

Effectiveness of visual and auditory learning on memory



ABSTRACT

This experiment was performed to compare the effectiveness between visual learning and auditory learning on short-term memory. Forty subjects were required to read a passage while another forty subjects were asked to listen to a recording of the same passage. After a three-minute filler task, the subjects were required to answer a set of ten questions relating to the passage. Most subjects had higher score for visual learning rather than auditory learning. A statistical z-test was used to compare the mean of these two sets of result. Calculation showed that at 5% significance level, visual learning was more effective in building short-term memory than auditory learning, concurring to the experimental hypothesis. There was sufficient evidence from statistical testing to show that the mean score in memory quiz for visual learning was greater than auditory learning.

(147 words)

NULL HYPOTHESIS

There is no significant difference between the score for visual and auditory memory test.

EXPERIMENTAL HYPOTHESIS

The score in visual memory test is higher compared to auditory memory test.

RESEARCH AND RATIONALE

The purpose of this experiment was to compare the effectiveness of both visual learning and auditory learning on short-term memory.

Memory is defined as the power or process of reproducing or recalling what has been learned and retained especially through associative mechanisms, which include encoding, storing and retrieving. According to Atkinson-Shiffrin Model (1968), human memory can be divided into three major groups, namely sensory memory (SM), short-term memory (STM) and long-term memory (LTM). [4]

Figure 1: Atkinson-Shiffrin Model

(http://www.audiologyonline.com/articles/article_detail.asp?article_id=1403)

(251 words)

Sensory memory is a buffer that captures, for just a moment, all that you can see, hear and feel. In general, sensory memory is the ability of sense organs such as eyes, ears and skin to retain sensory information for a very brief period (less than a second). It can be divided into iconic memory (vision) and echoic memory (hearing). When we focus attention on sensory memory, this moves sensory information into conscious memory which is known as short-term memory. Short-term memory can hold a limited amount of information for about 30 seconds, but it stays longer under continual rehearsal and will eventually converted into long-term memory. [1, 5]

Short-term memory is the temporary memory store used to store and manage information needed to perform complex cognitive tasks. It is formed by brief changes in the synaptic transmissions. It involves the firing of neurons which depletes the Readily Releasable Pool (RRP) of

neurotransmitter vesicles at presynaptic terminals. After the firing slows
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down, endocytosis causes the short-term memory to decay. The memory will disappear if it is not re-activated. Thus, periodically repeated information is needed so that information can retain for a longer period. [8]

Figure 2: Baddeley's model of working memory

(http://www.thefullwiki.org/Baddeley%27s_model_of_working_memory)

(448 words)

Alan Baddeley proposed a more complex working memory model for short-term store. It is an active three-part memory system that temporarily holds information which consists of an executive control central that coordinates the phonological loop (storage for language sound), visuo-spatial sketchpad (storage for visual and spatial information), and the episodic buffer. Working memory is very significant in helping us to solve problems that require reasoning and multitasking. [2, 6]

Long-term memory is the storehouse of the brain where its capacity is enormous and virtually permanent. It can be divided into declarative memory (consciously available) and procedural memory (unconsciously available). However, long-term memory distorts the facts and tends to become less reliable as we age. [1, 7]

Figure 3: The activation of specific sensory cortices during memory retrieval

(<http://www.pnas.org/content/97/20/11125.full>)

A study by Randy L. Buckner aimed to study whether the retrieval of

sensory-specific information will reactivate the regions of sensory cortex.

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The outcome revealed from functional MRI showed that secondary areas in auditory and visual cortex were reactivated when sound and image memories were recalled respectively. Since different regions were activated during information retrieval, visual memory should be different from auditory memory. Figure 3 shows the activation maps during perception of visual objects (a&c) and sound (e) as well as the recall of visual memory (b&d) and auditory memory (f). [9]

(660 words)

A study by Michael A. Cohen examined the inferiority of auditory to visual memory using recognition measure. The experiment was done by testing the ability of subjects to recall the stimuli, for instance sound clips, verbal description, picture or combination of both. Comparison of data showed that recall for picture is better compare to other stimuli. [10] Besides, Cohen also compared auditory and visual memory in musicians who have far better auditory recognition memory. However, the results showed that the memory for auditory stimuli was still inferior to visual object. Thus, it is clear from these results that auditory recognition memory performance cannot be on par with the levels of visual recognition memory. [11]

