

Running head: LECTURE OR PODCAST

When To Take Notes: During Lecture or During Podcast?
Weston Uribe¹, Toshiya Miyatsu², Carole L. Yue¹, and Robert A. Bjork¹

¹University of California, Los Angeles

²Washington University in St. Louis

Acknowledgements

This research was supported by Grant 29192G from the James S. McDonnell Foundation. We thank Mo Ally for help scoring and members of the Bjork lab for helpful comments regarding this research. Contact: Wesluri@g.ucla.edu

Abstract

Modern technology gives students many study options, including using audio podcasts during study sessions. Although students often take notes during lectures, taking notes during a subsequent study session—rather than during initial learning—may be more beneficial. This is not only because the burden of hurriedly taking notes in class can cause students to miss key ideas during lectures, but also because students may organize the material more effectively (Mayer, 2005). This experiment utilized a between-groups design, with timing of note-taking manipulated between groups. Undergraduates first viewed a multimedia science lesson, followed by studying with an audio podcast of the same lesson. Participants took notes during either the initial lecture *or* during the study session. Our results show that students who take notes during a subsequent audio podcast version of lecture recall more idea units than those students who take notes during lecture. These results have the potential to demonstrate how students' study strategies should be altered at different points in the learning process and suggest how available technology can be used to optimize learning.

Key words: learning, education, note-taking, podcast

When To Take Notes: During Lecture or During Podcast?

Note-taking is one of the most common activities in the learning process and many studies have demonstrated the benefits of note-taking for learning (e.g., Di Vesta & Gray, 1972; Kiewra & DuBois, 1991). Although the primary benefit of note-taking is generally considered to be its external storage function, evidence suggests that the initial act of recording notes also benefits learning (Kiewra & DuBois, 1991; Peper & Mayer, 1978). One reason for the latter benefit is that when students record notes in class, they must actively engage with the material in order to integrate, organize, and synthesize a spoken lecture into an abbreviated written form (Kiewra, 1989). These types of generative activities promote meaningful learning even without reviewing the notes (Ausubel, 1968; Wittrock, 1974).

LECTURE OR PODCAST

To test these benefits, Peper and Mayer (1978, 1986) showed participants a videotaped lecture on computer programming, statistics, or automobile mechanics, during which half the participants took notes and half did not. Note-takers performed better than non-note-takers on tests of problem solving transfer, while non-note-takers performed better than note-takers on more detailed, technical questions. In addition, note-takers were more likely to include information from other parts of the lecture in their responses to a particular question. These results suggest that note-takers are more likely to focus on higher-order relationships in a lesson, while non-note-takers are more likely to focus on the details.

In addition to the type of test used to measure learning, another variable worth investigating is working memory capacity (WMC), which is a measure of the amount of information that an individual can actively hold in the mind and manipulate. Note-taking during a lecture requires the learner to select and record key points while simultaneously comprehending new information, placing significant demands on his or her WMC (Kobayashi, 2005; Piolat, Olive & Kellogg, 2005). Thus, despite the potential benefits of generative note-taking, students with low working memory capacity may be at a disadvantage if the cognitive processing required to integrate and organize the information exceeds their ability to perform those functions. In previous studies concerning note-taking, learners only had the opportunity to hear the lecture one time. However, the relatively new educational practice of podcasting allows students to listen to a lecture multiple times, which may help overcome any potential disadvantage of low WMC.

An audio podcast is an audio recording that has been converted into an instantly streamable online version. Podcasts in the realm of education are usually accessible only to class participants, and they are most commonly live recordings of lecture material. Podcasting is a relatively recent phenomenon, with the first audio feeds appearing in July 2003. By mid-2005, there were approximately 10,000 different podcasts available on a wide range of topics (Hew, 2009).

From the learner's perspective, the main advantages of podcasting are the simplicity and convenience that it offers. While lectures are given within a constrained time period and location, learners can listen to podcasts at their own pace and in a location of their choice (Hew, 2009). Additionally, podcasting may function as an external storage device—rather than relying only on the notes they take in class, students have the option of replaying the exact narrative of a lecture.

