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The Effect of Prequestions on Learning from Video Presentations☆

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Asking students questions before they learn something has been shown to enhance memory for that information. Studies demonstrating this *prequestion effect* in reading tasks have shown that such prequestions may not enhance—and could even impair—learning of information that was not prequestioned, possibly due to learners' tendencies to selectively process the prequestioned information at the expense of non-prequestioned information. The current study explored the effects of prequestions on learning from videos, where such a selective processing strategy would be less likely to occur. Participants viewed an educational video and either answered prequestions prior to viewing each of three segments (Prequestion Group) or viewed the same video without answering prequestions (Control Group). A later test revealed a significant advantage for the Prequestion Group over the Control Group, and this pertained to both prequestioned and non-prequestioned information. Thus, prequestions appear to confer both specific and general benefits on video-based learning.

General Audience Summary

Asking students questions about what they are learning can significantly enhance their memory for that information. One specific way to do this is through *prequestions*—posing questions to students about to-be-learned material before they have learned it. Research has shown that prequestions prior to a reading assignment can enhance the amount of information that students remember from that reading. Unfortunately however, there is some evidence that prequestions may impair memory for sections of the reading that were not relevant to the prequestions, possibly because students attend more to sections of the passage that are relevant to the prequestions and could skip sections that are not relevant. In the current study, we explored the influence of prequestions on learning from video presentations, where such a strategy would be less likely due to the fact that the content and timing of videos are not learner-paced. Students viewed a brief educational video about the history of Easter Island. Some students answered two questions prior to viewing each of three segments of the video (the Prequestion Group), and others viewed the same video but did not answer prequestions (the Control Group). On a later test over all of the information from the video, the Prequestion Group performed higher than the Control Group. The Prequestion Group had better memory than the Control Group for information that was previously prequestioned, as well as for information from the video that was not prequestioned. These results suggest that prequestions are an effective tool for enhancing learning from relatively brief video presentations, without any harmful effects on non-prequestioned information, raising the possibility that they could be adapted for educational purposes to improve learning from videos or lecture presentations.

Keywords: Prequestions, Testing, Retrieval, Learning, Memory

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One of the most effective techniques for enhancing memory is to ask students questions about what they are learning. Decades of research on the *testing effect* have shown that students learn significantly more when they answer questions about material they are trying to learn, compared to simply restudying it (for recent reviews, see Carpenter, 2012; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Kornell & Vaughn, in press; Roediger & Butler, 2011; Rowland, 2014). So robust are the benefits of testing that cognitive scientists have often argued for its widespread implementation in educational settings as a straightforward and cost-effective tool for enhancing student achievement (Brown, Roediger, & McDaniel, 2014; Butler, Marsh, Slavinsky, & Baraniuk, 2014; Carpenter, 2014; Dunlosky et al., 2013; Pashler et al., 2007; Roediger & Pyc, 2012).

To date, most of what we know about the benefits of testing comes from studies in which students were tested over information after it was presented to them. We know much less about the mnemonic potential of asking students questions *before* they are presented with material to learn. Though such an approach might seem counterintuitive—how can students answer a question about material they have not yet learned?—research shows that such *prequestions* can significantly enhance students' encoding, and later memory, of the to-be-learned information. For example, Rickards (1976a) had participants read an 800-word passage about a fictitious African country Mala. The passage was organized into eight segments consisting of two paragraphs each. Some participants received a question that was relevant to the to-be-read segment prior to reading it ("How many inches of rain fall per year in southern Mala?"), whereas others read the passage without answering any questions relevant to the passage. On an immediate free-recall test over the passage, the group that received prequestions recalled significantly more than the group that read the passage without answering prequestions.

Other studies have demonstrated significant benefits of prequestions using reading tasks with slight variations in design, such as multiple-choice prequestions over the to-be-read passages followed by either a final multiple-choice test (Peeck, 1970) or a cued-recall final test (Little & Bjork, 2016, Experiment 3), or open-ended prequestions over the to-be-read passages followed by a final test containing multiple-choice questions (Bull & Dizney, 1973), fill-in-the-blank, short-answer, or cued-recall questions (Little & Bjork, 2016, Experiment 3; Pressley, Tanenbaum, McDaniel, & Wood, 1990; Richland, Kornell, & Kao, 2009; Rickards, Anderson, & McCormick, 1976), or a free-recall final test (Rickards, 1976b). In these studies, participants who received prequestions prior to reading the passages—even though explicit feedback of the correct answers was not provided at the time of the prequestions—performed better on the final test, compared to participants who read the same passages without answering prequestions first.

