The Timing of Note Taking and Effects on Lecture Retention

Joshua L. Williams, Nancy G. McCarley, James Parker, Ellen H. Williams, Christiaan Layer, and Dominique Walker
Armstrong Atlantic State University

Abstract

College students have long used note taking as a way to document, learn, and retain information in lecture-based courses. In this study we examined the impact that note taking has when used as an active reflection method post lecture rather than during lecture. We randomly assigned participants enrolled in introductory psychology courses to one of three conditions: a) note taking during lecture, b) note taking post lecture, or c) no note taking. All participants listened to a 30-minute lecture and completed a quiz over the information after 10 minutes and again after one month. Results suggest that note taking, regardless of the timing, does seem to aid information retention over the short term. However, participants permitted to take notes during the lecture exhibited the highest retention levels over the short term. Despite the superior performance in the note taking conditions over the short term, there was no indication of note taking aiding long-term retention. Results highlight the facilitative functions of note taking and
how these functions may work as a cooperative system to enhance student retention of lecture information.

**Keywords:** note-taking, lecture retention, quiz performance, immediate retention, delayed retention

### The Timing of Note Taking and Effects on Lecture Retention

In contemporary higher education, one of the most common information delivery systems continues to be teacher-centered, in which the teacher lectures while the students listen (Doyle, 2011). The practice of note taking during lecture has been associated with this arrangement and emphasized as an important metacognitive technique for recording and subsequently learning the content of the lecture (Dunkel, 1988; Dunkel, Mishra, & Berliner, 1989). Indeed, note taking is one key skill touted to be essential to students’ academic success (Arndt & Coleman, 2013; Halonen & Santrock, 2013; Harrington, 2013). In fact, Dunkel and Davy (1989) found that the vast majority of college students believed that note taking is important to their academic success.

With such an emphasis on the use of note taking, the question of whether it plays a facilitative role in the learning process has long been a topic of investigation. The most frequent proposals regarding the facilitative function of note taking fall into two categories, external storage versus encoding (Di Vesta & Gray, 1972; Hartley & Davies, 1978). Arguing for the external storage function of note taking is straightforward as it provides students with a record of lecture information for later review (Howe, 1974). However, the key to this facilitative function hinges on the initiative of students to review the information they recorded during the lecture. Indeed, review of notes taken enhanced students’ performance (Carter & van Matre, 1975; Dunkel et al., 1989; Hartley, 1983; Freyberg, 1956). On the other hand, some work has supported the notion that the simple act of taking notes induces differential cognitive engagement with the heard material during a lecture and subsequently facilitates the recall of lecture information, the so-called encoding function of note taking. In the absence of the opportunity to review notes after hearing a passage or short lecture, participants permitted to take notes recalled more specific ideas, relative to participants who did not take notes (Barnett, Di Vesta, & Rogozinski, 1981; Di Vesta & Gray, 1972, 1973; Einstein, Morris, & Smith, 1985).

Despite empirical evidence supporting both functions of note taking, Hartley and Davies (1978) and Howe (1974) criticized many of the studies from methodological standpoints. In some studies, the manipulations for testing the external storage and encoding hypotheses had methodological confound and provided little in the way of supporting either one. In a well-designed study, Knight and McKelvie (1986) better disentangled the two note taking functions. They found that the opportunity to review notes aided students the most with regard to retention. However, when encoding and reviewing functions were tested together, such that participants were able to take notes and review them, the impact on retention was greater than either alone. This seems to indicate that the two functions of note taking are most effective when used as a cooperative system rather than in isolation (Knight and McKelvie, 1986). Their findings address another major flaw in many note taking studies which is that in reality, students review their
notes multiple times before being tested (Howe, 1974; Knight & McKelvie, 1986). Thus, to consider the functions separately may actually lead us further from a more complete understanding of the facilitative process of note taking. In addition, this highlights a relatively under-investigated question in the area of note taking: May the act of note taking after rather than during a lecture serve a review function?

The notion that the act of note taking in and of itself serves a review function deals with the issue of the timing of note taking. Gates (1917) made a general comment on the possibility that taking notes post lecture would facilitate information retention more so than taking notes during lecture. This general comment indicates that post lecture note taking may be a method to help students actively engage the lecture material in a way that combines both the encoding and review function of note taking. Research in the area of active learning in higher education environments has highlighted that students learn in both passive and active manners, with much of the evidence pointing toward the superiority of active engagement (Bonwell & Eison, 1991; Doyle, 2011; Fink, 2003). The so-called testing effect is one active method that facilitates active recall of information (Roediger & Karpicke, 2006). Using the testing effect method, students actively retrieved information to which they were exposed in either lectures or readings. In terms of note taking post lecture, the delayed compilation of notes is considered a form of testing and may serve to improve memory for the lecture material.

