

The Impact of Time of Day and Type of Book on
Concentration Levels and Memory Retention

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Abstract

Audiobooks are becoming increasingly popular, but it is unclear what effect they have on the learning process. It is also unclear whether time of day impacts the learning process. The main question of this experiment was to determine whether there was a difference in concentration levels and memory retention when subjects were given a physical book to read versus an audiobook and whether the time of day impacted this as well. 16 university students between the ages of 19-22 participated in this experiment. Subjects were randomly placed into one of two groups. One group was asked to read a short story while the other group was asked to listen to an audiobook version of the story. After reading or listening, subjects were administered a short survey which contained a mixture of content-related questions and questions about how distracted they felt. Subjects were asked to rate their distractibility on a scale of 1-5 (1 = “very distracted, 5 = “not distracted”). All subjects were asked to complete two trials of the experiment, once in the afternoon and once in the evening. The results of this experiment indicated that subjects, regardless of the type of book they were assigned, on average performed better on the quiz during the evening trial than the afternoon trial. The results also indicated that subjects who listened to the audiobook reported a higher distractibility compared to subjects who read the story, although there was no significant difference in their actual performance on the content related questions. From this experiment, we conclude that there seems to be no difference in the learning process between listening to an audiobook and reading a physical book and that university students perform significantly better on tasks in the evening compared to the afternoon.

Introduction

Society always finds new ways to incorporate new technological changes into their day to day lives. One simple example is the rise of the audiobook. For generations, the typical school day involved students reading various physical textbooks and story books. But with the rise of listening devices, it has become easier and more efficient for students today to listen to audiobooks rather than read physical versions of books (Alter, 2016). But is there a difference in how much students comprehend while listening compared to when they read? There have been experiments studying the difference in an individual's concentration levels between reading and listening (Risko, Anderson, Sarwal, Engelhard & Kingstone, 2012; Varao Sousa, Carriere, Smilek, 2013). In an experiment carried out by Varao Sousa et al. (2013), participants were randomly placed into three groups. All three groups were assigned a reading. One group read silently, another read aloud and the final group listened to the passage being read to them. The experiment focused on levels of mind wandering between participants in the three groups. Researchers concluded that subjects from both groups that physically read the passage experienced less mind wandering compared to subjects in the listening group. They also found that subjects in both reading groups outperformed subjects in the listening group on a content recall task administered to them post reading/listening (Varao Sousa et al., 2013). However in an experiment carried out by Kintsch & Kozminksky (1977), researchers found no significant difference in content retention between subjects who listened to a tape recording of three stories and subjects who physically read the three stories. Both groups of subjects, after reading or listening to the stories, were required to write short summaries of each story, and researchers concluded that after comparing summaries from both groups, there was no significant difference

in the content of the summaries (Kintsch & Kozminsky, 1977). Researchers concluded that due to this, there was no evidence that listening to a book results in a different level of memory retention compared to reading a book. The contrast in the results of both of these experiments invite questions about whether students are truly retaining the same amount of information from an audiobook compared to if they actually physically read the book.

Time of day is another factor that could potentially impact an individual's concentration levels and memory retention on the reading and listening tasks. In an experiment conducted by Allen et. al (2008), researchers concluded that college students perform better in the afternoon and evening on certain cognitive tasks. In the experiment, each participant was measured at three different points during a day, morning, afternoon and evening. At each point they were given cognitive tasks that measured their language skills, speed, and memory recall. One task they used to measure memory recall was to provide the subjects with a list of vocabulary words to look over and then ask them to recall as many words as they can in 60 seconds that begin with the letters "S", "T" and "M". Based on subject's performance on these cognitive tasks, researchers concluded that college students perform better in the afternoon and evening compared to the morning. In another experiment performed by Folkard, Monk, Bradbury, & Rosenthal (1977), researchers found an interaction between the time of day and memory recall. One group of students were read a story at 9:00 AM, while another group of students were read a story at 3:00 PM. Both groups were administered a memory test post reading. Both groups were administered another memory test based on the reading one week later. Students who were read the story at 9:00 AM performed much better on the test compared to the students who were read to at 3:00 PM. But, students who were read to at 3:00 PM performed significantly better on the memory

test administered a week later compared to students who were read to at 9:00 AM. Researchers concluded that there is an interaction between how awake the subject is and their memory recall. Subjects who were read to at 3:00 PM had a higher amount of delayed memory recall, whereas subjects who were read to at 9:00 AM had a higher amount of immediate memory recall.

