AMERICAN PSYCHOLOGICAL ASSOCIATION

Scholarship of Teaching and Learning in Psychology

ISSN: 2332-2101

2026, Vol. 12, No. 2, 217–227
https://doi.org/10.1037/stl0000425

Online Studying and Restudying Text Versus Video

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With the dramatic rise in online courses, studying and restudying from on-screen text and video have become increasingly prevalent. In this experiment, we examined the influence of restudying modality by assigning participants to one of four conditions: (a) reading and rereading a text ($n = 98$), (b) watching and rewatching a video ($n = 86$), (c) reading a text and then watching a video ($n = 99$), or (d) watching a video and then reading a text ($n = 102$). In each condition, the content was identical on the two occasions. Restudy was followed by a multiple-choice test of the material. Performance on this test was best when both study and restudy involved reading the text ($p < .01$ vs. the other three conditions) as opposed to any of the three conditions that involved watching the video (all three ps $> .50$). Based on this experiment, the greater attention and more active processing required for reading online text than for watching online video appears to be beneficial for learning.

Keywords: restudying, online learning, video lectures, rereading

Studying is an important and pervasive element of formal education. Students spend a substantial amount of their time studying in preparation for quizzes, tests, and examinations. Repeated interactions with course materials through studying—and restudying—are essential both to encoding the information into long-term memory and to successfully retrieving that information at a later time. Consequently, there is extensive research dedicated to understanding the best ways to learn and remember course material and there are many sources aimed at helping people to study more effectively (see, e.g., Brown et al., 2014; Dunlosky et al., 2013; Miyatsu et al., 2018).

There are many study techniques that students can consider using when studying for their courses, among them reading/rereading materials, highlighting, writing/rewriting notes, self-testing, and creating mnemonics (Maurer & Shipp, 2021). Yet despite the variety of techniques available, many students still study in the same way: They repeatedly go over the information from a textbook or from their notes (see, e.g., R. A. Bjork et al., 2013; Callender & McDaniel, 2009; Karpicke et al., 2009). We know, of course, that simple repetition of information—rehearsal (see, e.g., Dark & Loftus, 1976; Rundus, 1971)—does increase the likelihood of remembering it. We also know, however, that more elaborative encoding that emphasizes meaning and integration is a considerably more effective way to learn (Bradshaw & Anderson, 1982; Chi & Wylie, 2014; Craik & Lockhart, 1972). Yet many students do not realize the value of elaboration—or they do not take this to heart. Instead, the method that intuitively seems most beneficial to learning—due to repetition and to spending a great deal of time on the material—is simply rereading the information (Miyatsu et al., 2018). To many students, it seems reasonable to assume that the more times they cover the material—at whatever level—the more likely they will be to remember it and even to understand it. It is likely that this longstanding assumption, and hence restudying behavior itself, has not changed substantially with the move to online courses.

This article was published Online First August 29, 2024.
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This research was supported by Discovery Grant A7459 from the Natural Sciences and Engineering Research Council of Canada awarded to Colin M. MacLeod and represents the senior honors thesis of Brooke A. MacLeod conducted under the supervision of Laura J. Bianchi and Colin M. MacLeod.
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At least sometimes, however, rereading does not confer a benefit. Consistently over four experiments, Callender and McDaniel (2009) reported no difference in test performance between having read a text only once and having reread it. They argued that the text was processed similarly—and rather shallowly—each time it was read, consequently not affecting its representation in memory. Rawson (2012), however, did report a benefit of rereading in a similar study and suggested, based on reading time data, that participants in the Callender and McDaniel study had switched to faster "skimming" when rereading, a less effective encoding strategy because it results in relatively minimal elaboration.

Phillips et al. (2016) also observed no benefit of rereading but suggested a different reason. They had participants read one text only once and another text twice. They observed no difference in comprehension test scores between the text read once and the text read twice. In a follow-up study where the texts were replaced with videos, performance on the test again was similar for the once-viewed and twice-viewed material (Martin et al., 2018). Critically, both of these studies measured mind wandering, the tendency for thoughts to drift off task, by using occasional probes asking participants whether they had just been on task or mind wandering. In both studies, mind wandering increased during restudying, offering a different explanation for why rereading and rewatching were not beneficial relative to a single study episode. Of course, skimming and mind wandering need not be mutually exclusive.