Eisner and Rohde (1959) examined the impact that the timing of note taking had on the recall of information from a lecture. One group of participants took notes during the lecture and had 15 minutes to study those notes post lecture. A second group did not take notes during the lecture but had 15 minutes post lecture to compile notes. Ultimately, when examining scores on true-false tests, Eisner and Rohde (1959) failed to discover any differences in error rate between those who compiled notes during or after the lecture. In that study all Eisner and Rohde (1959) demonstrated was a lack of difference in rate of error production between participants who compiled notes at different times. However, a more important comparison would be between participants who compile notes during or after lecture with a non-note taking control. This comparison would not only provide information about whether the timing of note taking produces differential retention performance but also whether taking notes in general drives higher performance relative to not taking notes.

In the present study, we examined two aspects of note taking in college students enrolled in an introductory psychology course. First, we examined perceptions of the importance of note taking to academic success and students’ assessment of note taking skill. We expected students’ beliefs about note taking to be consistent with those reported by Dunkel and Davy (1989), in which students placed high importance on note taking as a facilitator of academic success. In addition, we expected students to hold the belief that they were strong note takers.

Second, we extended Eisner and Rohde (1959) in order to examine the impact that the timing of note taking has on immediate and long term retention of lecture material. Participants took notes either during or after a face-to-face lecture. We added a no notes control condition in which participants did not take notes at any point during the study to better assess both the general impact of note taking and the timing of note taking on information retention. All participants had 10 minutes after the lecture as a review period in an attempt to maintain a more
realistic college situation (Howe, 1974). After the review period, all participants completed an immediate lecture retention quiz and then an unannounced, delayed retention quiz one month later. If the act of note taking itself, regardless of the timing, is beneficial to information retention, then both note taking groups should significantly outperform the no notes control on the retention quizzes. If the act of taking notes post lecture is a beneficial review, or active reflection, method (Bonwell & Eison, 1991; Doyle, 2011; Fink, 2003), then the participants who compiled notes after the lecture should be the highest performers on both retention quizzes. If note taking is not beneficial to information retention, then no differences should arise amongst the conditions in information retention.

Method

Participants

Participants were college students enrolled in three sections of Introduction to Psychology at a small, regional university in southeast Georgia during the spring semester of 2013. The initial sample consisted of 104 participants. However, we excluded from analysis data from 16 participants with incomplete protocols (missed one experimental session) and five who had Marlowe Crowne social desirability scores greater than 26. The final sample of 83 participants (\( M = 19.34 \) years, \( SD = 3.06 \)) consisted of 18 males and 65 females, of which 42 were White, 29 were African American, 4 were Asian, and 8 were of multiple races. We randomly assigned each section of Introduction to Psychology to one of the following conditions: a) note taking during lecture (NTD; \( n = 25 \)), b) note taking post lecture (NTP; \( n = 26 \)), and c) no note taking (NNT; \( n = 32 \)).

Materials and Procedure

There were two experimental phases: An immediate retention phase and a delayed retention phase. The first phase of the experiment, the immediate retention phase, took place during participants’ normal class time and in their normal classroom. Upon completion of the informed consent process, all three sections of Introduction to Psychology heard the same 30-minute lecture on ethology. We selected ethology as the topic because the course instructors did not cover it. The content of the lecture included topics such as critical and sensitive periods, fixed action patterns, imprinting, instincts, sign stimuli, and key people of ethology. The lecturer was an adjunct faculty member in the department of psychology at the university, who was blind to the purpose, hypotheses, and conditions of the study. The lecturer delivered the information in face-to-face fashion with Microsoft PowerPoint slides, similar to that of a typical college course. During the lecture, only participants in the NTD condition compiled notes on paper provided by the experimenters. Participants in the NTP and NNT conditions listened to the lecture but did not have the opportunity to take notes in real time. At the conclusion of the lecture, participants in the NTD condition reviewed the notes taken during the lecture for 10 minutes. Participants in the NTP condition, however, had 10 minutes to construct notes on the lecture information they had just heard. We asked those in the NNT condition to “think” about the information presented during the lecture for a 10-minute period. After 10 minutes elapsed, all participants completed a 26-question quiz that consisted of 13 multiple-choice questions and 13 fill-in-the-blank questions. After the quiz each student rated their level of agreement with statements about the
importance of note taking to their academic success (“Overall, note taking is very important to my academic success”) and perceived skill at note taking (“In general, my note taking skills are very strong”). Each student rated their level of agreement on a seven point Likert scale on which “7” indicated strong agreement and “1” indicated strong disagreement.

