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Visual, Tactile and Auditory Memory: Any Difference Between Students?

Memori Visual, Tactile dan Auditori: Ada Perbezaan antara Pelajar?

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To recall objects depends on how we receive information in our daily life. There is three-way to receive information: hear, see or touch. Each way react differently to memory performance. Thus, the main purpose of this study is to investigate the differences between auditory, visual and tactile information in the memory performance. Besides, this study also aimed to find out the differences between gender and field of study in their memory performance. A total of 60 sciences and social sciences students in university (30 females and 30 males) involved in this study. The tool to record the memory performance was namely *A Message from Your Brain*. The result has shown that visual and tactile information were more efficient than auditory information in the memory performance. The finding also shows there was a significant difference between male and female students in auditory memory. Females were outperformed in auditory memory performance compared to males. The result also shows that there was a significant difference between science students and social sciences students on visual memory performance. Students from the sciences field have better performance in visual and tactile memory than social sciences students.

Keywords: visual, tactile and auditory memory, gender, student

Bagi mengingati semula objek-objek bergantung kepada bagaimana kita menerima maklumat dalam kehidupan harian kita. Terdapat tiga cara untuk menerima maklumat: mendengar, melihat, atau menyentuh. Setiap cara itu bertindak balas secara berbeza ke atas prestasi ingatan. Justeru itu, tujuan utama kajian ini adalah untuk mengkaji perbezaan antara maklumat pendengaran, visual dan sentuhan dalam prestasi ingatan. Selain itu, kajian ini juga bertujuan untuk mengkaji perbezaan antara jantina dan bidang pengajian dalam prestasi ingatan. Seramai 60 orang pelajar universiti dari bidang sains dan bukan sains (30 wanita dan 30 lelaki) terlibat dalam kajian ini. Alat untuk merekod prestasi memori dikenali A Message from Your Brain. Hasil kajian menunjukkan bahawa maklumat visual dan sentuhan adalah lebih berkesan daripada maklumat mendengar dalam prestasi ingatan. Dapatan ini juga menunjukkan bahawa terdapat perbezaan yang signifikan antara pelajar lelaki dan perempuan dalam memori pendengaran. Pelajar wanita adalah lebih baik dalam prestasi ingatannya melalui maklumat mendengar daripada lelaki. Keputusan juga menunjukkan terdapat perbezaan yang signifikan antara pelajar sains dan pelajar bukan sains dalam prestasi ingatan visual dan sentuhan. Pelajar sains menunjukkan prestasi yang lebih baik dalam ingatan visual dan sentuhan daripada pelajar sains sosial.

Kata kunci: memori visual, tactile dan auditori, jantina, pelajar

Memory is the ability of the brain to remember the received information which is very important for the learning process among students. The information that we get from our senses which is the visual, auditory and touch sensory will be encoded, stored and retrieved as a memory when needed (Sherwood, 2015). The three senses portray differently in presenting the received information that also affects memory performance.

Visual memory describes the relationship between perceptual processing and the encoding, storage, and retrieval of the neural representations. Visual memory is one of the cognitive systems whereby all the interconnected parts are combined to form memory (Berryhill, 2008). Visual information that captured by eye sends to the lateral geniculate nucleus in the thalamus before it reaches the visual cortex. The visual cortex is in the occipital lobe of the cerebral cortex, a crucial part of the brain to process the received information. Visual memory can have a profound effect on learning (Berryhill, 2008). This suggested that visual memory is essential for students to learn.

Auditory memory involves listening, processing, organizing and storing the information that has been heard, then acting upon the information. This memory is essential to establish a language that could be understood. Auditory cortex that located in the temporal lobe of the cerebral cortex responsible to process auditory information that received through hearing. The auditory memory is part of the auditory system whereby function to perform basic and higher hearing, for instance, exchange languages (Pickles & James, 2012).

Tactile memory is formed based on touch stimuli. The memory is triggered when familiar items are assessed through grip and interaction (Johansson, Gordon, Wrestling, & Cole, 1993). Bliss, Crane, Mansfield, and Townsend (1996) claimed that

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instant recall after assessing the touched objects is a haptic memory.

The above-discussed type of memory whereby the input is gained from the human body senses towards its environment is categorized as sensory memory. The sensory memory is formed after the information is processed by the nervous system and stored as short-term memory. Nerve cells strengthen its connection, this condition called synapses to create a memory. The memory is stored as short term memory (Fields, 2005). The short-term memory is transformed into long-term memory when the hippocampus, located in the temporal lobe sends the message to the brain that the information comes from one experience and would determine it give longer memory (Fields, 2005).

