were allowed to make eye movements during the retention interval. Second, when participants were instructed that they were free to move their eyes naturally, they fixated on the spatial locations previously occupied by objects in the memory array during the blank retention intervals" [10]. The first experiment proves their hypothesis of the spatial rehearsal mechanism theory.

The second experiment is to ask the participants to focus on the fixation point and memorize a set of objects. Later they would ask the participants to identify the change in the set of objects. The results are that the accuracy of detecting the change decreased during this experiment. Their findings "showed how an index of overt visual–spatial attention can be used to study how selective processing aids the maintenance of object representations in visual working memory" [11]. This quote shows that the spatial rehearsal mechanism theory is very important in studying the relationship between visual aids and working memory.

In the third experiment, they found that the participant's ability to maintain visual memory was interfered with by attending to the fixation point. This is important because it proves that the spatial rehearsal mechanism can aid visual working memory.

This contributed to this paper such that the attention is directed to the location where the picture is. At the same time, this action leads to the maintenance of the memory. Therefore, we need to make sure that the picture is not distracting the memory.

2.2. Patient's Memory for Medical Information

When people listen to the doctors' information about how should they treat their disease after they get home, they are always quite impatient and would forget the information quickly. According to research, "40–80% of the medical information provided by healthcare practitioners is forgotten immediately" [12]. This paper focused on developing the most effective way to deliver medical information to patients.

The paper suggested that old people have a greater chance of forgetting medical information due to impaired capacity to deal with unstructured information. It also examined the relationship between stress and memory loss. By researching and conducting experiments they found that "two phenomena are especially relevant in clinical settings—namely, attentional narrowing and state-dependent learning" [12]. They found that more medical information can be remembered when the patients are more stressed about their disease. They also studied the perceived importance of medical information. They emphasized the importance of putting the instruction in the most important position when talking to the patients. They found that explicit categorization of medical information increase memory. At last, they stated that visual aids are very important in increasing the patients' memory, "In addition, spoken information should be supported with written or visual material. Visual communication aids are especially effective in low-literacy patients" [12]. This emphasizes the importance of visual aids when delivering medical information to patients.

This paper is useful to my study because it states the importance of visual aids when communicating complex and overwhelmingly-much information. It also provides a potential application of my study result which makes my study more meaningful. Other than the information related to my study, it also teaches me a lot of new concepts and principles about short-term memory. This knowledge can be conducted in future studies or extensions of this project.

2.3.   Using Visual Aids as Authentic Material in ESL Classrooms

As English becomes the common language among all people in the world, more and more people who are not English native speakers developed the need for studying English. This paper analyzes the importance of visual aids when teaching English to people who have English as their second language. First, it talks about audio-visual aids in ESL (English second language) classrooms. Teachers are required to use images and videos to make the class authentic. These visual aids increase the interactions between teachers and students. As the author has stated, "Visual medium is the most powerful medium to propagate ideas and influence minds. Visual aids like movies in particular exercise an appeal on the collective imagination of youth across countries and cultures". As this proves the power of visual aids to human cognition, the paper goes on to talk about the types of visual aids and their function. Pictures help the students to visualize the language they see. Films and movies with subtitles can also help the students focus on the images and the words at the same time. They would be more appealing and easier to understand for those ESL students. Powerpoint slides are also a powerful visual aid. It can condense the information into several bullet points which can help the students understand and memorize. It is also the most effective in its organization.

This paper is helpful because it lists out several different types of visual aid and their function. With the help of this paper, I compared those types of visual aids and decide on the type of visual aid I would use for my experiment. I eventually chose pictures because this experiment is only testing short-term memory, so there is no need to insert movie clips into my psychopy. This is not convenient and wastes time. On the other hand, this paper also provides a potential application of my experiment results.

3.   Questions and Hypothesis

From the above investigation, we can conclude 3 things about this topic. First, the spatial rehearsal mechanism can help with the maintenance of visual memory. Second, visual aids are commonly used when doctors are trying to express medical information to patients. Third, different kinds of visual aids are used in ESL classrooms to help with linguistic studies.