In this experiment we are interested in studying the difference in concentration levels and memory retention of participants who physically read books versus participants who listen to audiobooks. We will randomly separate participants into two groups. One group will be given a physical copy of a short story to read, and the second group will be given an audiobook version of the same short story. In order to test for a possible interaction between time of day and type of book participants in both groups will be asked to complete the experiment twice, once in the morning and once in the afternoon. They will be given a different short story at each meeting. After the reading/listening task is completed, subjects in both groups will be administered a short survey containing content related questions as well as questions about their focus and concentration level while reading or listening to the short story. Memory retention will be measured based on how many of the content related questions participants answered correctly. Focus and concentration levels will be evaluated based on the self-reported results in the survey. If subjects in the physical book score higher overall on the content related questions compared to the subjects in the audio book group, we have reason to believe that physically reading a book may result in one retaining more information compared to listening to an audiobook. If subjects in the audiobook group score higher overall on the content related questions compared to subjects in the physical book group, then we have reason to believe that one may retain more information listening to an audiobook compared to physically reading. If there is no difference in

the scores on the content related questions between the morning and the afternoon sessions, then we will not have evidence to conclude that one time of day is better than the other. This experiment could shed some light on potential differences in memory retention and concentration levels while reading physical books or listening to audiobooks.

Methods

Participants

16 undergraduate students between the ages of 19 to 22 participated in this experiment. 8 participants were randomly assigned to listen to the audiobook version of the short stories while the remaining 8 participants were assigned to read the physical book version of the short stories.

Design

Subjects completed the experiment in person or through email. Subjects were randomly assigned to either the audiobook group or the physical book group. In if person, subjects were given a laptop and headphones to listen to an audiobook or a paper copy of the short story. If through email, subjects were emailed a .mp3 file of the audiobook or a PDF version of the short story. Both groups were also emailed the appropriate instructions and specifications. After reading or listening to the short story, they were then administered a survey based on the story they just read. Subjects in both groups were tested twice, once in the afternoon and once in the evening, in order to study whether time of day had an effect on the subject's survey performance. The time of day for the first trial varied for participants and was counterbalanced. About 25% of the participants did the evening trial before the afternoon trial. The type of book did not vary from trial to trial. The participant received a different short story each trial. The order in which the participants read/listened to the short stories was counterbalanced.

Stimuli

Two short stories were used. They were “The Lottery” by Shirley Jackson and “The Necklace” by Guy de Maupassant. One group of subjects were asked to listen to the audiobook version of the short stories while the other group were asked to read the short stories. The audiobook version of both short stories were approximately twenty minutes long. The survey administered afterwards was 10 questions. The survey contained a mixture of content-related questions and questions related to the subject’s experiment with the short story. In the survey, subjects were asked to determine how distracted they felt during the reading/listening on a scale of 1-5.

Procedure

Subjects were randomly assigned to one of two groups. Group 1 was either given a paper copy or a PDF version of the short story. Group 2 was given an audiobook version of the short story. Within both groups, subjects were randomly assigned to read/listen to “The Lottery” or “The Necklace”. Subjects in Group 1 were asked to read the short story and complete the survey immediately after. There was no time limit given to complete the task. Subjects in Group 2 were asked to listen to the audiobook version of the short story through headphones and then take the survey immediately afterwards. The audiobook version of the short story was approximately 20 minutes long. Subjects in both groups were instructed to not refer back to the reading or audiobook while answering the questions of the survey. Participants were not shown the results of their survey. The experimental procedure did not vary between afternoon and evening trials. The time of each subject’s afternoon trial was between 12:00 PM - 3:00 PM. The time of each subject’s evening trial was between 4:30 PM - 3:00 AM. The entire experiment was

approximately 25 minutes per trial. Each subject spent approximately 50 minutes to complete the entire experiment. Subject's concentration levels were determined based on the distracted levels reported in the survey. Memory retention levels were determined based on how many questions were answered correctly in the survey.