Students are prone to learn in various way including visual learners, auditory learners, and kinaesthetic learners. The three learning styles are affirmed in Gilakjani and Ahmadi (2011) studies as well. According to Taylor (2015), to learn through visually has a higher chance to recall the information compare to by listening. Cole (2014) studies also confirmed human is better to remember an incident that they experience by sensory of seeing compare to hearing.

Munnelly (2016) suggested that memory performance between male and female students is different. She also stated that men outperform women on visual memory tasks. Men are having the advantage of visual processing tasks compare to women because men's brain is more asymmetrically (McGlone, 1980). While, Pauls, Petermann, and Lepach (2013) experiment study confirmed women outperformed men in auditory memory tasks. They found that women have higher verbal abilities compare to their counterparts.

Past studies also found interesting facts that memory performance between sciences and social sciences students is different. According to Shaaidi (2012), pure science students preferred input through visual and tactile compared to other fields like accounting students. Veena and Shastri (2013) have shown that applied sciences students that enroll subjects like Physics, Chemistry, and Mathematics are prone to learn visually compare to pure science students with the engineering field. The applied science students prefer input from diagrams and symbolic devices such as graphs, flow charts, hierarchies, models and arrows. Meanwhile, Jayakumar, Suresh, Sundaramari and Prathap (2016) have proved that engineering students are better in visual and kinaesthetic. Hamdani (2014) has stated that sciences students are visual students and art students are tactile students.

Memory performance is an essential element to help students to excel in their studies. Past studies indicated each student is unique to perform their memory. Gender and field of study are two factors that prone to differentiate students' memory performance. Thus, this study was aimed to investigate how well the visual, auditory and tactile information on memory performance. This study also keen to find whether there are differences in gender and field of study.

Method

Research Design

This study used an experimental approach to collect data from 60 participants. The advantage of the approach is the process is more streamlined and decrease the potential skewing differences. Participants underwent 2 phases and required to follow the instructions during the experiment.

The independent variables in this study including gender, a field of study, auditory, visual and tactile information and one dependent variable, the memory performance. The extraneous variables in this study were situational variables and participant variables. The situational variable is surrounding noise beyond the control of this study during the experiment. The noise could distract the participants when audio and muted video were played. Apart from considering the quiet place, earphones were provided to ensure the situational variable does not interrupt the experimental. The participant variable is the characteristics of the participants. The duration of this experiment was 15 minutes, participants were prone to feel tired that could influence their memory performance. To reduce the fatigue effect, this experiment would continue to phase 2 after 5 minutes break from the time phase 1 finished. Each item in every set of the tools took 15 seconds to test.

Participants

This study has 30 female and 30 male participants around the age of 21 to 24. The participants' study of the field was sciences and social sciences with 30 persons respectively. There were 2 faculties involved: i) Faculty of Science and Natural Resources and ii) Faculty of Psychology and Education.

Simple random sampling was used because it increases the chance and equally to be selected like anyone else (Kelley, Clark, Brown, & Sitzia, 2003). The advantages of this sampling are the results can be generalized to a larger population and perform statistical analysis (Kelley, Clark, Brown, & Sitzia, 2003). The participants were randomly selected at the foyer of both faculties. Although this is a random approach, voluntarily participation is the main priority.

Location

The location was in public university, Universiti Malaysia Sabah. To be specific, Faculty of Psychology and Education, at psychology block and Faculty of Science and Natural Resources.

Tools

The experimental method is an important tool to test and collect information from the participants. This study used an experimental tool named 'A Message from Your Brain'. The tool was used to measure memory performance. This experimental study was divided into 2 phases. In the first phase, 3

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sets of test tools were prepared including visual memory, auditory memory, and tactile memory. Each set of tools consists of 10 items. The second phase was performed whereby 5 items from the 10 items were replaced with new items. The scoring was a range between 0 to 10 for each set. A higher score indicates greater memory performance.

Procedure

In phase 1, 10 videos that were mute were prepared and showed to the participants. Each video has 15 seconds duration. The transition of the video from first to second and so on has 5 seconds of a break. The second set of tools involved 10 audios that last for 15 seconds for each. Similar to the previous set, the experiment used 5 seconds to break before new audio was played. The last tools consist of 10 items stored in an opaque box. The participants were required to touch each item for 15 seconds on a one-time basis until all 10 items were covered.