These empirical studies suggest that restudying is not always an effective way to enhance learning of lecture material, whether rereading or rewatching the material. Both are often done at quite shallow levels of processing, with minimal elaboration. In their Interactive, Constructive, Active, and Passive framework for classifying learning activities, Chi and Wylie (2014) suggested that optimal learning occurs during interactive activities (e.g., defending an argument). These are better than more passive activities, like reading a text or watching a lecture, due to enhanced cognitive engagement with the material. Thus, the Interactive, Constructive, Active, and Passive framework would equate reading a text to watching a lecture because both are ordinarily passive unless the learner additionally engages with the material (e.g., by taking notes). Learners may prefer more passive forms of learning as their study choice because these feel fluent, leading the learner to think that they are learning easily—even though challenging themselves with a more difficult strategy would be a better way to learn (e.g., desirable difficulties; E. L. Bjork & Bjork, 2014; R. A. Bjork et al., 2013).

Students who restudy material this way may be using their time inefficiently and could be learning more effectively by using other strategies. But might it be that restudying material in the identical format is part of the problem? We know that encoding variability can promote greater learning (see Maddox, 2016; Zawadzka et al., 2021), enhancing elaboration and providing additional retrieval paths to the information. Consequently, in the present study, we set out to compare same-mode to different-mode restudying, using text and video versions of the same content. It is not uncommon for instructors to provide students with a video lecture as well as a closely related reading, with very considerable overlap in content between the two. In particular, if the same information was presented once as text and once as video, would studying in both ways be more beneficial than watching or reading the same material twice? This has not yet been explored and thus formed a key motivation for the present study.

The online environment readily permits variability in the mode of delivery of material. Online instructors can use online texts as well as prerecorded videos to aid in student learning, in addition to or in place of traditional lectures. A review of online learning with videos versus lectures suggests that the videos are comparable to face-to-face learning when it comes to learning outcomes (Noetel et al., 2021). This, along with the increased use of prerecorded lectures in courses after the COVID-19 pandemic, has led many to begin to assess video lecture formats in more detail. Videos are a unique method for conveying information as they are considered forms of multimedia, meaning that they convey information via multiple channels, primarily the visual and auditory channels (Mayer, 2020).

Integrating information from the visual and auditory channels is proposed to lead to superior learning than that resulting from only a single channel (e.g., reading, which mainly uses the visual channel) as long as the information input remains below the learner's information load capacity (Mayer, 2020). This could suggest that

learning from video may be better than learning from reading a text; indeed, work on which is a better format to learn—reading a text or watching a video—has become a popular topic for research (List, 2018; Merkt et al., 2011; Tarchi et al., 2021). Researchers who have examined this issue empirically have not, however, been as uniform in their preference for videos over texts. Tarchi et al. (2021) provided a selective review of studies comparing the two modes, noting some of the confounds that exist in trying to make such direct comparisons. This led us to our secondary motivation: to investigate whether, in an online environment, one form of presentation of material was more beneficial than the other. Do students learn more from text or video, or are these two sources of information equally effective?

In the present investigation, we sought to answer our two questions regarding how restudying interacts with the mode of material presentation by comparing restudying conditions using the same lecture content but using two modes: video format and text format. Our first research question was whether learning was improved when individuals learned through mixed formats compared to restudying in the same format, as mixed formats would seem to offer encoding variability for the same information. Our second research question aimed to contribute to the debate about learning from video versus text, specifically whether just watching a video or just reading a text are comparable in learning outcomes. To answer these two questions, participants in this study were presented with the same information twice, with some participants given the same mode both times (i.e., text twice or video twice) and others provided with the text once and the video once, in either order. Thus, the only change in the two mixed-mode cases relative to the two same-mode cases was the presentation format itself. In addition, a postexperiment questionnaire probed participants' intuitions about the four restudy conditions and about their confidence and their attention during the experiment.

