

A Comparative Study of Auditory Memory Capabilities with Visual Memory Capability of Teenagers and Young Adults

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Abstract: *The difference in memorial capabilities between the auditory pathway of memory and visual memory has long been displayed in people's daily lives. In this work, a group of participants are presented both a visual memory task and an audio task with the same content and for the same amount of time. When the participants recall the content of their memory tasks, an advantage in the visual version of the task is revealed in the results. According to the results of this work, it might indicate the existence of a comparative advantage in visual memorial capabilities than auditory memorial capabilities.*

Keywords: *Auditory memory, Visual memory, Memorial capabilities, Comparative advantage*

1. Introduction

Although previous studies have established that different types of sensory information have separate systems to approach to the brain ^[1], a series of studies revealed that auditory and visual representations partly share common pathways to the brain ^[2] as well as similar transformation processes while they are "encoded and retrieved from memory" ^[3]. The similarities that are discovered in the distinct sensory systems' approaches to the brain gives rise to a question: are there differences in Memory capabilities between the two systems?

To date, cognitive experiments and studies gave a positive answer to the question and suggested that human's memory capabilities for auditory stimuli are relatively weaker than that of visual memory ^{[4][5]}. Bigelow and Poremba's studies used non-verbal visual stimuli as well as tones to test a group of undergraduates' memory results, while Cohen and Horowitz tested recognition memory of both senses. Another similar study was led by Zhang in China, the experiment was participated by residents from a Chinese community, and the English alphabets were used as the content of both visual and auditory memory tasks ^[6]. Results of both studies reported a higher correction rate in the short-term visual memory tasks than in the short-term auditory memory tasks; both research groups concluded that short-term memorial abilities for auditory information are weaker than short-term memorial abilities for visual information. However, the limitations of both studies requires more study to confirm their conclusions and to generalize them to a larger group of people: Bigelow addresses that his study on short-term recognition memory did not test short-term memory by letting participants recall immediately, in which way the result might behave differently from their study, and could not measure whether the result was affected by participants' familiarity with the test materials and memory forms ^[4](Bigelow & Poremba, 2014); while Zhang's study was restricted by its small sample size, and not ruling out the confounding variables such as age, gender, and educational background, and participants' familiarity with the text might ^[6] (Zhang, 2015) also affect the responses because of those confounding variables.

Being aware of the limitations in the previous studies, the recent experiment we designed wanted to address those limitations. We required our participants to recall immediately after each memory task, and used basic Chinese phrases in our test, as Chinese is the mother language of all our participants, and the basic phrases would rule out the influence brought by familiarity as much as possible. We also designated our participants to be a group within the age range of teenagers and young adults (14-22) and had similar educational backgrounds. By addressing limitations of age, familiarity of texts as well as educational background and referring to the results of the previous studies, the hypothesis that auditory short-term memory capabilities are weaker than visual short-term memory capabilities will be supported challenged by a wider and more comprehensive data basis.

2. Method

2.1 Participants

In sum, 40 volunteers aged from 14 to 22 were planned to participate in the experiment. All the participants have received high school education in China and are fluent as native Chinese speakers.

Stimuli

For the visual memory task, we designed a group of 20 2-word Chinese phrases that are unrelated to one another. For the auditory memory task, we used a recorded clip that read the same twenty phrases for two times at the same sequence.

2.2 Procedure

The participants with native Chinese fluency were randomly divided into two groups (group1:19, group2: 15). The first group performed a visual memory task by watching the phrases for 160 seconds, and then two days later they listened to the verbally recorded clip for the same text and for the same amount of time. Each task required them to recall immediately after being exposed to the stimuli by writing down what they remembered. In order to counterbalance the effect brought by the sequence of the two memory tasks, another group performed the auditory memory task first and the visual task two days later. To counterbalance the possible effect that the first task might have on the results of the second task, we used another version of both the visual and audio material in the second task for both groups. The new version was created by changing the sequences of the words from the first version while all other conditions remain unchanged. The entire experiment was done online via video conference between 8 p.m and 10 p.m, standard Beijing time to avoid incorrect results as much as possible. After the participants finished their responses, we recorded their accuracy in the form of numbers out of twenty.

3. Results

By the end of the experiment, we received a total of 42 pairs of data on accuracy on the visual and auditory test. After deleting one pair whose participant did not complete the experiment due to internet issues, and seven pairs of data generated by average participants, 33 participants' results (16 female, 15 male) were qualified for data analysis.