After 5 minutes break when phase 1 completed, the phase 2 experiment was continued. The phase 2 experiment was similar to the previous experiment whereby participants were exposed and tested like in phase 1, but used new items and audios. Half of the 10 items of each set were changed to new items. The participants were required to watch mute videos, listen to the audios and touched objects that consist of 10 items each. After the completion of phase 2, the participants were asked if the items in phase 2 appeared in phase 1. Scores were recorded for each test.

Data Analysis

The data were analyzed by using IBM Statistic SPSS Version 21.0. Descriptive statistics like central tendency, mean and standard deviations were used to test the difference in visual, tactile and auditory information in memory performance. Meanwhile, independent-samples t-test is to determine whether gender and study of field factors have different memory performance.

Results

The difference of Memory Information in Memory Performance

Table 1 showed the mean score and standard deviation of auditory, visual and tactile memory performance for 60 participants.

Table 1
The Difference of Memory Information in Memory Performance

Sensory Information	*M*	*SD*
Auditory	8.80	1.13
Visual	9.55	0.59
Tactile	9.48	0.68

The mean scores for the sensory information were: i) auditory (*M*=8.80, *SD*=1.13), ii) visual (*M*=9.55, *SD*=0.59) and iii) tactile (*M*=9.48, *SD*=0.68). The results showed auditory has the lowest score, which explains it has the weakest memory performance among the 3 sensory information. Meanwhile, the mean score for visual and tactile has slightly different, 0.07. Therefore, both tactile and visual information was better than auditory information in the memory performance.

The Difference between Male and Female in Visual, Tactile and Auditory Memory Performance

Table 2 showed the result of the independent-sample t-test between male and female students' memory performance in visual, tactile and auditory.

Table 2
Results of t-tests and Descriptive Statistics Auditory, Visual and Tactile Memory Performance by Gender

Memory Performance	Gender						*t*	*df*	*p*
	Male			Female					
	M	*SD*	*n*	*M*	*SD*	*n*			
Auditory	8.37	1.19	30	9.23	0.90	30	3.19	58	.002*
Visual	9.53	0.57	30	9.57	0.63	30	.22	58	.830
Tactile	9.53	0.63	30	9.43	0.90	30	-.57	58	.571

*p < .05

The result showed that there was a significant difference (t = 3.19, p<.05) between female (M = 9.23, SD = 0.90) and male (M = 8.37, SD = 1.19) in the auditory memory performance. The mean score for female was higher than male in auditory memory performance. The result showed female are good at auditory memory compared to male. For the visual memory performance, there was no significant difference (t = -0.22, p>.05) between female (M = 9.57, SD = 0.63) and male (M = 9.53,

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SD = 0.57). Similarly, the result for tactile memory performance showed that there was no significant difference (t = -.57, p > .05) between female (M = 9.43, *SD* = 0.90) and male (M = 9.53, *SD* = 0.63). The results indicated that male and female have similar ability in visual and tactile memory performance.

The difference of Memory Information of Science and Non-science Students

As presented in Table 3, the analysis showed there was a significant difference between sciences and social sciences students in the memory performance.

Table 3
Results of t-tests and Descriptive Statistics Auditory, Visual and Tactile Memory Performance by field of study

Memory Performance	Field of Study						*t*	*df*	*p*
	Non-Science			Science					
	M	*SD*	*n*	*M*	*SD*	*n*			
Auditory	8.77	1.17	30	8.83	1.12	30	-.226	58	.882
Visual	9.40	0.67	30	9.70	0.47	30	-2.004	51.55	.050
Tactile	9.30	0.79	30	9.67	0.48	30	-2.164	47.65	.035

*p < .05

Meanwhile, there was no significant difference between sciences and social sciences students on auditory memory performance (t = -.226, p > .05). The mean scores were: i) sciences student (M = 8.83, *SD* = 1.12) and ii) social sciences students (M = 8.77, *SD* = 1.17). In contrast, there was significant difference (t = -2.004, p < .05) between social sciences (M = 9.40, *SD* = 0.67) and sciences students (M = 9.70, *SD* = 0.47) on visual memory performance. The result indicated that sciences students outperformed than social sciences students on visual memory. For the tactile memory performance, there was a significant difference (t = -2.164, p < .05) between sciences students (M = 9.67, *SD* = 0.48) and social sciences (M = 9.30, *SD* = 0.79). The result showed that sciences students outperformed than social sciences students on tactile memory.