Method

Participants

A total of 484 University of Waterloo students were recruited through the Sona participation system (https://www.sona-systems.com/) to take part in a fully online study. This participant pool consists of 75.34% female and 24.11% male students (with the remaining 0.55% declining to answer) having a mean age of 20.68 years (SD = 4.00). Prior to collecting data, and after a little local piloting, we decided that the data of participants who took less than 15 min (N = 66) or more than 1 hr (N = 32) to complete the study would be discarded. One further student was excluded because technical difficulties prevented them from studying the material twice. After removing these participants, there were 385 usable data sets: 86 in the video–video condition, 98 in the text–text condition, 102 in the video–text condition, and 99 in the text–video condition.

As remuneration, participants received 0.5 credits toward a University of Waterloo psychology course. Consequently, it can be assumed that most participants were psychology students or at least had some background in psychology. Participants read a recruitment letter before the study and a feedback letter after the study, the latter providing them with information about the study and with contact information to reach the researchers if they had any questions. The study was approved by the University of Waterloo's Office of Research Ethics (Protocol No. 42433).

Design

In a between-subjects design, participants were assigned to one of four study/restudy conditions: (a) reading and then rereading a text of a lecture (text–text), (b) watching and then rewatching the corresponding video lecture (video–video), (c) reading the text and then watching the video of the lecture (text–video), or (d) watching the video lecture and then reading the text (video–text). The main dependent variable was the proportion correct on the test following the second study phase.

Materials

The materials consisted of two video lectures and their corresponding texts, one about insurance and one about politics. Both videos showed the lecturer speaking but did not include any background slides or the like, nor did the texts have any additional tables or graphics. Consequently, text and video closely corresponded. Participants were randomly assigned to one set of materials; the two sets of materials were used to provide

generalization. The video lectures were from Yale University's Open Yale Courses (Shiller, 2011; Smith, 2006) and were each between 9 and 10 min in duration uninterrupted. The texts were transcripts of the video lectures that we created. These were edited minimally to be more fluid and text-like, yet to contain the same information as the videos. Reading of a text by a participant was self-paced with instructions to read the text once at a normal rate without going back over all or part of it. The time to read a text was recorded as the time between a button press to display the text and a button press to proceed to the next phase of the experiment. Note-taking was not permitted in any of the conditions.

We created two tests, one for the insurance material and one for the politics material. Each test consisted of 10 four-alternative multiple-choice questions that related to the information in the lectures, with an effort made to spread the questions evenly throughout the entire material.

There also were follow-up questions that asked participants about (a) their experiences in the study, (b) which of the study conditions they thought would be most beneficial for learning, and (c) how confident they felt in their comprehension of the material before and after their second exposures to the material. This section comprised six questions: three multiple-choice questions, two yes/no questions, and one question requiring a typed response.

Procedure

Participants signed up for the study via the Sona system. The study was online and was designed to fit comfortably into a 30-min session. Participants were randomly assigned to one of the four study conditions and to one of the two possible topics.

Once they had given consent to continue the study, participants were presented with instructions. These began with the following information: "During this study, you will be studying material on a topic twice. Studying will be followed by a quiz relating to that material, as well as a quiz that is unrelated to the material." They then either watched a video or read an on-screen text about the topic. After they were done, they were given further instructions on what their second learning condition would be, and once again either watched a video or read a text about the same topic. After they had completed these two study episodes, participants were asked to estimate the percentage of questions that they would answer correctly on a 10-question multiple-choice test about the information just studied. The purpose of collecting self-assessed learning estimates was to compare participants' confidence on content understanding with their actual performance. We would also be able to determine whether the mode of study/restudy influenced the degree of confidence.

Participants completed both of the self-paced 10-question multiple-choice tests. To avoid possible contamination, all participants first completed the test of the material that they had actually studied. They then completed the test of the material that they had not studied under instructions to try their best despite not having been exposed to this content previously. This second test for the unstudied material served as a baseline, indicating how participants would have performed on the test had they not studied the material. Next, participants were asked about the experiment itself—whether there were any issues with it, what they thought it was about, and whether they felt more prepared for the test after restudying the material. The purpose of these questions was to ensure that there were no technical issues in the study and to assess what people thought the best study strategy was. Finally, participants were informed about the purpose of the study, thanked for participating, and redirected to the Sona system to receive their credit.

Results

Test Performance

There was clear evidence of learning as measured by test performance.[1] As expected, participants performed significantly better on the test for the topic that they had studied ($M = 0.49$, $SE = 0.01$) than on the test for the topic that they had not studied ($M = 0.30$, $SE = 0.01$), $t(384) = 15.79$, $p < .001$, $d = 1.047$), with performance on the unstudied test being quite close to chance (.25).