The benefits of prequestions have been attributed to their potential to serve as an orienting device that provides students with a preview of what they will be learning (Hannafin & Hughes, 1986; Mayer, 1984), or to the tendency for prequestions to arouse curiosity about the to-be-learned information (Berlyne, 1954, 1962; Bull & Dizney, 1973). There is also the (non-mutually-exclusive) possibility that prequestions act as a metacognitive "reality check," serving to inoculate students from the detrimental effects of overconfidence that so often occur during learning (Bjork, Dunlosky, & Kornell, 2013; Finn & Tauber, 2015). Only by trying—and *failing*—to answer a question might students gain the explicit awareness that they do not know the content, and this might facilitate more effective encoding strategies.

Further research suggests that the benefits of prequestions may be limited, however. Namely, the learning advantage that results from prequestions is typically restricted to the information in the reading passage that was prequestioned (Bull & Dizney, 1973; Frase, 1968; Pressley et al., 1990; Richland et al., 2009). For example, in reading about the fictitious country Mala (Rickards, 1976a), answering a prequestion about the annual rainfall in southern Mala facilitated later memory for that same piece of information, but did not facilitate, relative to the control group, memory for other information about Mala that was not prequestioned, such as facts about its history, government, or social conditions.

Of greater concern is the finding that prequestions might even produce harmful effects on the learning of non-prequestioned information. In comparing a group that received prequestions versus a control group on their later memory of both prequestioned and non-prequestioned information, some studies have shown that the group receiving prequestions outperformed the control group on the prequestioned information, but actually performed *worse* than the control group on the non-prequestioned information (Peeck, 1970; Rickards, 1976a, 1976b; Sagaria & Di Vesta, 1978).

As it would seem unwise to advocate the use of a technique that has been shown to impair the learning of information under some circumstances, the educational potential of prequestions is currently uncertain. Further research is needed that can clarify the nature of these effects and when they can be expected to occur. In particular, why might prequestions produce harmful effects on later memory of non-prequestioned information? Some researchers have proposed that prequestions might encourage the selective processing of information during reading, in that participants attend more strongly to the information in the passage that is most relevant to the prequestions and attend less to (or possibly even skip altogether) information that is not relevant to the prequestions (e.g., Peeck, 1970; Pressley et al., 1990; Sagaria & Di Vesta, 1978).

Such a selective processing strategy would be easy to do while reading. Having the passage directly available and being permitted to read at their own pace, participants could decide which parts of the passage to pay more attention to and could elect to skip some parts altogether. Some support for this possibility might be gleaned from Sagaria and Di Vesta's (1978) observation that participants who received prequestions spent less overall time on the reading passage compared to participants who read the same passage but received the questions after, rather than before, reading the relevant segments.

To date, the known research on prequestions has relied heavily on reading materials as stimuli. An alternative task that has not been systematically explored in studies of prequestions is learning from presentations. When students attend a lecture

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or view a video presentation (assuming they are not provided with the materials to read), in order to learn they must attend to the information being presented without knowing exactly what will be presented and when. Thus, learning from presentations, in which the upcoming content is uncertain and learners themselves do not control the pace of the information, could encourage greater attentiveness and result in a general benefit of prequestions on later memory, even for information that was not prequestioned. Given the importance of lectures and video-based presentations in education, a worthwhile and timely research question is whether prequestions enhance learning of information provided in presentations.

In the current study, students viewed a brief video presentation that was divided into three segments. Students either answered prequestions prior to each segment (the Prequestion Group) or viewed the same video segments without answering any prequestions (the Control Group). Upon completing the video, all students were given the same test containing some questions that had previously appeared as prequestions (i.e., prequestioned information) and some that had not (i.e., non-prequestioned information). Consistent with previous findings, we expected the Prequestion Group to outperform the Control Group on the final test, and that this advantage would be stronger for the prequestioned information than for the non-prequestioned information. If prequestions encourage overall processing of the video, then we may also expect the detrimental effect of prequestions on non-prequestioned information—as found in some previous studies using reading tasks—to be eliminated or reversed.

Method

Participants

Eighty-five undergraduate students from Iowa State University participated in exchange for partial course credit. Of these participants, 59% were female and 41% were male.