The outcomes of this experiment could be significant in education, working place and business strategy. Educators should focus on visual teaching by preparing more visual stimulus such as diagrams, slideshows or mind maps to make the lessons more effective and enhance the student memory. Managers should provide a copy of information rather than giving instruction verbally to prevent employee from making error. Moreover, companies

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should provide visual effect when advertising through television or poster rather than via radio so that consumers can remember better of that company.

(859 words)

VARIABLES

Manipulated variable : Type of stimulus (visual or auditory)

Responding Variable : Score in memory test (degree of memory)

Constant Variables : Age and education level of the subjects, period of the test

PLANNING

As stated above, assumption was made that both visual and auditory learning have the same effect on short-term memory, thus all these trials were conducted using only one type of stimulus which is visual stimulus.

Trial 1: Length of the passage

This trial was conducted to find out the most appropriate length of passage for the memory tests. Four subjects were given a passage of 234 words while another four were given a passage of 843 words to read. After that, the subjects were required to answer a set of ten questions related to the passage.

Length of the passage

Memory test score

1st

2nd

3rd

4th

Average

234 words

10

10

10

9

9.75

843 words

5

4

4

5

4.5

Table 1: Results of first trial experiment

From Table 1, subjects' performance is almost perfect in the memory test when dealing with the short passage of 234 words. On the other hand, subjects who deal with the long passage of 843 words answered less than half of the question correctly. Therefore, I decided to use a moderately long passage of around 500 words to obtain an ideal result in the real experiment.

(1086 words)

Trial 2: The necessity of filler task

This trial was done to find out whether a filler task is necessary and its duration before proceeding to the memory quiz. First two subjects were not required to do any filler task (Sudoku puzzle) while the remaining subjects were asked to do the filler task within 2, 3 and 4 minutes respectively.

Duration of Filler Task (minutes)

Score

Average

1st

2nd

Without

8

8

8

2

7

8

7.5

3

6

7

6.5

4

5

5

5

Table 2: Results of second trial experiment

From Table 2, subjects who answered the question without distraction task was slightly higher than those who had done the Sudoku puzzle. Besides, it was noted that the last few questions where the answers were found on the last part of the passage were answered correctly for those without filler task.

Thus, a distraction task is necessary to distract the subjects from rehearsing the information they had just received and answering the question directly without having the information converted into short-term memory. Besides, the duration of filler task was fixed at 3 minutes as it seemed long enough to prevent subjects from rehearsing the newly received information but not too long to cause memory decay.

(1293 words)

Trial 3: Suitable Timeframe

This trial was conducted to investigate the perfect timeframe for the subjects to complete the memory test. Six subjects took part in this trial, with two in a group. They were given a passage that later used in the actual experiment to read and answer ten questions within time limits. The three groups required to answer within 1, 2 and 3 minutes respectively.

Time limit (min)

Score

1st

2nd

Average

1

3

4

3.5

2

5

6

5.5

3

8

7

7.5

Table 3: Results of third trial experiment

From Table 3, the longer the time limit, the higher the score each subjects obtained. The subjects were debriefed after the memory test regarding the time limit given. Those who underwent time limit of 1 and 2 minutes claimed that the time given was too short for them to complete all the questions. Subjects who did the test within 3 minutes claimed that they only manage to complete the questions on time. They felt stressed during the experiment and this might limit the subject's performance. Hence, I decided to leave out the time limit so that subjects can answer the question in a stress-free condition.

The visual stimulus administered was a one-page printed passage that I get from the reference book “ Cambridge Practice Test for IELTS 2”, Test Four, Section 2. On the other hand, the auditory stimulus used was a three-minute recording of the same passage taken from the CD-ROM. A passage was used instead of simple words, number or image recall to mimic real-life situation in work place or in classroom where people were bound to lots of information which they have to remember. This passage consisting of 551 words was chosen as it was designed by an experienced author who written for IELTS reference book and IELTS is a recognised international English testing system. The passage was clear, concise and contained a lot of information and there were questions provided. Besides, the person who produces the tape script has high proficiency in English, thus there will be no complain about the clarity of the tape script.