Results

Two separate Mixed Measures ANOVAs were conducted to determine the effects of the time of day and type of book on the percentage of questions answered correctly and the average distraction level of the subject independently.

The first Mixed Measures ANOVA analyzed the Type of Book and the percentage of questions answered correctly on the subsequent survey for the afternoon and evening trials. The between subjects factor was the Type of Book (physical book vs. audiobook) while the within subjects factor was Time of Day (afternoon vs. evening). The dependent variable was percentage of questions answered correctly. The Mixed Measures ANOVA showed a main effect of Time of Day, $F(1,1) = 5.97, p = .03$. The average percentage of questions answered correctly during the evening trial among all subjects was 85.9% while the average percentage of questions answered correctly during the afternoon trial among all subjects was 64%. The physical book group had the lowest average percentage correct in the afternoon trials ($M = 62.5\%, SD = .189$) among both groups but had the highest average percentage correct in the evening trials ($M = 90.6\%, SD = .129$). There was no significant difference in the average percentage of questions answered correctly between both types of books, $F(1,1) = .118, p = .73$. The average percentage of questions answered correctly between the Physical book group ($M = 76.6\%, SD = .213$) and the Audiobook group ($M = 73.4\%, SD = .322$) for all the time of day trials were relatively close. There was no

significant interaction between time of day and type of book, $F(1,1)=.487, p=.5$. The effect of Time of Day on percentage of questions answered correctly is shown in Figure 1.

The second Mixed Measures ANOVA analyzed the Type of Book and the average distracted level for the evening and afternoon trials. The between subjects factor was the Type of Book (physical book vs. audiobook) while the within subjects factor was Time of Day (afternoon vs. evening). The dependent variable was the average distraction level, which was ranked on a scale of 1-5 (1= “very distracted” , 5 = “not distracted at all”) by the subject while they completed the survey, for afternoon and evening trials. the Mixed Measures ANOVA displayed a main effect of the between subjects factor, Type of Book, $F(1,1) = 4.71, p = .048$. Subjects in the Audiobook group reported a higher distraction level across both the afternoon and evening trials ($M = 2.31, SD = .946$) compared to subjects in the Reading group ($M = 3.13, SD = 1.02$). The Audiobook group reported the highest distraction level in the afternoon trial ($M = 2, SD = .756$) while the Physical book group reported the lowest distraction level in the evening trial ($M = 3.346, SD = .916$). There was no main effect of time of day, $F(1,1) = 3.24, p = .093$, shown through the ANOVA.

The effect of type of book on the average reported distraction level for afternoon and evening trials can be shown in Figure 2.

Discussion

The main question of this experiment was to determine whether there was a difference in concentration levels and memory retention when subjects were given a physical book to read versus an audiobook and whether the time of day impacted this as well. Subjects were randomly assigned to either read a physical copy of a short story or listen to an audiobook version of the

same short story. Each subject participated in two trials, one in the afternoon and one in the evening. The results of the present experiment indicated two significant points. First, there was an effect of the time of day on how well the subject's performed on the memory retention task. Second, there was an effect of the type of book assigned to the subject on their perception of how distracted they felt.

Across both subject groups, there was a significant increase in the percentage of questions answered correctly in the evening trials compared to the results of the afternoon trials. This result implies that university students seem to perform better on comprehension tasks in the evening times, after 4:30 PM, compared to when they carry out the task in the afternoon which in this experiment was defined to be between 12:00 PM to 3:00PM. This result supports the results found by the experiment conducted by Allen et. all (2008). In the experiment, researchers concluded that university students performed significantly better on cognitive tasks in the afternoon and evening compared to the morning. This experiment contrasted with the results found in an experiment performed by Folkard, Monk, Bradbury & Rosenthal (1977). In that experiment researchers found that school students performed significantly better on immediate memory recall tasks in the morning compared to when they administered the task in the afternoon. The results of the experiment at present, in which the short survey was administered directly after the subject completed reading or listening, show that students performed better on the immediate memory recall task in the evening trial compared to the morning trial. This difference may be due to the fact that the above experiment was performed with middle school children whereas the experiment at present was performed with university students. University students are typically more inclined to work during later hours compared to middle school

children, which could be why in the experiment at present subjects performed better in the evening.