Materials and Design

Participants viewed a brief educational video about the history of Easter Island. The video was modified from its original version to create three segments of similar length (2 min 22 s, 2 min 33 s, and 2 min 15 s, respectively). Each segment related to a specific theme including the original settling of the island (Segment 1), religious practices on the island (Segment 2), and the arrival of outsiders to the island (Segment 3). Four short-answer questions were written from each segment of the video, for a total of 12 questions over the video (see the Appendix).

Each participant was randomly assigned to the Prequestion Group ($n = 43$) or the Control Group ($n = 42$). Prior to viewing each segment of the video, the Prequestion Group answered two questions—randomly selected from the four questions available for that segment—pertaining to the segment they were about to view. The Control Group viewed the same video segments but did not answer prequestions beforehand. After viewing the last video segment, participants in both groups were given a final test containing all 12 questions over the video.

Procedure

Participants used individual personal computers and headphones for the duration of the experiment. After giving informed consent, participants were seated at a computer and read instructions on the computer screen informing them that they would be learning information from a brief historical video, on which later they would receive a memory test. Participants in the Prequestion Group were given additional instructions informing them that they would be asked two short questions about the video before viewing each segment.

Before each video segment, participants in the Prequestion Group answered two questions randomly drawn from the four questions specific to that segment. Participants were informed that although they may not know the correct answers to these questions, they should give their best guess. Responses were typed into a box on the computer screen while the question was presented directly above it. Participants had unlimited time to enter their responses and were instructed to press the Enter key when they were finished. Feedback was not provided after the prequestions. After answering the two prequestions, participants viewed the video segment pertaining to those questions. This procedure was then repeated for the remaining two video segments.

The Control Group viewed the same video segments, in the same order, without answering prequestions. Prior to each video segment, instead of answering prequestions, participants in the Control Group were shown a screen instructing them to press the spacebar to move ahead to the next video segment.

Following the final video segment, participants in both groups were given a test consisting of the entire set of 12 questions over the video. For participants in the Prequestion Group, six of the questions were the same prequestions that had been seen before (two per segment), while six of the questions (also two per segment) had not been seen before. Thus, for each participant in the Prequestion Group, a unique set of questions on the final test tapped prequestioned and non-prequestioned information. For participants in the Control Group, the same 12 questions all served as non-prequestioned information. For each participant, the order of the 12 questions on the final test was randomized. Participants had unlimited time to enter their responses to each question using the same answering format as with the prequestions, and feedback was not provided.

Following the completion of the final test, participants answered a question concerning whether they had any detailed knowledge of the material covered in the video prior to participating in the experiment. Upon completing this question, participants were thanked and debriefed. The entire procedure lasted less than 20 min.

Results

Scoring and Pre-Analyses

Each question was worth 2 points and was scored as fully correct (2 points), partially correct (1 point), or incorrect (0 points). Forty-two percent of the participant responses were scored by two independent raters. Interrater correlations were

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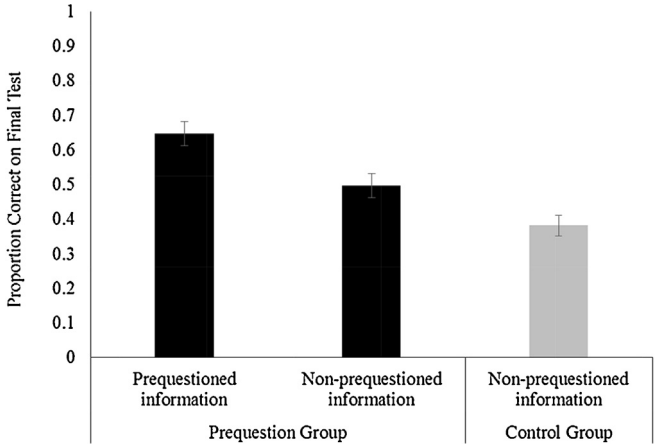

Figure 1. Final test performance on prequestioned and non-prequestioned information for the Prequestion Group and Control Group. The Prequestion Group answered questions prior to viewing each of three segments of a video, whereas the Control Group viewed the same video without answering any prequestions. On an immediate test over the video, participants in the Prequestion Group scored significantly higher than participants in the Control group, and this advantage applied to both prequestioned information and non-prequestioned information.

.80 for prequestion responses, .97 for pre-questioned information on the final test within the Prequestion Group, .98 for non-prequestioned information on the final test within the Prequestion Group, and .98 for final test scores in the Control Group (all $ps < .001$). Given the high interrater reliability, the remaining responses were scored by a single rater.