[1] Note that responses to two questions on the politics test and one on the insurance test suggested that these items were not ideal. The Appendix reports analyses with these questions removed but because none of the findings reported in the main text were altered by this removal, here we report analyses using all 10 questions.

The principal question was whether the four study/restudy conditions resulted in differential learning as measured by the test scores. The relevant means and standard errors are displayed in the leftmost column of Table 1. We first carried out a 2 × 4 between-subjects analysis of variance that included the factors of material (insurance vs. politics) and restudy group (text–text, text–video, video–text, and video–video). The main effect of material was significant: Participants who had studied the insurance topic ($M = 0.53$, $SE = 0.02$) performed better on their test than participants who had studied the politics topic performed on their test ($M = 0.46$, $SE = 0.01$), $F(1, 377) = 15.59$, $MSE = 0.04$, $p < .001$, $\eta_p^2 = .04$. Critically, material did not interact with restudy group, $F(3, 377) = 0.49$, $MSE = 0.04$, $p = .69$, $\eta_p^2 = .004$. The main reason for using two sets of materials was for generalization, and it is clear that the results of primary interest were consistent across materials.

Of primary interest, the test scores differed significantly over the groups, $F(3, 337) = 7.36$, $MSE = 0.04$, $p < .001$, $\eta_p^2 = .06$. Because inspection indicated that performance in the text–text condition was better than in the other three conditions, we followed up with post hoc Tukey comparisons.[2] These showed that, indeed, performance in the text–text condition was significantly better than that in each of the three other conditions (video–video: $p < .001$; text–video: $p = .009$; video–text: $p = .002$) and that the three other conditions did not differ from each other (all ps > .50). Put simply, reading a text twice resulted in better test performance than did any condition that involved watching a corresponding video.

We prefer the analysis just presented, where the four conditions are treated as a single level. However, a 2 (first study format: text vs. video) × 2 (second study format: text vs. video) between-groups analysis of variance, collapsing over the two different materials, supports the same conclusion, favoring reading text over watching video. In the 2 × 2 analysis, there was a significant effect of first study format, $F(1, 381) = 9.06$, $MSE = 0.04$, $p = .003$, $\eta_p^2 = .02$, with participants who had read the text ($M = 0.52$, $SE = 0.02$) performing better on the test than participants who had watched the video ($M = 0.46$, $SE = 0.02$). There also was a significant effect of second study format, $F(1, 381) = 6.42$, $p = .012$, $\eta_p^2 = .02$, again with participants who had read the text ($M = 0.52$, $SE = 0.02$) performing better on the test than participants who had watched the video ($M = 0.46$, $SE = 0.01$). The interaction was not significant, $F(1, 381) = 1.84$, $p = .175$, $\eta_p^2 = .005$. Put simply, reading a text resulted in better test performance than did watching a corresponding video whether that text was read first or second.

Table 1

Mean Proportion Correct on the Test and Mean Reading Time in Seconds for the Study and Restudy Episodes as a Function of the Four Study/Restudy Conditions

Study/restudy condition	Test score	Reading time	
		Study	Restudy
Text–text	.56 (.02)	357 (16.49)	322 (19.35)
Text–video	.48 (.02)	323 (19.39)	
Video–text	.47 (.02)		438 (19.31)
Video–video	.45 (.02)		

Note. Standard errors are shown in parentheses beside the corresponding means. The time to view the videos was approximately 600 s (10 min) for the politics video and approximately 551 s (9 min, 11 s) for the insurance video. Each viewing time is substantially longer than the time that participants took to read the corresponding text.

Reading Time

Collapsing across the groups, those who studied the insurance topic ($M = 521$ s, $SE = 21.45$) took significantly longer to read than did those who studied the politics topic ($M = 447$ s, $SE = 22.37$), $t(297) = 2.32$, $p = .021$, $d = 0.27$. This difference in reading time may, in part, account for the better test performance by those who studied the insurance topic, although it is also the case that the insurance text (1,113 words) was 48 words longer than the politics text (1,065 words). Of course, other factors, such as differential interest and comprehensibility, could also have been influential, factors for which we had no indices.