The second phase of the experiment, the delayed retention phase, occurred one month after the immediate retention phase during participants’ normal class time and in the normal classroom. We used a delay of one month to simulate a typical retention interval in a college lecture-based course. During this phase, the participants took the same quiz administered during the immediate retention phase. Participants did not know in advance that they would be taking the quiz during the second phase in an attempt to examine retention of the lecture information with minimal to no further rehearsal. Upon completion of the quiz, we debriefed all participants.

Analyses

Statistical analyses examined data from two key aspects of the experiment. First, single sample \( t \)-tests examined participants’ agreement about the importance of note taking to their academic success and their perceived skill at note taking. We compared participants’ mean ratings for each question against the scale midpoint of four, which represented neutral agreement. In addition, a paired samples \( t \)-test compared participants’ mean agreement on the importance of note taking with perceived skill at note taking. Second, we calculated a total quiz score for each participant by combining correct answers on multiple choice and fill-in-the-blank questions. Then, we examined the immediate and delayed quiz scores for the experimental note taking groups (NTD and NTP) relative to the no notes control (NNT). Due to the non-normality of the distributions, we used nonparametric analyses to examine differences between the total quiz scores within and between the experimental conditions.

Results

Note taking importance and skill

We analyzed the data to gain general insight into how participants viewed note taking in terms of academic success and note taking ability. Figure 1 depicts the collapsed mean agreement ratings on note taking importance and skill. First, participants indicated their level of agreement on whether the practice of taking notes was important to their overall academic success. The mean agreement rating for students across all conditions (\( M = 6.46, SD = 0.97 \)) was significantly greater than the neutral midpoint, which indicated agreement, \( t(82) = 23.167, p < 0.0001, d = 2.54 \). Second, participants indicated their level of agreement on whether they believed their note taking skills to be strong. The mean agreement rating for students across all conditions (\( M = 5.55, SD = 1.08 \)) was significantly greater than the neutral midpoint, which indicated agreement, \( t(82) = 13.052, p < 0.0001, d = 1.43 \). The agreement patterns with regard to note taking importance and skill held true within individual conditions. Overall, mean agreement ratings were higher for the importance of note taking to academic success relative to strong note taking ability, \( t(82) = 6.458, p < 0.0001, d = 0.893 \).
Figure 1. The overall mean student rating (± 1 SD) of the importance of note taking to academic success and strength of note taking skills for all conditions combined. The midpoint of the scale is four and depicted by the solid line.

Retention quiz performance

Figure 2 depicts the median quiz scores for each condition for both the immediate and delayed phases of the study. Planned Mann-Whitney U-tests examined differences in immediate and delayed quiz performance between the experimental note taking conditions (NTD and NTP) relative to the no notes control (NNT). On the immediate retention quiz, participants in the NTD condition (Mdn = 14.00) scored significantly higher than participants in the NNT condition (Mdn = 12.00, U = 277, Z = 1.991, p = 0.046 (two-tailed), r = 0.264). Participants in the NTP condition (Mdn = 13.50) scored higher, although only approaching significance, relative to participants in the NNT condition (Mdn = 12.00, U = 305, Z = 1.748, p = 0.08 (two-tailed), r = 0.230). On the delayed retention quiz, we found no differences between the NTD condition (Mdn = 9.00) and the NNT condition (Mdn = 9.50, U = 385.5, Z = 0.268, p = 0.789 (two-tailed), r = 0.035) nor between the NTP condition (Mdn = 10.00) and the NNT condition (Mdn = 9.50, U = 356, Z = 0.944, p = 0.345 (two-tailed), r = 0.124).
Immediate Delayed Quiz Score (Mdn)

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**Figure 2.** Median quiz scores for the immediate and delayed retention sessions by group.

Planned Wilcoxon Signed-Ranks tests examined changes in quiz performance within each condition from the immediate retention phase to the delayed retention phase. Participants in all conditions exhibited a significant decline in quiz performance over time (NTD: $Z = 4.156$, $p < 0.0001$, $r = 0.831$; NTP: $Z = 4.022$, $p < 0.0001$, $r = 0.789$; NNT: $Z = 3.928$, $p < 0.0001$, $r = 0.694$, see Figure 2).