To sum up, of the background information and the critique of the 3 papers, our goal right now is to make sure that our attention is focused on the information that we need to memorize. At the same time, we will try to use visual aids to help us improve our short-term memory. This is a bit conflicting because if we make sure our attention is focused on the words we need to remember, why do people study better when using visual aids? When we look at the visual aids and the words at the same time, isn't our attention divided to achieve the two tasks? Therefore, we need to find the most effective way to combine these two principles. We need to find a way to display the visual aids that will not distract the memorization of the words. This leads to my essential research question: what is the most appropriate layout of the visual aids to maximize the improvement of people's memory?

According to previous sessions and my outside research, the hypothesis is that when studying with related visual aids, a human's short-term memory is the most effective. All the other types of visual aids will distract the quality of short-term memory.

4.   Methods

The experiment would contain 3 experiment groups. Each group contains 5 people who are English native speakers. The groups will see 10 words with a visual aid and later recognize the 10 old words from a group of 20 words. During the studying stage, the participants will see a fixation for 0.5 seconds to make sure that their attention is focused on the middle of the screen. Then, they will see the words with the picture for 3 seconds each. In the recognition phase, participants will see the words

on the top of the page. They will have three choices: old, new, or not sure, written on the bottom. Participants will press 'o', 'n', or 's' on the keyboard for the answer.

The independent variable I change is the position and layout of the visual aid with the words. The first group has an image on the right of the word. The image size is 0.4*0.4 in Psychopy, and the coordinate is (0.2, 0). The coordinate of the words is (-0.2, 0). The second group has an image on the right of the word. The image size is 0.4*0.4 in the Psychopy, and the coordinate of it is (0, 0.2), while the words are at (0, -0.1). The third group has the words in the middle of the image. The words are in black ink so that the words stand out from the images below. The images have dimensions of 0.4*0.4 and the coordinate is (0, 0). The words are also at (0, 0).

5. Results

There are two variables that I will be measuring and recording in this experiment. One is accuracy, whether the answer they choose matches the fact. One is their reaction time. I would use correctly as number '1', and incorrect answers as '0' in the excel sheet. For "not sure", I would take it as 0.5 because they are better than being sure about a wrong answer. I would calculate the means for each experimental group in the excel sheet. Accuracy can directly show the effectiveness of visual aid. According to my processed data, 5 people in experiment group number 1 have an accuracy of 0.9, 0.975, 1, 0.925, and 0.8 each. The average for them is 0.92.

Table 1: The Accuracy of Memorization for Experiment Group 1.

	Jack	Freya	Joy Yu	Joy Tang	Lucia	
Shirt	1	1	1	1	1	
Juice	1	1	1	1	1	
Apple	1	1	1	1	1	
Hands	1	1	1	0.5	0	
Paper	1	1	1	0	1	
Green	1	1	1	1	1	
Earth	1	1	1	1	1	
Tiger	1	1	1	1	1	
Cloud	1	1	1	1	0.5	
Glass	1	0.5	1	1	1	
Snake	1	1	1	1	1	
Clock	1	1	1	1	0.5	
Dress	1	1	1	1	0	
Mouse	1	1	1	1	1	
Chair	1	1	1	1	0	
Shark	1	1	1	1	1	
Books	1	1	1	1	1	
Knife	0	1	1	1	1	
Bread	1	1	1	1	1	
Table	0	1	1	1	1	
Mean	0.9	0.975	1	0.925	0.8	0.92

For the second experiment group, 5 people got accuracies of 0.9, 0.95, 0.95, 0.95, 0.95 each. The average for them is 0.94.

Table 2: The Accuracy of Memorization for Experiment Group 2.

	Gabi	Ida	Zhao	Yiwi	Tony	
Apple	1	1	1	1	1	
Glass	1	1	0	1	1	
Mouse	1	1	1	1	1	
Bread	1	1	1	1	1	
Green	1	1	1	1	1	
Dress	1	1	1	1	1	
Paper	1	0	1	1	1	
Knife	1	1	1	1	1	
Tiger	1	1	1	1	1	
Hands	0.5	1	1	1	1	
Clock	1	1	1	1	1	
Books	1	1	1	1	0	
Shark	1	1	1	1	1	
Cloud	1	1	1	1	1	
Chair	1	1	1	1	1	
Earth	1	1	1	1	1	
Juice	1	1	1	1	1	
Shirt	1	1	1	0	1	
Snake	1	1	1	1	1	
Table	0.5	1	1	1	1	
Mean	0.9	0.95	0.95	0.95	0.95	0.94

For the third group, the 5 people have 1, 0.95, 0.9, 1, 0.95 as their accuracy. The mean for this group of data is 0.96.