Most interesting are the reading times, which are displayed in the two rightmost columns of Table 1. Impressively, participants in the text–text condition took a similar amount of time on both readings, $t(97) = 1.72$, $p = .089$, $d = 0.20$, suggesting that they took the study seriously and did not switch to skimming on the second reading. There was, however, a significant difference between the (first) reading time in the text–video

[2] Bonferroni and Tukey p values were virtually identical, so we report only the Tukey p values.

group and the (second) reading time in the video–text group, $t(199) = 4.20$, $p < .001$, $d = 0.59$. Specifically, the video–text group read for significantly longer than the text–video group did. Examining just the first readings, participants in the text–video group and the text–text group did not differ in how long they read, $t(195) = 1.36$, $p = .177$, $d = 0.19$. Examining just second readings, participants in the video–text group took significantly longer to read than did those in the text–text group, $t(198) = 4.22$, $p < .001$, $d = 0.60$.

Furthermore, a one-way analysis of covariance was conducted using reading time as the covariate to investigate whether differences in test scores between study conditions persisted after controlling for time spent reading. Only the three study conditions that involved at least one session of reading the text (i.e., text–text, text–video, and video–text) were included. There was a significant main effect of reading time, $F(1, 295) = 8.67$, $MSE = 0.04$, $p < .001$, $\eta_p^2 = .029$, but no main effect of study condition, $F(2, 295) = 1.56$, $MSE = 0.04$, $p = .212$, $\eta_p^2 = .010$, further suggesting that reading is an important component of successful studying.

Correlational Analyses

We also examined the correlation of reading time with test performance in the conditions where participants read the text. Longer reading time appears to result in better test performance, but mainly when the text was read first. Collapsing across conditions, there was a significant positive correlation between reading time and subsequent test score, $r(297) = .24$, $p < .001$. The correlation was significant for the text–video group, $r(99) = .26$, $p = .011$, but not for the video–text group, $r(100) = .01$, $p = .896$. For the text–text group, the correlation was significant with the first reading time, $r(96) = .21$, $p = .041$, but marginal with the second reading time, $r(96) = .17$, $p = .094$.

Recall that participants provided estimated test scores prior to the test, allowing us to relate how they thought they would do on the test to how they actually did. There was a significant overall negative correlation between participants' estimated scores and their actual scores, $r(381) = -.49$, $p < .001$.[3] Essentially, participants expected to score higher than they actually did, a kind of overconfidence not unprecedented in the metamemory literature (e.g., Son & Kornell, 2009). This correlation was present in all four conditions: text–text, $r(96) = -.655$; text–video, $r(96) = -.443$; video–text, $r(100) = -.503$; and video–video, $r(83) = -.390$; all ps $< .001$.

Postexperiment Questionnaire

Turning to the questionnaire, several observations emerged from the three performance-related questions. Most notably, in answer to the question "For studying, which of these do you think would result in the best learning, as measured by the test?" 16% selected "Reading the text twice," 12% selected "Watching the video twice," 41% selected "Reading the text and then watching the video," and 32% selected "Watching the video and then reading the text." Thus, most participants (73%) thought that a mixed-mode study would result in the best learning. In fact, the key factor was reading the text. Note that 32% of participants selected the condition that they had actually experienced as "best" for learning, so it is possible that the manipulation influenced their response to this answer.

In response to the postexperiment question "Did your confidence in your knowledge about the subject change after the second presentation?" 51% selected "I was more confident than after the first presentation," 17% selected "I was less confident than after the first presentation," and 32% selected "My confidence didn't change." Not surprisingly, then, confidence in the knowledge gained generally increased or remained steady after the second exposure to the material. For those who said that their confidence in the material dropped after the first exposure, 63% were in a mixed-format condition, which might suggest that changing the study format made them more aware of what they had not learned. That said, there was no significant difference in accuracy in their estimates of their test performance based on being in a same-format versus a mixed-format condition, $t(381) = 0.42$, $p = .67$, $d = 0.04$.