Since the phenomenon of podcasting is relatively new, research on the topic is scarce. Much of the work that does exist demonstrates how to create effective podcasts (e.g., Geoghegan & Klass, 2005; and Jham, Duraes, Strassler & Sensi, 2008), but research on how students should be utilizing this new technology is severely lacking. One exception examined the learning outcomes associated with podcasting and found that most students who use podcasts think they are helpful, but podcasts actually have little advantage over a written transcript of the lecture. From a practical standpoint, however, full transcripts of lectures are unlikely to be provided in most classes. The process of transcribing a lecture would be time-consuming, and students may be less likely to read through pages of transcripts than listen to an audio recording.

To fully understand the role of podcasting in the learning process, it should be assessed in conjunction with other typical study activities, such as note-taking. Some students may choose to take notes during the initial lecture, and some may choose simply to listen during the initial lecture and then take notes while studying with a podcast. It is possible that the timing of note-taking influences the effectiveness of the generative activities thought to occur while students

LECTURE OR PODCAST

record notes.

The Current Study

The current study explores how note-taking during different encoding opportunities could affect learning. Participants experienced two study sessions of scientific content, resembling a student attending lecture then studying with a podcast of the lecture. The final test included a free recall test to assess memory for details, as well as a transfer test to assess participants' comprehension of major concepts and their ability to make inferences using those concepts. We hypothesized that, by taking notes during only one study session, it may be possible for students to receive the problem-solving transfer benefit of note-taking as well as the fact-retention benefit of non-note-taking. Specifically, taking notes during *only* the podcast review, may allow participants to acquire a more broad and organized understanding of the material during lecture before engaging in the generative processes associated with note-taking. Along this line of reasoning, we predict that optimal timing of note-taking (i.e., during a podcast study session) may combine with the generative benefits of note-taking to produce greater overall learning. Furthermore, this benefit may be even greater for people with low WMC—although people with high working memory are linked to better performance on a number of measures (Unsworth & Engle, 2007), shifting the timing of note-taking to the podcast study session may allow low-working memory individuals to overcome any difficulties they usually face.

Method

Participants

A total of 79 undergraduate students from the University of California, Los Angeles participated in the study. Seven participants were eliminated due to prior knowledge (i.e., scoring above a 7 on the pretest), and seven were eliminated due to technical errors, leaving 65 participants in the final analysis (45 female, average age: 20.1 years). Participants were enrolled in various psychology courses and were given extra credit for participating in the study.

Design

The experiment utilized a between-groups design, with timing of note-taking manipulated between groups. Half the subjects took notes during the initial lecture (lecture notes group), while half took notes during the podcast review (podcast notes group).

Materials and Procedure

Participants took a pre-test on the computer to assess their pre-existing knowledge of astronomy. They were told that the test was self-paced, and they could leave items blank if they did not know the answer.

After completing the pre-test, participants put on headphones and watched a four-minute animated, narrated presentation on the life cycle of a star. Participants in the lecture notes group received a blank sheet of paper and a pen and were told to take as many notes as possible during the lecture. On the other hand, participants in the podcast notes group were not given paper or a pen and were instructed to simply pay attention and try to remember as much information as possible. Both groups were instructed to try to remember as much information as possible, for they would be tested at the end of the experiment. After the initial presentation, the experimenter collected the notes from the lecture notes group. Then, both groups were given a math distractor task for five minutes.

LECTURE OR PODCAST

After the initial distractor task, both groups listened to the podcast version of the lecture. They were told that they would be experiencing the same material that was covered in the first presentation; however, this time there would be no video. Participants in the lecture notes group were told that they would not be taking notes, and that they should just try to listen to best of their ability. Participants in the podcast notes group were now given a blank sheet of paper and a pen and were told to take as many notes as possible. Again, both groups were instructed to remember as much information as possible, and that the test was coming up shortly. After the podcast version of material ended, the notes taken by participants in the podcast notes group were collected. Then, both groups worked on a different math distractor task for five minutes.

After the second distractor task, participants began the final test. The first question was a free recall question that required participants to type all the information that they could remember from the lecture. They were informed that they would have 10 minutes to complete this first question, so they were encouraged to continue writing as much as possible during this entire time. After the time was up, the participants then continued with the rest of the test, which consisted of five transfer questions. Transfer questions tested information that was not directly stated in the material, but the participant should have been able to infer a correct answer from the presented information, thus demonstrating a deeper level of understanding and an ability to integrate abstract concepts effectively. For example, one transfer question read, "Imagine that two clouds of dust and gas become protostars of identical mass at the same time. What could cause these stars to enter the red giant phase at different times?" One possible correct answer was that these two stars could have different levels of external gravity affecting them, which participants could infer from other facts presented in the lesson.