Table 3: The Accuracy of Memorization for Experiment Group 3.

	Ryan	Harry	Alice	Rachael	Stanley	
Apple	1	1	1	1	1	
Books	1	1	0	1	1	
Snake	1	1	1	1	1	
Juice	1	0	1	1	1	
Glass	1	1	1	1	1	
Table	1	1	1	1	1	
Paper	1	1	1	1	1	
Green	1	1	1	1	1	
Shark	1	1	1	1	1	
Knife	1	1	1	1	1	
Dress	1	1	0	1	0	
Hands	1	1	1	1	1	
Shirt	1	1	1	1	1	
Bread	1	1	1	1	1	
Clock	1	1	1	1	1	
Mouse	1	1	1	1	1	

Table 3: （continued）

Earth	1	1	1	1	1	
Chair	1	1	1	1	1	
Cloud	1	1	1	1	1	
Tiger	1	1	1	1	1	
Mean	1	0.95	0.9	1	0.95	0.96

The reaction time indicates the difficulty of the retrieval of the information. The longer the time it takes for a participant to think of an answer, the harder it is to retrieve the memory. The reaction time is all rounded to the nearest hundredths of a second. The first group has a reaction time of 3.10, 2.39, 2.26, 3.43, and 3.03 each. The mean for them is 2.84.

The second group has a reaction time of 2.54, 2.32, 2.23, 3.80, and 2.29 each. The average for them is 2.63. The 5 people in the third group have reaction times of 2.57, 2.34, 1.98, 1.97, and 1.90. The mean for them is 2.15.

Among the three groups, the third group has the highest accuracy for memory. It is also the group with the least reaction time. The result is that the layout with the words in the middle of the image is the best way to improve memory. This result is that the participants see the image and the words at the same time, and both of the information are processed in the brain at the same time. The other two groups have relatively lower accuracy and reaction time. By considering human reaction time (0.2 seconds) in the results, the two groups have similar results. Therefore we can conclude that the top-bottom layout and the left-right layout have a similar impact on memorization.

6.   Discussions and Conclusion

The experiment result can reflect that the visual and linguistic area of perception is related and can affect each other. This demonstrates that people should utilize visual aids correctly and effectively. Many people are visual learners, which means the image sticks in their brains stronger than words do. The best way to utilize visual aids to help to learn is to put the words in the middle of the picture so they can focus on the words and the visual aid at the same time.

However, there are still some limitations to this experiment. For example, this time we take the letters in each word to be constant, but the syllables for each word are not the same. For linguistic perception, maybe syllables are valued more than letters when determining the length of a word. Besides, the old words and the new words are randomly selected. Maybe some new words would be hinting at the answer. For example, if the participants see the word "orange" during the recognition phase, maybe they will recognize that they have seen words with similar characteristics before, thus affecting the experiment result.

Furthermore, the experimental result can be implemented in real life. For example, teachers should use the layout that is the most effective when teaching their students. Linking back to the third paper I investigated, teachers can use PPT slides and movie clips to aid teaching. In the hospital, the doctors can use visual aids to help patients who suffered from amnesia, Alzheimer's disease, etc. People use posters with strong visual appeals to convey ideas and propagate their products. Students can also use the help of images to study for an exam…

To a broader extent, this experiment can be taken further to study more about short-term memory. This time we used concrete nouns. Next time we can try this experiment with abstract nouns and see if the results are still the same. Maybe we can also try it with verbs, adjectives, sentences… Additionally, this time we used visuals as an aid, and maybe next time we can try it with other senses. Audio, smell, touch, etc. There are still abundant interesting things for me to explore on this topic, and beyond this topic.

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