The results of the present experiment also indicate that there is a main effect of the type of book on the subject's reported distraction levels. When the survey was administered, subjects were asked to report on a scale of 1-5, with 1 being "very distracted" and 5 being "not distracted at all", how distracted they felt while reading or listening. The average self-reported distraction level for the subjects in the audiobook group was significantly higher than those of the subjects in the physical book group, implying that listening to an audiobook may result in a person feeling more distracted compared to when they are simply reading a physical version of the book. This result partially supports the result found earlier in the experiment carried out by Varao Sousa et al. (2013). In that experiment, researchers concluded that subjects who physically read a passage experienced less mind wandering and performed better on a content recognition task compared to subjects who had to listen to a passage being read to them. Although in this experiment, the distraction level were self-reported by the subjects themselves, there was a significant difference in the perception of distractibility between both groups. The subjects in the listening group reported feeling more distracted while listening the audiobook compared to subjects in the physical book group. In the experiment by Varao Sousa et al. (2013), researchers also concluded that when administered a content recall task, subjects in the reading groups outperformed subjects in the listening group. In the current experiment, although there was an effect of type of book on reported distraction levels, there was no effect of type of book on memory retention. There was no significant difference in the average percentage of questions answered correctly between subjects in the physical book group and subjects in the audiobook

group. This implies that subjects in the physical book group did not perform significantly better than subjects in the audiobook group on the content recall task administered afterwards. This aspect of the result did not support the other findings in the experiment carried out by Varao Sousa et al. (2013). Instead, the results of the current experiment supported the findings of the experiment carried out by Kintsch & Kozminksky (1977), in which researchers concluded that there was no significant difference in the performance on a content recall task between subjects who listened to a story and subjects who read the story. One group of subjects were asked to listen to a recording of a story while the other group of subjects were asked to read the story. After completing the reading/listening, subjects were asked to write a summary of the story in order to display how well they remembered and retained the content of the story. Subjects in both groups performed similarly on the task. Similar to that experiment, the results of the experiment at present did not indicate that the method which the subject comprehended the short story had any effect on how they performed on the survey administered afterwards. Both groups performed similarly while answering the content related questions.

The experiment indicated that the time of day when the subject performed the task impacted how well they performed on the memory retention task and that the type of book assigned to the subject impacted their perception of how distracted they felt. Given the nature of the experiment, the resulting data could have been impacted by a few factors. One factor that could have significantly impacted the results of the experiment is how subjects in the listening group performed their experiment. There were no specific instructions about what the subject had to do while listening to the audiobook. Since this was not controlled, many subjects in the audiobook group performed other tasks while listening to the story. One subject reported eating

lunch while listening the audiobook. Another subject was observed to browse the internet while listening to the audiobook. It seems that many subjects in the audiobook group were multitasking during the experiment. Due to this, many in the audiobook group, when asked about distractibility, may have reported a higher level. This could have led to the higher overall average reported distraction level among subjects in the listening group.

The results of the present experiment have brought up new questions about how time of day and type of book impact an individual's distractibility and memory retention. The effect of time of day on an individual's memory retention performance brings up the question of what time of day is ideal for administering university exams? If the results of this experiment show that there is a significant difference in performance between the afternoon and evening on immediate memory recall tasks, the next question that comes to mind is whether there will be a significant difference in performance on high stakes testing between the afternoon and evening. The effect of type of book on an individual's perceived distractibility reveal an interesting contradiction in audiobooks. A question that comes to mind is whether audiobooks should replace physical books in schools. If students feel more distracted while listening to an audiobook, maybe it is not ideal to increase the presence of audiobooks in schools, although there is no difference in actual memory retention. Another question that comes to mind is how effective lecture style teaching may be given that students are more distracted while listening? Students may pay less attention while listening to a lecturer compared to if they read the content of lecture themselves. All of these questions are important in determining how schools can use effective techniques to teach their students.