After the final test, the participants completed a demographic questionnaire and a running span task (Broadway & Engle, 2010) to measure working memory capacity. The task took approximately five minutes, and then participants were debriefed and released.

Results

Scoring

Three independent raters scored the free recall and transfer tests for 32 subjects. Free recall responses received one point for each idea unit recalled, up to a possible total of 24 points. Each transfer question received one point for a correct answer, for a possible total of 5 points. Interrater reliability was .93; discrepancies were discussed among raters, and the remaining data were scored by one of the original raters.

Scores from the running span task were divided into two groups using a median split, creating a high WMC group and a low WMC group.

Recall

Figure 1 presents the proportion of correctly recalled idea units as a function of time of note-taking and WMC. We analyzed recall using a 2 (time of note-taking: lecture versus podcast) x 2 (WMC: high versus low) analysis of variance (ANOVA). As seen in Figure 1, the high WMC group tended to score better on the final recall test ($M = .56$, $SD = .13$) than the low WMC group ($M = .43$, $SD = .15$), $F(1,61) = 16.1$, $MSE = .28$, $p < .01$.

In support of our hypothesis, we also found a main effect of time of note-taking, $F(1,61) = 7.69$, $MSE = .14$, $p = .007$. The podcast notes group recalled more idea units ($M = .54$, $SD = .15$) than the lecture notes group ($M = .45$, $SD = .15$).

Contrary to our prediction, WMC and time of note-taking did not interact, $F(1,61) = .488$, $p = .488$.

Transfer

Figure 2 presents the proportion of correctly answered transfer questions as a function of time of note-taking and WMC. A 2 (time of note-taking: lecture versus podcast) x 2 (WMC: high versus low) analysis of variance (ANOVA) revealed that the high WMC group scored better on the transfer test ($M = .57$, $SD = .24$) than the low WMC group ($M = .38$, $SD = .26$), $F(1,61) = 8.65$, $MSE = .56$, $p = .005$. However, there was no effect of time of note-taking on transfer score, $F(1,61) = .90$, $p = .35$, and no interaction between WMC and time of note-taking, $F(1,61) = .04$, $p = .84$.

Individual Differences in Note-taking Behavior

Using the running span score as a continuous variable, correlational analyses indicated that WMC was positively correlated with the number of idea units contained in participants' notes, $r = .40$, $p = .001$, but there was only a marginal relationship between WMC and the number of words present in the notes, $r = .24$, $p = .06$. Furthermore, students who wrote down more idea units in their notes tended to score better on the final recall test ($r = .43$, $p < .001$), but not the transfer test ($r = .15$, $p = .22$).

Discussion

In the present study, we found that, unsurprisingly, people with high WMC performed better on final recall and transfer tests than people with low WMC (cf. Unsworth & Engle, 2007). A more novel finding, and one that supports our initial hypothesis, showed that participants who took notes during the podcast study session scored higher on a final free recall test than participants who took notes during the lecture study session. This benefit is likely a result of the increased efficacy of generative activities during a second study session. Specifically, because note-taking requires comprehension, selection of information, and written production processes, performing all these actions simultaneously may cause cognitive overload (Kellogg, 2005), especially during the initial lecture. When students take notes with a podcast after the lecture, however, having processed the information once should lessen the cognitive demand for comprehension. Thus, a podcast study session should be a more optimal note-taking opportunity. Furthermore, having learned the material once provides a unique opportunity for the podcast notes group to make connections between their existing knowledge and what they are processing while taking notes and allows them to understand the material holistically. Therefore, these students are able to be more efficient note-takers and remember more information by utilizing the podcast session in such a manner. Although we initially predicted that people with low WMC would benefit more than those with high WMC from being able to take notes during a later study session, that was not the case; rather, it appears that note-taking during the podcast study session is equally beneficial to both high and low WMC groups.

We did not find a difference in transfer scores as a result of the timing of note-taking, although the data are numerically in the hypothesized direction. It is possible that the timing of note-taking has less of an effect on inferential abilities than it does on factual memory. Thus, if transfer skills receive the same benefit regardless of the timing of note-taking, then learners may wish to take notes during a podcast study session in order to optimize both retention and transfer, especially if both types of skills will be tested.