(1645 words)

METHOD

Random sample of 80 subjects were selected from the Advanced Level students in Intec Education College.

The subjects were divided into two groups that carried out visual and auditory test respectively.

For visual test, each subject was given three sheets of paper beforehand.

(A passage, a memory test of ten questions and a Sudoku puzzle)

For auditory test, each subject was given two sheets of paper beforehand.

(A memory test of ten questions and a Sudoku puzzle)

The subjects were instructed to read the passage and listen carefully to the recording played by a radio inside the classroom once only and try to memorize as much information as they can.

Immediately after the presentation of stimuli, the subjects were asked to complete the Sudoku puzzle as a filler task in 3 minutes to reduce rehearsal.

After that, the subjects were required to do the memory test without a time limit and hand in the answer sheet after they had done.

The scores of each subject from each group were calculated and recorded in a table. A box-plot and a bar chart were drawn to represent the data. Z-test was used to compare the mean of visual and auditory memory test at 5% significant level.

RISK ASSESSMENT

All subjects' personal details were kept anonymous for confidentiality purpose. They were instructed not to disclose any information regarding the quiz to anyone who had not taken the test. Besides, subjects were told that this experiment was not done on testing the individual's intelligence or memory power to avoid any unnecessary stress which could affect the subjects' performance. The volume of the recording played over the radio was set at an acceptable volume so that everyone could hear clearly and did not cause any impairment on hearing. Otherwise, this was a low-risk procedure.

(1942 words)

RESULTS

Number of people, f

Memory test scores, X

Visual, X1

Auditory, X2

0

0

0

1

0

1

2

0

3

3

0

5

4

2

8

5

4

10

6

8

7

7

11

4

8

10

2

9

5

0

10

0

0

Mean

 $\bar{x}_1 = 6.95$ $\bar{x}_2 = 4.75$

Table 4: Results for memory test of visual and auditory learning

(2005 words)

Graph 1: Box plot for memory quiz score of visual and auditory learning

(2018 words)

STATISTICAL ANALYSIS

X1: Visual memory test

Memory quiz scores, x

Visual, f

fx

x^2

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fx2

0

0

0

0

0

1

0

0

1

0

2

0

0

4

0

3

0

0

9

0

4

2

8

16

32

5

4

20

25

100

6

8

48

36

288

7

11

77

49

539

8

10

80

64

640

9

5

45

81

405

10

0

0

100

0

 $n = 40$ $\hat{\mu} = 6.95$ $\hat{\sigma}^2 = 1.7975$

Table 5: Statistics for visual memory test

Mean, $\bar{x} = 6.95$ Variance, $s^2 = 1.7975$ Standard Deviation, $s = 1.34070877$

(2138 words)

X2: Auditory memory testMemory quiz scores, x Auditory, f fx

x2

fx2

0

0

0

0

0

1

1

1

1

1

2

3

6

4

12

3

5

15

9

45

4

8

32

16

128

5

10

50

25

250

6

7

42

36

252

7

4

28

49

196

8

2

16

64

128

9

0

0

81

0

10

0

0

100

0

n = 40

 $\hat{\mu} = \frac{\sum fx}{n} = 190$ $\hat{\mu}^2 = \frac{\sum fx^2}{n} = 1012$

Table 6: Statistics for auditory memory test

Mean, $\bar{x} = \frac{\sum fx}{n} = 4.75$ Variance, $\bar{s}^2 = \frac{\sum fx^2}{n} - \bar{x}^2 = 2.7375$ Standard Deviation, $\bar{s} = \sqrt{2.7375} = 1.65453921$

(2258 words)

Z-test is a statistical test extended from t-test. It follows a normal distribution where the data have the same mean, median and mode. It is used to handle large samples when $n \geq 30$ and standard deviation is given. In this experiment, there was one variable (type of stimulus), two

samples (visual and auditory memory tests) and 40 observations for each sample. The data was unmatched as each subject sat for the test once only. The difference between variances in the two samples is small (0.94). Thus, a z-test was applied. [3]