Discussions

Visual, auditory and tactile are 3 different memory performance abilities. Visual memory is the ability to recollect information from things that are seen, auditory memory refers to the received information through hearing, and tactile memory is formed when individuals have an idea about the object through hand sensory. This study has shown that students are more likely to remember an incident through visual like watching a video and also tactile information by touch.

Based on the finding, visual and tactile information are adaptable for students to recall. The majority of the students were able to memorize better through tactile memory, which could help their learning process. In this experimental setting, the result suggested that auditory memory is less effective. Nevertheless, the auditory long-term memory allowed the participants to remember items like ambulance, crying of baby and bird. The images used in the experimental were simple and played at considerate speed, this help to stimulate the visual sense that later store as long-term memory. The experimental played more than 1000 sound, the sensory was less effective in receiving auditory information as compared to visual information. This explains why auditory information is less impressive if exposed to various sounds at the same time. Individuals could opt for auditory information if it is presented at a one-time basis.

Tactile memory systems involved the storage and retrieval of information. In a study about behavioral, neuropsychological, neurophysiological, and neuroimaging research on tactile memory, it reveals that the memory can be subdivided into several functionally distinct neurocognitive subsystems, for instance, auditory and visual memory (Gallace & Spence, 2009). Some of these subsystems are peripheral and short-lasting and others are more central and long-lasting. The result was also proven that tactile information could interact with other sensory like visual, auditory and kinaesthetic. The neural network for tactile memory might be shared with other sensory modalities. Therefore, the multisensory information-processing network seems a key role player to store tactile information in the brain.

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According to Norman, Dawson, and Raines (2000), although the human ability to perceive differences in the local metric structure such as depth and curvature is less accurate, but touch and vision show similar ability because both are sensitive to an object's shape. That suggested that receiving information through touch sensory triggers visual sensory too. Thus, tactile and visual both contribute much to memory performance that essential for the learning process.

This study showed that there was a difference between males and females in auditory memory. Female students outperformed male students in auditory memory. While there was no significant difference between males and females for visual memory and tactile memory. The experiment showed female students have greater volumes on the left side of the temporal lobe, the level of trend is on the right side, which encompasses the primary auditory cortices (Brun et al., 2009). The result could be related to fMRI findings by Phillips et al. (2001) of which shows males' temporal lobes are more active in language semantic tasks than phonological tasks, while females showed no difference. Females also able to activate both temporal lobes while hearing from one side, whereas males' activation is lateralized (Phillips et al., 2001). Witelson, Glezer, and Kigar (1995) found a greater density of neurons in posterior temporal areas in women than men.

The experiment result showed that female students displayed significantly higher amplitudes in the evoked gamma response compare to male students. This may be associated with sensory processes, a phenomenon of the sensory register (Karakaş & Başar, 1998). The correlation of the amplitude of the evoked gamma response with different ability measures (Jokeit & Makeig, 1994; Karakas et al., 2003) suggests that it may reflect more distinct sensory information accompanied by a more fully elaborated stimulus processing. A similar finding was reported in Jaušovec and Jaušovec (2009) studies.

From the aspect of the field of study, there was significance between sciences and social sciences students in visual memory and tactile memory. The finding demonstrated that sciences students are more workable in visual memory. The test used symbols and pictures during science subject classes like Biology, Chemistry Physics class and Science. According to Veena and Shastri (2013), pure sciences and applied sciences students prefer visual learning style which is diagrams and symbolic devices. Besides, science students are good at tactile memory. They are familiars with role-playing or hands-on learning as they have been introduced with various experiments during their studies (Shaaidi, 2012).

There were several limitations to this study. The number of participants was small with only 60 persons. The participants confined to students from two faculties in Universiti Malaysia Sabah. This study used simple random sampling, thus the sample may not represent the actual population. Future research could consider extending to other fields either in the same university or other universities that include students with a background of engineering, medical, biotechnology geography, business, and music.

Conclusion

In conclusion, the visual and tactile information is better than auditory information in-memory performance even though the mean score of tactile information is slightly lower than visual information which is just 0.07 differences. For the gender factor, it can be concluded that female students outperformed male students in auditory memory. Whilst, visual and tactile memory performance has no difference regardless of gender. In the study of the field, students with science background outperformed than others in the visual and tactile memory performance. Both fields have similar memory performance if through the sensor of auditory.

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