In response to the question "How did your attention to the information compare on the two presentations?" 41% selected "I paid more attention the first time," 37% selected "I paid more attention the second time," and 22% selected "I paid the same amount of attention

[3] Note that two participants did not provide estimated scores.

both times." The similar rates of selecting each of the choices could suggest that participants were not well calibrated for how much attention they paid or that, after the experiment was completed, they could not recall how well they had attended. Of course, in the absence of a behavioral measure of attention, these responses could also simply be accurate.

Discussion

By way of reminder, our first research question was whether learning from a lecture would be improved when studying on two occasions was based on different formats as opposed to the same format, the idea being that different formats potentially provide encoding variability for the same information on the two occasions. Our second research question focused specifically on learning from video versus text, asking whether watching a video of a lecture or reading a corresponding text results in comparable learning outcomes.

We were surprised that our results did not support the intuition that a change in the mode of presentation between the initial study and subsequent restudy would enhance test performance relative to repetition of the same mode on the two occasions. Indeed, on the questionnaire following the experiment, the majority of participants indicated that they shared this intuition, believing that mixed-mode conditions would lead to better test scores. Consequently, it may not be how the content appears that is important but whether it is identical in terms of information across the two study episodes.

We were also surprised to find that what mattered most for understanding and remembering the content of online lectures was having the opportunity to read the material twice. The only condition that stood out was the text–text condition: It was better than the other three conditions, which were all very similar to each other. This was true despite the fact that reading times were the same in the text–text and text–video conditions, in both of which reading time was faster than in the video–text condition. That the total time spent reading bore no relation to test score suggests that the benefit of reading text is not simply a consequence of how long one spent reading, a conclusion inconsistent with a "total time" hypothesis (see Cooper & Pantle, 1967).

For sources containing the same content, reading a text was more beneficial than watching a video. This runs counter to the prevalent view that video is a richer and therefore better source of information in terms of ultimate learning. Participants may have paid less attention to the videos, possibly even succumbing to mind wandering. It is also conceivable that the apparently prevalent belief that watching video is the better way to consume information led to less effort put into elaborative processing when watching a video relative to when reading a text (Cennamo, 1993). Studying from text may actually bring about a "desirable difficulty" (E. L. Bjork & Bjork, 2014), promoting more elaborative processing.

One avenue to consider in trying to understand the importance of the mode of online study is the crucial role of attention in learning and memory. Attention determines the information that will be encoded (Chun & Turk-Browne, 2007) and therefore directly influences subsequent test performance. It may well be that, relative to the processing of video, the processing of text is done more "deeply" (Craik & Lockhart, 1972), with greater attention devoted to meaning and elaboration. Put another way, reading may be a more active process, and watching a video may be more passive, at least with regard to how learners approach these two tasks. It is certainly well established that active processing results in better learning (see Dunlosky et al., 2013; Freeman et al., 2014), and previous research has suggested that active learning promotes greater engagement with the material (e.g., Dorestani, 2005). A key component of active learning likely is the deployment of greater attention to meaning.

There is at least one way in which the study method enforced here may not directly parallel study practices in the real world. In our procedure, two consecutive exposures to study materials occurred without a substantial break between them. In typical study scenarios, it is likely that students take a break—possibly a long break—between study sessions, availing themselves of the benefits of spaced learning (see Benjamin & Tullis, 2010). It is possible that a break would increase the effectiveness of a second study by restoring attentional resources, and so restudying—and possibly even mixed-mode restudying in particular—might be more beneficial when there is a greater temporal gap between study and restudy.

Additionally, the videos used here likely were different from video (or in-person) lectures commonly presented to students. The use of a slideshow with bullet points and graphics, in addition to the instructor speaking, is commonplace in academic settings. In contrast, the videos used here only depicted the speaker lecturing, without a co-occurring slide show. It is possible that the added visual stimulation often associated with typical lectures might maintain attention better, but it is also possible that it might interfere with processing information, and thus lead to learning outcomes that differ from those in our study (cf. the split attention principle; for a review, see Ayres & Sweller, 2014). There also is evidence that learning from a live lecture does not differ from learning from a video recording of the lecture (Artz et al., 2022).

In future investigations, it would be useful to examine whether the same benefit of reading text also appears when longer texts and videos are studied. In the present study, the texts were only about 1,000 words, and the videos were approximately 10 min long. These materials are substantially shorter than what has traditionally been used in real educational settings, such as lectures or textbook chapters, although shorter materials are common in research on classroom learning. It is an open question whether reading a text would still be more beneficial for memory than watching a video lecture when the material is longer. Reading a long text could deplete attention faster than watching a long video, thus a video might be more advantageous in this scenario.