Number of samples, n

Mean, \bar{x}_i ,

Standard Deviation, \bar{s}_i

Visual, \bar{x}_1 , 1

40

6.95

1.34070877

Auditory, \bar{x}_2 , 2

40

4.75

1.65453921

Table 7: Basic statistics for both memory test scores

Hypothesis Test for Two Population Means

$H_0: \hat{\mu}_1 = \hat{\mu}_2$ (The mean scores in both visual and auditory memory test are equal)

$H_1: \hat{\mu}_1 > \hat{\mu}_2$ (The mean score in visual memory test is greater than that in auditory memory test)

Given the null hypothesis and $\hat{\sigma}_1 = 1.34070877$, $n_1 = 40$, $\hat{\sigma}_2 = 1.$

65453921 , $n_2 = 40$

$x_{i,1} - x_{i,2} \sim N(0, +)$

By Central Limit Theorem, the test statistics is:

$Z =$

Since under H_0 , $\hat{\mu}_1 = \hat{\mu}_2$ then in this case $\hat{\mu}_1 \text{ visual} = \hat{\mu}_1 \text{ auditory}$ and thus

$Z =$

$= 6.53615718$

$\hat{\mu} \approx 6.5362$

(2483 words)

According to the Table for Critical values for two-tailed z test, the critical value for a two-tailed test when $p = 0.01$ will be the critical values for $p = 0.05$ for a one-tailed test. Thus, the critical value for Z is $z = 1.647$. From the result above, the value of z at 5% probability level is 6.5362 which are higher than the critical value of 1.6449. Therefore, the null hypothesis, H_0 is rejected. There is sufficient evidence that the mean score in memory quiz for

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visual memory is greater than that for auditory memory. This agrees with the experimental hypothesis and matches with the two studies stated earlier which were done by Michael A. Cohen proving that auditory memory is inferior to visual memory, yielding better short-term memory recall. Since Z calculated is a lot higher than Z critical, there is much less than 5% chance that the results occurred by chance, and more than 95% chance that the mean for visual memory test is higher even if the experiment is repeated on the similar population.

(2659 words)

Graph 2: Bar chart for memory quiz score of visual and auditory learning

(2672 words)

DATA ANALYSIS

Graph 2 shows that the score range of visual test is within 4 to 9 whereas the score range for auditory test is within 1 to 8. The modes for visual and auditory memory test are 5 and 7 respectively. It is a huge contrast as most of the subjects scored less than half of the total marks for auditory test while most of the subjects scored more than half of the total marks for visual test. Thus, it is obvious that subjects tend to forget the information more quickly when it is presented by oral compared to visual.

There were anomalies in this investigation, especially in the auditory test group. One subject gets only one answer correct in the memory test and it had been reconfirmed that there was no marking error. This might be due to the particular subject was tired and lack of sleep the night before. This

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explanation was supported by the research of Polzella and Donald J. that stated sleep deprivation increases the occurrence of lapses, periods of lowered reactive capacity, which prevent the encoding of items in short-term memory. [12] Likewise, two of the subjects get eight questions right in the memory test. This might be due to both subjects are Grade 8 pianist who have a better listening ability and are good auditory learner that can remember the auditory information outstandingly. This was stated in Michael A. Cohen's research that musicians have far better auditory recognition memory. [11]

However, I found out that some subjects with high scores in the memory test did not even complete half of the Sudoku puzzle. This may be due to the fact that they kept recalling what they had read during the distraction test but not concentrating on the Sudoku puzzle. During the real test, they were just rehearsing the information they read a few minutes earlier.