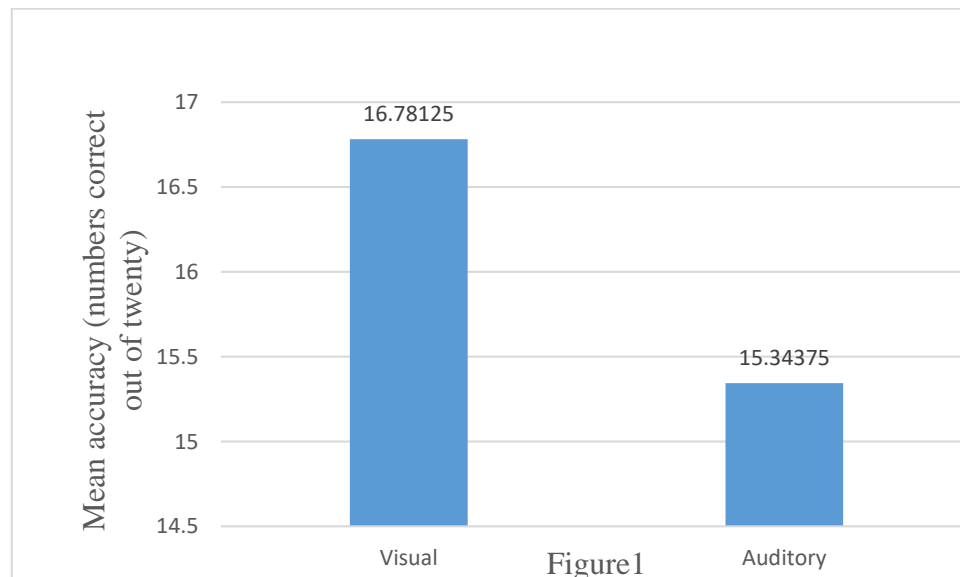


Figure 1. Participants' mean accuracy in auditory and visual memory task

As displayed in figure 1, the average accuracy for visual short-term memory is relatively higher than that of auditory short-term memory (visual 16.78 out of 20; auditory 15.34 out of 20). The difference was also revealed and confirmed by a paired t-test with the accuracies of visual and auditory memory tasks as factors ($p < 0.04419$).

To address the possibility that short-term memory capabilities between two genders would differentiate, we did two extra analysis that takes the two genders, the mean auditory task accuracy and the mean of visual task accuracy as factors.

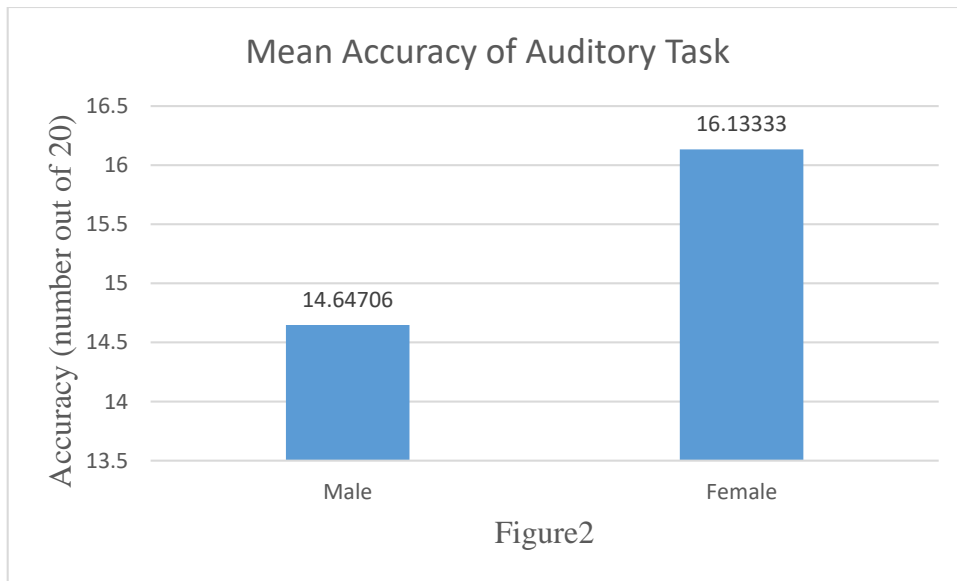


Figure 2. Mean accuracy in the audio memory task of male and female participants

Figure 2 demonstrates that there is a relative weakness in the mean auditory memory task accuracy of male participants (14.647) than of female participants (16.133), but an individual t-test suggested the difference had no significance ($p < 0.5$). However, when the sample size is doubled, the difference would have statistical significance ($p > 0.5$).