If the material length does matter, and shorter texts are more beneficial than shorter videos, this knowledge could be applied to studying by splitting a longer reading into shorter sections or "modules," a technique that is becoming more common in online and hybrid courses. Students indicate a preference for shorter modules and appear to learn better from them as well (cf. content chunking; Humphries & Clark, 2021).

One of the motivations for this project was to examine whether restudying using mixed-mode materials would result in a benefit over using same-mode materials. Although no advantage of mixed-mode studying and restudying was observed, there were still clear results with implications for studying practices. Relative to watching a video, reading text demonstrated a significant benefit on later test scores, suggesting that reading remains a valuable studying method. This has implications for students looking to optimize their studying practices, as well as for teachers seeking to instruct more efficiently. In a studying and restudying context, students should ensure that they read the material in addition to consuming the information in other formats. Indeed, this fits with the longstanding practice of professors urging their students to read the material before coming to class, although reading it after class may be just as useful. In conclusion, although this research did not find a beneficial effect of multimode restudying versus same-mode restudying, it does emphasize the importance of integrating reading into study sessions, especially when restudying is likely to occur.

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Appendix

Details on Individual Test Questions

Three test questions were potentially problematic. On the politics test, participants who studied that material did not answer Questions 5 and 9 consistently better than chance (see Table A1). On the insurance test, Question 3 actually was answered correctly more often by individuals who had not studied that material. All three of these questions also had small and nonsignificant item-to-total correlations ($r < .1$, $p > .1$), indicating that they did not correlate well with the rest of the test. We therefore computed new test scores with these items dropped: Politics test scores were now out of eight, and insurance test scores were now out of nine. These changes did not, however, alter any of the patterns or change any of the conclusions reported in the main text.

On the politics test, participants in the politics study condition still did better ($M = .42$, $SE = .01$) than did those in the insurance study condition ($M = 0.29$, $SE = .01$), $t(383) = 7.52$, $p < .001$, $d = 0.84$; on the insurance test, participants in the insurance study condition still did better ($M = 0.50$, $SE = .02$) than did those in the politics study condition ($M = 0.24$, $SE = .01$), $t(383) = 14.47$, $p < .001$, $d = 1.45$.

When we reran our 2×4 analysis of variance with these problematic items dropped, there was still a main effect of material, $F(1, 377) = 22.17$, $MSE = 0.04$, $p < .001$, $\eta_p^2 = .06$, and the

Table A1

Proportions of Participants Who Answered Each Test Item Correctly as a Function of the Material That They Studied

Politics test	Politics lecture	Insurance lecture	Insurance test	Insurance lecture	Politics lecture
Q1	.66	.35	Q1	.64	.22
Q2	.48	.43	Q2	.79	.40
Q3	.34	.20	Q3	.33	.44
Q4	.57	.27	Q4	.31	.16
Q5	.17	.10	Q5	.82	.45
Q6	.43	.41	Q6	.34	.10
Q7	.69	.61	Q7	.38	.33
Q8	.40	.27	Q8	.62	.25
Q9	.23	.16	Q9	.53	.14
Q10	.56	.30	Q10	.55	.36
M	.45	.31	*M*	.53	.28

Note. Q = Question.

(*Appendix continues*)

interaction still was not significant, $F(3, 377) = 0.57, MSE = 0.04, p = .636, \eta_p^2 = .005$. And again, there was a significant main effect of the restudy group, $F(3, 377) = 7.58$, $MSE = 0.04$, $p < .001$, $\eta_p^2 = .06$. We therefore followed up with post hoc comparisons. These showed that, indeed, performance in the text–text condition was significantly better than that in each of the three other conditions (video–video: $p < .001$; text–video: $p = .022$; video–text: $p = .009$) and that none of the three other conditions differed from each other (all ps $> .50$). Put simply, reading a text twice resulted in better test performance than did any condition that involved watching a corresponding video on at least one of the two occasions.

Received November 29, 2023
Revision received May 13, 2024
Accepted June 17, 2024 ■