(2980 words)

The superiority of visual memory can be explained according to the way the information is perceived and stored as memory. Auditory verbal information enters automatically into the phonological store whereas visually presented words are transformed into phonological code by silent articulation first and subsequently into the phonological store. Thus, the visual information stored twice as visual code rather than auditory code. [6]

From the study by Buckner, we know that visual and auditory memory retrieval involves the activation of different brain region. The sensory-specific regions are activated most robustly during recall of visual memory <https://assignbuster.com/effectiveness-of-visual-and-auditory-learning-on-memory/>

whereas auditory memory represents a distinct subset of those activated during perception. The reason behind may be the capacity for visual memory is larger than auditory memory, thus complex visual memory can be converted into memory more rapidly and easily. [9]

The properties of auditory and visual information are different. In terms of physics or psychophysics, auditory information is said to be less memorable than their visual counterparts. It could be that the remarkable ability to rapidly encode and remember meaningful stimuli is a feature of visual processing. [12] Eberman and McKelvie proposed that a person was more prone to form vivid images, particularly if the original source was visual than if it was auditory. [13]

Visual stimuli are seen and heard through rehearsal maintenance in the brain while auditory stimuli are only heard, making it more difficult to perform. When the brain is processing a visual image, the cognitive functioning requires the discovery of a 'mental image', but when the cognitive functioning is the process of an auditory stimulus, the brain needs to hear the word and then create a 'mental image' in order for a correct recall to take place. Thus, auditory learning seems slower compare to visual learning. [14]

(3271 words)

EVALUATION

There might be variation in memory capacity between individuals, thus a large sample of eighty subjects was used in the experiment to ensure

sufficient replicates were produced to support the conclusion. Besides, <https://assignbuster.com/effectiveness-of-visual-and-auditory-learning-on-memory/>

random choosing and grouping of subjects and consistency of gender will help improve the reliability of the results because there will be no bias in terms of subjects selected to participate in which test.

The age of the subjects was kept constant (20) because capability to memorise varies with age. For example, older people were more prone to develop dementia and were less effective in memorising information, thus giving an unreliable result. Moreover, subjects must have the same level of education as people who weak in English and understanding might not be able to answer the questions properly, be it in visual or auditory form.

Subjects must not have any problem related to their eyes (reading) and ears (listening) to ensure the experiment done smoothly. In addition, the period of the test conducted must be fixed as the effectiveness of learning varies throughout the day. Subjects might feel hungry at the noon and tired around the evening after whole day of academic session. Thus, the entire test was conducted in the morning as it is the golden period for the subjects to learn and memorising information effectively. Participant who were physically sick or mentally tired were excluded from this investigation as their condition might deteriorate their memory performance.

In conclusion, the results can be considered to be valid and reliable as the whole experiment was conducted with minimal errors and a large sample size.

(3537 words)

LIMITATIONS AND MODIFICATIONS

In this experiment, since the same subject cannot sit for both test due to same passage used, it has been assumed that the individual variations amongst the subjects do not affect the results of the study. However, different people might have different memorising power, thus one modification that could be made is by having the same subjects doing both visual and auditory memory test but on different passage which are closely similar in terms of length, information and standard of English.

Although the subjects involved in this experiment are selected randomly, it is only representing the population in International Education College but not whole general college-aged students. Therefore, the experiment can be modified by having a larger sample size from other colleges to obtain a more conclusive, representative and reliable results.

However, it was difficult for a person to memorise all the information in the long passage. They may miss out some points which will affect the outcomes of the investigation. Thus, the passage can be replaced by 30 phrases so that they know exactly what to remember.

FURTHER INVESTIGATION

Further research can be done by investigating the efficiency of visual and auditory learning method in varying age cohorts. Besides, other types of memory measures such as recognition of image and words can be carried out for further study. Lastly, a comparison between genders in terms of both types of memory can be conducted as the memorising power between males and females could be different.

(3780 words)

SOURCE EVALUATION

Source 1 is an e-book that written by psychology experts while source 2 and 3 are published books so the information in it should be facts. They are all credible sources as their content would have been reviewed by other experts prior to publication.

Source 4 is a website from Indiana University while source 5 is a website supported by Bryn Mawr College and Howard Hughes Medical Institute, thus the information are reliable. Source 6 and 7 is from Wikipedia where most of the data and information obtained are cited and linked to many literatures and academic research.