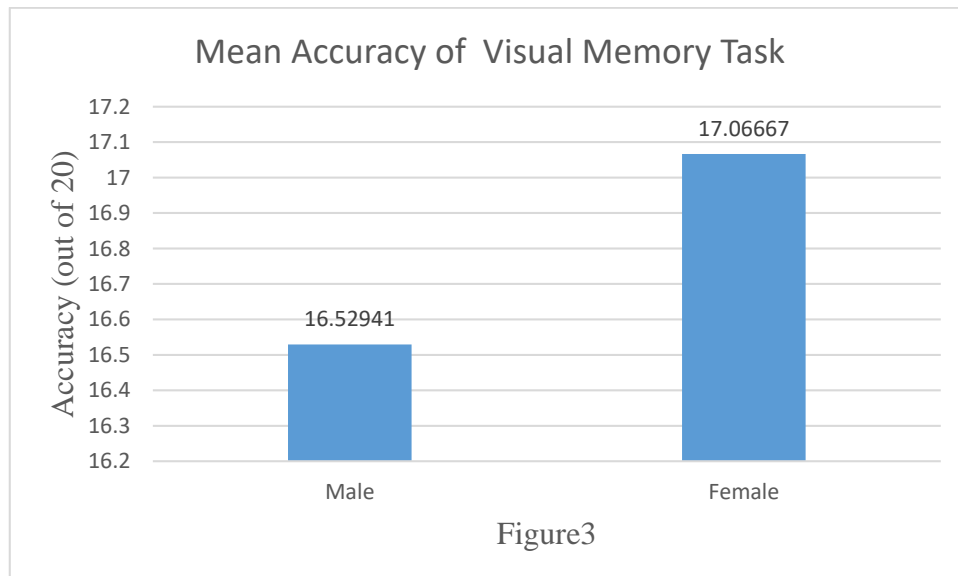


Figure 3. Mean accuracy of the visual memory task of male and female participants

Figure 3 is the graphical representation of the mean accuracy of the visual memory task for male and female participants. The accuracy of female participants is also higher than that of male participants, but individual t-test demonstrated that the difference has no significance as well ($p < 0.5$).

4. Discussion

Generally, the data is an implication of the weakness that lies in teenagers and young adults' capabilities for auditory short-term memory than that of visual short-term memory. We can also observe that the difference was not caused by confounding variables such as gender differences, participants' familiarity with the test materials, or test time based on the design of the experiment. The overall data

corresponds with the hypothesis and also is consistent with the conclusions driven by data in previous experiments within the same field.

As teenagers and young adults in the age range of 14 to 22 are in the prime age of learning and would require to perform a large number of memory tasks daily as students, the study specified on these group of people would not only testify the hypothesis made by previous researchers studying memory abilities for auditory and visual information, it would also provide the perspective of the memory pattern of members within the group. An extended study focusing on the group and the difference of memory capabilities between different sensory information might help discover special techniques to maximize their memory abilities ways for these students to be better adapted to their intense memory needs during the process of their study.

However, the several defects in the study that might lead to another result. The sample size is not qualified to represent the entire group of teenagers and young adults aged between 14 and 22. More participants are needed in the experiment to make a conclusion that is accurate enough to confirm the difference between auditory and visual short term memory capabilities.

Also, although the experiments were done via video conference, the researchers were not able to fully guarantee that all participants are under the same condition while performing both tasks, and the difference in the participants' task-performing environments might cause the result to deviate from its actual appearance, and a laboratory environment would minimize errors caused by this variable.

Moreover, the material of the memory task in the experiment is another limitation of the study. The only type of the stimuli in the experiment restricted the result to linguistic stimuli, while the results may be different when the stimuli unrelated to language are used in the experiment. A larger variety of stimuli such as music clips and images are to be added to the experiment to generate a well-rounded data set and conclusion.

5. Conclusion

It is suggested by the results of our study that there is a relative weakness in short-term auditory memory capabilities than visual memory capabilities, but the study is still in need of improvement by having a larger sample size, creating a controlled laboratorial environment in which participants perform memory tasks, and a larger variety of stimulus to have a more comprehensive and accurate result.

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