Inspection of responses revealed that participants in the Prequestion Group complied with the instructions to type in a response—even if guessing—on the prequestions. Accuracy on the prequestions was only 5% on average, indicating very little prior knowledge of the material. Any questions that received a correct or partially correct response on the pretest were excluded from further analyses, ensuring that any benefit of prequestions observed on the final test was specific to information learned from the video.[1]

No participants reported having detailed prior knowledge of the information in the video. Only three participants reported that they may have learned the information before, but could not remember the details prior to participating in the experiment. Whether or not the data from these three participants were included did not change the significance of the statistical effects, so we included them for completeness.

Final Test Performance

Figure 1 shows final test performance for the Prequestion Group and Control Group. Consistent with predictions, overall performance was significantly higher for the Prequestion Group ($M = .57$, $SD = .18$) compared to the Control Group ($M = .38$, $SD = .20$), $t(83) = 4.61$, $p < .001$, $d = 1.00$. Performance within the Prequestion Group was also higher for prequestioned information ($M = .65$, $SD = .23$) compared to non-prequestioned information ($M = .50$, $SD = .23$), $t(42) = 3.73$, $p = .001$, $d = .57$.

Did prequestions facilitate the learning of non-prequestioned information? A comparison of final test performance for non-prequestioned information in the Prequestion Group relative to the Control Group revealed a significant advantage for the Prequestion Group, $t(83) = 2.47$, $p = .016$, $d = .54$. Thus, prequestions produced enhanced learning of the information from the video, even if that information was not asked about in the prequestions.

Discussion

The current study demonstrated that students who received prequestions over a video presentation remembered more information from the video than students who viewed the same video without receiving prequestions. This finding replicates a number of studies showing positive effects of prequestions on the retention of information from reading passages (e.g., Little & Bjork, 2016; Peeck, 1970; Pressley et al., 1990; Richland et al., 2009; Rickards, 1976a, 1976b). Also consistent with some of these previous studies was our finding that prequestions facilitated later memory for prequestioned information more than for non-prequestioned information.

Whereas some studies have reported a detrimental effect of prequestions on non-prequestioned information (Peeck, 1970; Rickards, 1976a, 1976b; Sagaria & Di Vesta, 1978), in the current study we observed a significant benefit of prequestions on both prequestioned information and non-prequestioned information. A likely explanation for this "spill over" benefit is that a video presentation, in which the unfolding of contents is uncertain and the pace is not controlled by the learner, may be more likely than a reading task to encourage processing of the entire content and discourage selective processing of the prequestioned content.

Consistent with the selective processing hypothesis, some studies using reading tasks have found that the detrimental effect of prequestions on non-prequestioned information does not occur under conditions that direct attention to the entire passage and encourage participants to sufficiently process the material that will be needed for the later test. For example, in the study by Pressley et al. (1990), participants in all conditions were required to rate the comprehensibility of each paragraph immediately after reading it. Under these conditions, the detrimental effect of prequestions on non-prequestioned information did not occur. Instead, a slightly (non-significantly) greater proportion of participants who received prequestions (54%), relative to the control group (51%), remembered the non-prequestioned information on the final test.

Along similar lines, Richland et al. (2009) observed a slight (non-significant) disadvantage for non-prequestioned information in the group that received prequestions compared to the control group under typical reading conditions (Experiment 1). Under conditions in which the information in the passage that would later appear on the test was bolded, however (drawing attention to the information that participants needed to know, Experiment 3), participants who received

[1] All of the analyses on final test performance were repeated without excluding any prequestions that were answered correctly, and the same significant effects were observed.

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prequestions performed marginally better than the control group on the non-prequestioned information ($p = .062$). Furthermore, a recent study by Little and Bjork (2016) showed that multiple-choice prequestions significantly enhanced later memory for non-prequestioned information that was related to the prequestioned information by virtue of competitive alternatives. That is, answering the prequestion *What is the tallest geyser in Yellowstone National Park?* (a) *Old Faithful*, (b) *Steamboat Geyser*, (c) *Castle Geyser*, (d) *Daisy Geyser* (correct answer: Steamboat Geyser) facilitated later memory for the fact that Castle Geyser is thought to be the oldest geyser in the world. The authors proposed that the presence of the multiple-choice alternatives during the pretest encouraged processing of information related to those alternatives during reading of the passage, resulting in a benefit not only for information associated with the correct answer to the prequestion, but also for information associated with the alternatives that would later be the correct answer to a different but related question. These results and those of Richland et al. (2009) and Pressley et al. (1990) suggest that a key contributor to the effectiveness of prequestions on non-prequestioned information might be the degree to which participants fully process the material related to that information.