Sources 8, 9, 10, 11, 12, 13 and 14 are scientific journals that written by experts from renowned universities. Their research papers consist of experiments similar to my scientific investigation topic. The results obtained are widely recognised and have been peer-reviewed by other scientists before being published, thus they are trustable.

CONCLUSION

It is clear that visual learning is more effective than auditory learning on short-term memory. It is proven by the mean score in visual test which is 6.95, which is greater than the auditory test which is 4.75. The z-value, 6.5362 is higher than the critical value at 5% significance level. Experimental hypothesis is accepted.

(4984 words)

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APPENDIX

TEXT PASSAGE

Great. Well, hi, everyone! My name's Jody and I'm one of the four recreation officers here at Rainforest Lodge. My job is to make sure that you all have a great stay here with us and go away feeling relaxed and refreshed. As you can see, we're literally in the middle of nowhere at the Lodge. There are no newspapers or TVs and there's only one phone and that's in the office. The Lodge is a complete 'get away from it all' experience: a place to unwind and appreciate the world without a lot of interruptions and distractions.

From your cabin balcony you'll find that you can't see anyone else and the only noise you should hear is the birds. When the luggage comes, one of the guys will take it across to your cabin for you and make sure you know the way back here to the main centre for dinner in the restaurant. Dinner will be served in about an hour or so.

All the times of each day's activities are printed on the blue sheet you should have got in the information guides that were handed out on the coach. Each Explorer trip has a different focus, so it doesn't matter how many you do or on what day, because there's always something new to discover in the rainforest.

Tomorrow I think we've still got places on the Orchid and Fungi Tour. This is on foot and takes you to different parts of the rainforest. Or, if you'd prefer, there's the Four- Wheel-Drive tour to the waterfalls, or the fishing trip where I promise you we'll catch some lunch, and last but not least, the famous Crocodile Cruise that leaves at 11 am each day. (Just in time for the

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crocodile's lunch!) Plenty to choose from here at Rainforest Lodge or just sit on your balcony relax and unwind and enjoy the views. In the evenings there is the Spotlight Tour, one of my favourites. The Spotlight Tour leaves at sundown and lets you catch a glimpse of some more of the rainforest's wildlife as it comes out at dusk to feed. That's a great trip and if you can, I'd really try to make sure you do it during your stay.

(4359 words)

You've chosen to visit the rainforest in March, which is just at the end of the wet season, so you'll soon notice how well the waterfalls are running and also how damp the ground is. Things can tend to get a bit slippery, too, so if you didn't bring any walking boots I'd advise you to hire some from the office. You'll also be much better off in long trousers rather than shorts because they will give your legs more protection and socks are a good idea too.

There's no need to be nervous of the rainforest provided that you treat it with respect and common sense. Most of the animals and wildlife are gentle and harmless. There are some venomous snakes to beware of, but really they're much more frightened of you than you are of them. The other thing is that certain plants can cause irritation if you touch them with bare skin.

Well, that's about all for the time being. The guys are here to take you and your luggage to the cabins . . .

(4538 words)

QUESTIONS

At Rainforest Lodge there aren't any ...

telephones or TVs.

newspapers or TVs.

telephones or newspapers.

The guests are told to ...

carry their luggage to the cabin.

go straight to the restaurant.

wait an hour for dinner.

TOUR NAME

DETAILS

Orchid and Fungi

walking tour

Four-Wheel-Drive

tour to the 3)_____

Fishing

to catch lunch

Crocodile Cruise

departs at 4) _____ daily

5) _____

departs at sundown

What THREE items of clothing does the speaker recommend for the rainforest?

6) _____

7) _____

8) _____

Which TWO things in the rainforest does the speaker give a warning about?

9) _____

10) _____

(4636 words)

DISTRACTION TASK

8

2

8

7

6

4

3

1

9

5

8

4

9

6

1

8

1

3

5

4

7

2

7

4

7

6

4

3

5

6

CRITICAL VALUES FOR A TWO-TAILED Z TEST

Probability value

Z

0. 10

1. 647

0. 05

1. 960

0. 01

2. 576

0. 02

2. 326

0. 002

3. 100

0. 001

3. 291

(4681 words)