References

- Allen, P.A., Grabbe, J., McCarthy, A., Harrison Bush, A., Wallace, B. (2008). The Early-Bird Does Not Get the Worm: Time-of-Day Effects on College Students' Basic Cognitive Processing. *American Journal of Psychology*, 4, 551-564.
- Alter, A. (2016, September 23). Audiobooks Turn More Readers Into Listeners as E-Books Slip. Retrieved March 21, 2018, from <https://www.nytimes.com/2016/09/23/business/media/audiobooks-turn-more-readers-into-listeners-as-e-books-slip.html>
- Folkard, S., Monk, T.H., Bradbury, R., Rosenthal, J. (1977). Time of day effects in school children's immediate and delayed recall of meaningful material. *British Journal of Psychology*, 68, 45-50.
- Kintsch, W. & Kozminsky, E. (1977). Summarizing Stories After Reading and Listening. *Journal of Educational Psychology*, 69, 491-499.
- Kirkham, N.Z., Slemmer, J.A., Johnson, S.P. (2002). Visual statistical learning in infancy: evidence for a domain general learning mechanism. *Cognition*, 83, B35- B42.
- Risko, E.F., Anderson, N., Sarwal, A., Engelhardt, M., Kingstone, A. (2012). Everyday Attention: Variation in Mind Wandering and Memory in a Lecture. *Applied Cognitive Psychology*, 26, 234-242.
- Varao Sousa, T.L., Carriere, J.S.A., Smilek, D. (2013). The way we encounter reading material influences how frequently we mind wander. *Frontiers in Psychology*, 4.

Appendix

De Maupassant, G. (1884). The Necklace. [PDF file].

Retrieved from <https://photos.state.gov/libraries/hochiminh/646441/vantt/The%20necklace.pdf>

Jackson, S. (1948). The Lottery. [PDF file].

Retrieved from https://sites.middlebury.edu/individualandthesociety/files/2010/09/jackson_lottery.pdf

Figure Captions

Figure 1. Effect of Time of Day on Percentage of Questions Answered Correctly for the Physical Book and the Audiobook group.

Figure 2. Effect of Type of Book on Average Reported Distraction Level During Afternoon and Evening Trials

Figures

Figure 1.

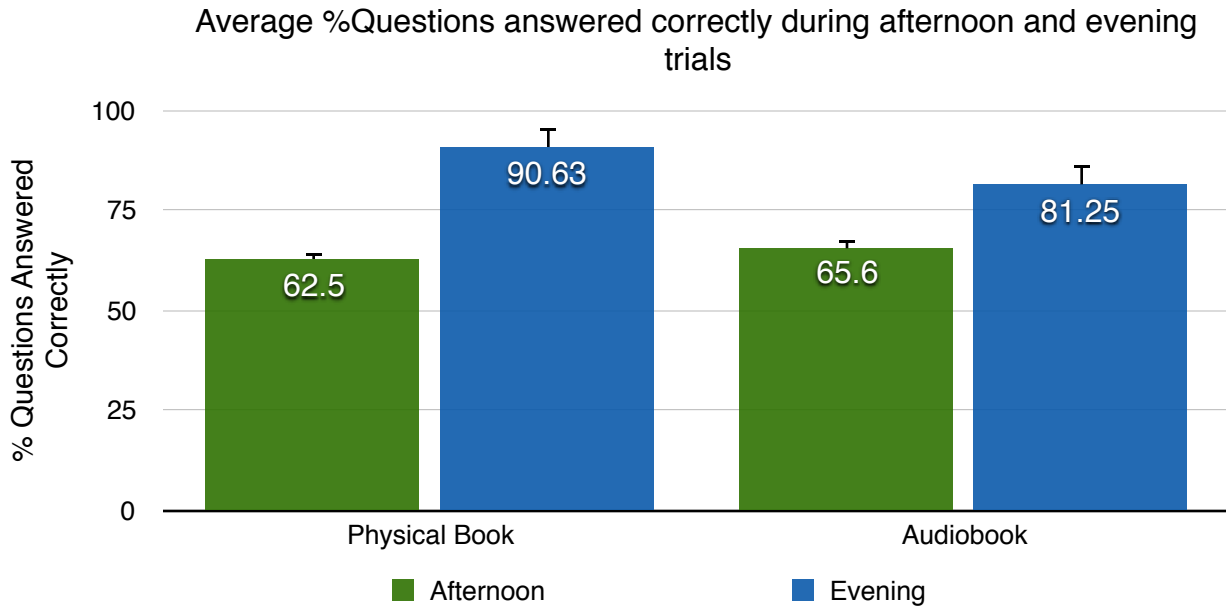


Figure 2.