Conclusion

LECTURE OR PODCAST

Our results suggest that if students were to take notes *either* during lecture *or* during a podcast study session, the students who took notes during the podcasted study session would likely receive higher grades on a subsequent test of that material. However, many students may choose to take notes during both the initial lecture and the podcast review. Thus, a logical next step would be to examine the three following conditions: two groups that take notes both in the lecture *and* in the podcast session (one being allowed to add to their previous notes, and the other having to create two separate set of notes for each of the two study sessions), and a third group that does not take notes in any study session.

We also see great potential in conducting experiments that manipulate the ability for participants to pause and rewind the presentation in the podcast session. This function of podcasts is another reason that they are a useful note-taking tool. This advantage may benefit those in the podcast session by making them even better note-takers, and therefore, even better test takers than those taking notes in the lecture session.

This line of research has both theoretical and practical implications—it provides insight on the cognitive processes that influence how typical study strategies, such as note-taking and studying with podcasts, interact. Furthermore, it offers practical suggestions for how students can improve their learning.

References

- Ausubel, D. P. (1968). *Educational psychology: A cognitive view*. New York: Holt, Rinehart, & Winston.
- Broadway, M. J., & Engle, R. W. (2010). Validating running memory span: Measurement of working memory capacity and links with fluid intelligence. *Behavior Research Methods*, 42, 2, 563-570. DOI: 10.3758/BRM.42.2.563.
- Di Vesta, F. J., & Gray, G. S. Listening and note taking. *Journal of Educational Psychology*, 63, 8-14.
- Geoghegan, M. W., & Klass, D. (2005). *Podcast solutions*. Apress.
- Hew, K. F. (2009). Use of audio podcast in K-12 and higher education: A review of research topics and methodologies. *Educational Technology Research and Development*, 57, 3, 333-357. DOI: 10.1007/s11423-008-9108-3.
- Jham, B. C., Duraes, G. V., Strassler, H. E., & Sensi, L. G., (2008). Joining the Podcast Revolution. *Journal of Dental Education*, 72, 278-281.
- Kiewra, K. A. (1989). A review of note-taking: The encoding-storage paradigm and beyond. *Educational Psychology Review*, 1(2), 147-172.
- Kiewra, K. A. & DuBois, N. F. (1991). Note-taking functions and techniques. *Journal of Educational Psychology*, 83, 2, 240-245.
- Kobayashi, K. (2005). What limits the encoding effect of note-taking? A meta-analytic examination. *Contemporary Educational Psychology*, 30, 242-262.
- Mayer, R. E. (Ed.). (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.
- Peper, R. J., & Mayer, R. E. (1978). Note taking as a generative activity. *Journal of Educational Psychology*, 70, 4, 514-522.

LECTURE OR PODCAST

Peper, R. J., & Mayer, R. E. (1986). Generative effects of note-taking during science lectures. *Journal of Educational Psychology*, 78, 34-38.

Piolat, A., Olive, T., & Kellogg, R. T. (2005) Cognitive Effort during Note Taking. *Applied Cognitive Psychology*, 19, 291-312. DOI: 10.1002/acp.1086.

Unsworth, N., & Engle, R. W. (2007). The nature of individual differences in working memory capacity: active maintenance in primary memory and controlled search from secondary memory. *Psychological review*, 114(1), 104.

Wittrock, M. C. (1974). Learning as a generative process. *Educational Psychologist*, 11, 87-95.