These results suggest that prequestions can be effective learning tools, at least for learning relatively brief passages of information. Whereas the specific benefits of prequestions have been consistently demonstrated, the general benefits of prequestions on non-prequestioned information are weaker and it is presently unclear what the magnitude and consistency of these effects might be. However, four studies have now shown that under conditions in which participants are encouraged to attend to the non-prequestioned information—by using videos in the current study, by requiring comprehension ratings of the material as it is being read (Pressley et al., 1990), by bolding key information in the reading passages (Richland et al., 2009), or by increasing the relatedness of the prequestioned information to the non-prequestioned information (Little & Bjork, 2016)—pretesting of information does not appear to result in any harmful effects and may even produce beneficial effects, on later memory for non-pretested information.

Whereas the current study suggests that prequestions can benefit learning of brief video presentations, their effects on more complex lecture-based learning are less clear. Only one known study has explored the effects of prequestions in a classroom setting. McDaniel, Agarwal, Huelser, McDermott, and Roediger (2011) gave students in a middle school science class a number of prequestions prior to starting a lesson over a chapter of material. Students then received a list of questions over that same chapter—some had appeared as prequestions and some had not—after the lesson had ended, and then another list of questions as a review activity just prior to the exam. On the end-of-lesson quiz (occurring up to several days after the prequestions), students performed better on questions that had previously appeared as prequestions versus never-before-seen questions from the same lesson (though this effect was only significant in one of two experiments). However, on the delayed review quiz (occurring up to about one month after the prequestions), students did not perform significantly better on questions that had previously appeared as prequestions versus never-before-seen questions from the same lesson. These findings suggest that the long-term effects of prequestions in educational settings may not be particularly strong, or could be tempered by factors present in classrooms that weaken the connection between the prequestion and the relevant content. These factors could include time delays (i.e., in a 90-minute class, the time elapsing between the prequestion and coverage of the prequestioned content may be too substantial to facilitate strong associations between the prequestions and the content), the complexity of the information being learned, or the frequency of out-of-class studying.

Further research on the effects of prequestions in classroom settings is encouraged and can shed light on the conditions under which such questions may be worthwhile. Prequestions may be most effective, for example, for learning brief content such as short videos, segments of a lecture, or in-class demonstrations. Classroom research comparing a prequestion group versus a control group would also shed light on whether the overall benefit of prequestions—observed in several laboratory studies with reading materials (e.g., Little & Bjork, 2016; Pressley et al., 1990; Richland et al., 2009)—applies to classroom learning. The increasing use of technology in the classroom, including "clicker" devices that afford the efficient and frequent use of in-class questions (Mayer et al., 2009), would seem to provide a timely and convenient opportunity to explore these possibilities in educational settings.

Conflict of Interest Statement

The authors declare that they have no conflict of interest.

Author Contributions

Shana Carpenter conceived the idea for the study. Alexander Toftness obtained the video materials, programmed the experiment, and collected and analyzed the data. Both authors contributed to the writing, editing, and final preparation of the manuscript.

Appendix

Questions Used in the Current Study

Question	Correct Response
How many families originally settled on the island of Rapa Nui?	One
The people who originally settled on the island of Rapa Nui came from what area of the world?	Polynesia; Tonga; Marquesas; Samoa
The building of the Moai resulted in the depletion of what resources on the island of Rapa Nui?	Trees; Wood
For what purpose did the inhabitants of Rapa Nui build the Moai?	Spirit Guardians
What was the most prominent religion on the island of Rapa Nui directly after the fall of the Moai?	Cult of the Bird Man

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Question	Correct Response
In the annual competition for tern eggs, what did the winner do that signified the end of the competition, and alerted contestants that it was time to return to the starting point?	Shouted back to Clan Leader
There is evidence that indigenous peoples from what area of the world visited Rapa Nui?	South America
In the annual competition for tern eggs, contestants chosen by a shaman competed on behalf of whom?	Clan Leaders; Tribe Leaders
Why did a number of inhabitants of Rapa Nui go to Peru?	They were enslaved; Slavery
How did Rapa Nui acquire the name "Easter Island"?	Europeans discovered it on Easter
After arrival of European missionaries, how long did it take to convert the entire population of Rapa Nui to Catholicism?	4 years
What was the approximate population of Rapa Nui from 1722 to the 1860s?	2000–3000

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