**Discussion**

Note taking continues to be one of the typical skills emphasized in the higher education environment to aid students in lecture-based courses (Arndt & Coleman, 2013; Halonen & Santrock, 2013; Harrington, 2013). With such an emphasis on developing note taking skills, we predicted that participants would believe note taking to be important to their success. In line with our prediction, participants in the current study placed a high importance on note taking to facilitate their academic success in college. Furthermore, we predicted that participants would believe that they were strong note takers and the data supported this prediction. However, their ratings about strength of note taking skills were significantly lower than the ratings on the importance of note taking, which seems to indicate recognition of room for improvement.

As note taking is not only an emphasized skill, but also one held in high regard by students in higher education, previous work investigated its facilitative impact on information retention. Most of this prior work focused on two separate, potential functions of note taking: external storage and encoding (Di Vesta & Gray, 1972; Hartley & Davies, 1978). Supporting evidence exists for each potential function. However, some studies with more methodologically rigorous designs indicate that concurrently emphasized functions increased the facilitative potential of note taking (Howe, 1974; Knight and McKelvie, 1986). Therefore, in the current study we examined a particular way in which the act of note taking could serve both potential
functions of note taking simultaneously. Specifically, and similar to Eisner and Rohde (1959), we manipulated the timing of the note taking act in such a way that some participants took notes during a lecture, some took notes post lecture, and others did not take notes at all. In this way, we attempted to address the notion of whether note taking in general aids students in retaining lecture information, but also if note taking could serve as an effective review, or active reflection, method.

With regard to the general facilitative effect of note taking, we predicted that if note taking in and of itself aids students in retaining lecture information, then both note taking groups would outperform the non-note taking control. We found partial support for this hypothesis as participants in both note taking conditions outperformed the non-note taking control on the immediate but not the delayed retention quiz. However, only the participants who were permitted to take notes in real time and subsequently review those notes post lecture scored significantly higher than the non-note taking control on the immediate quiz; the participants who compiled notes post lecture exhibited only marginally higher scores relative to the control. The fact that only the participants who took notes and then reviewed the notes taken showed the highest performance immediately is in line with the work from Knight and McKelvie (1986) in that when there is full integration of the external storage and encoding functions, note taking seems to have the most positive impact on retention. As the participants who compiled notes post lecture did not display significantly higher retention scores relative to the control on either quiz, which could be a by-product of a relatively small sample size, we did not find full support for the notion that note taking served an effective active reflection method. However, despite lacking statistical significance both note taking conditions did perform better than the non-note taking control on the immediate retention quiz, which seems to suggest that regardless of the timing at which it occurs, note taking may serve to enhance information retention over the short term.

Despite the differential performance on the immediate retention quiz between the note taking conditions and the control, it is important to note that after a one month interval, during which time neither note taking group reviewed their notes, retention in all groups declined significantly and retention levels did not differ from the control group. Some may view this particular aspect of the study as low in ecological validity since it is unlikely that students would not consult their notes before being tested again (Howe, 1974). However, it is important to note that in our study students did not know about the delayed retention quiz. In a college environment, there is certainly the possibility for pop-quizzes, which would reflect the design of our study. Thus, this particular finding highlights the importance for further engagement of the external storage function through repeated review of notes. The positive effects of repeated review on retention of information from notes compiled was highlighted by prior research and it appears that without it information decays in memory quite significantly over time (Freyberg, 1956; Howe, 1970a, 1970b). It is possible that participants in the note taking conditions would have exhibited superior performance relative to the control on the delayed retention quiz had the opportunity to review notes compiled, regardless of when they were compiled, been provided.

In looking to the future, rather than examining the utility of note taking by honing in on isolated functions of note taking in facilitating student success in college (Barnett et al., 1981; Carter & van Matre, 1975; Di Vesta & Gray, 1972, 1973; Dunkel et al., 1989; Einstein et al.,
1985; Hartley, 1983; Freyberg, 1956), it is important to examine how the proposed functions work together. Taken together with the results of Howe (1970a, 1970b) and Knight and McKelvie (1986) the results of this study indicate that note taking may reach its full facilitative potential for retention of lecture information when repeated review of notes taken and cognitive engagement with the presented material are examined as a functional unit.

References