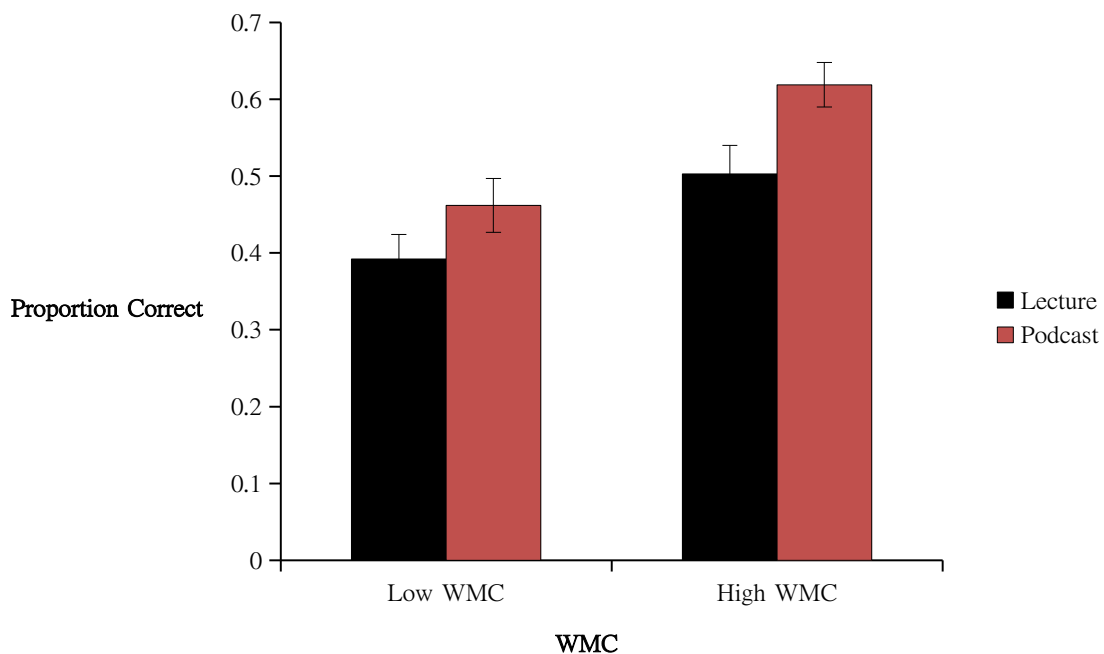


Figure 1. Proportion correct on the final free recall test as a function of time of note-taking and working memory capacity (WMC).

LECTURE OR PODCAST

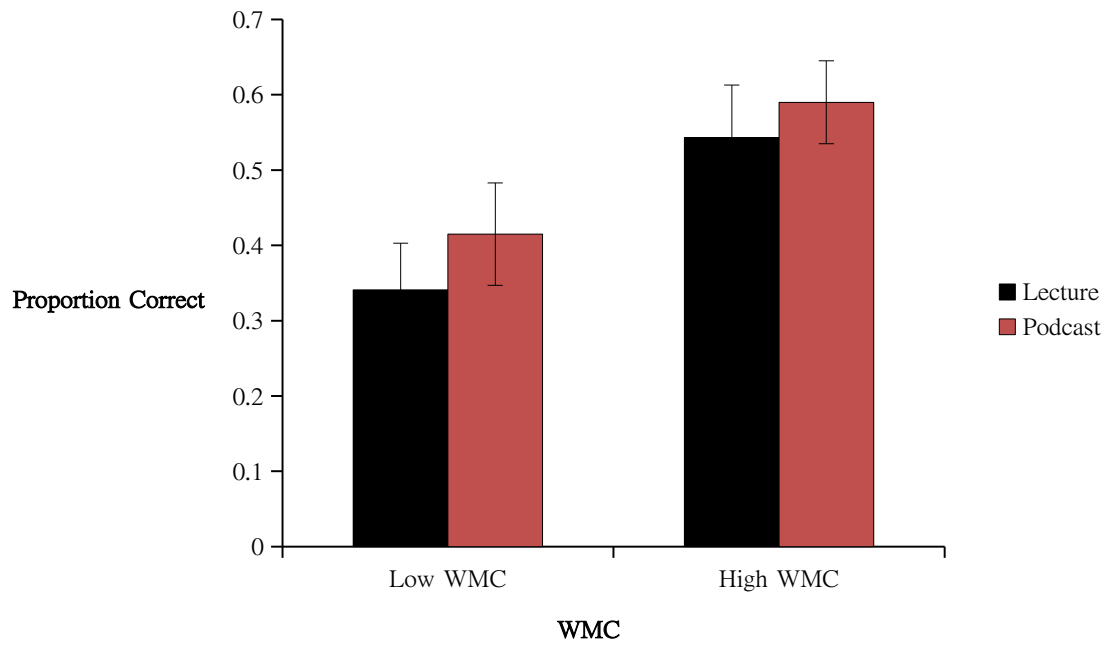


Figure 2. Proportion correct on the transfer test as a function of time of note-taking and working memory capacity (WMC).