

*Estudos Linguísticos & Aplicados***COGNITIVE PSYCHOLOGY IN ONLINE ENGLISH CLASSES:  
USING INTERACTIVE VIDEOS FOR RETRIEVAL PRACTICE***Melissa Bettoni\***Fernando Rosseto Gallego Campos\*\**

**ABSTRACT:** The present study aimed at investigating participants' perceptions about interactive videos with pop-up questions as a retrieval practice (Experiment 1 and 2) as well as effects of such interaction (Experiment 2). Three interactive videos about biographies of famous literature writers (Edgar Allan Poe, Arthur Conan Doyle and Agatha Christie) were produced with different question distribution and 25 participants watched them and answered a questionnaire. The data-gathering happened during the isolation period triggered by the Covid19 pandemic when lack of interaction and physical distance imposed extra barriers for education. The participants stated they prefer and consider having learned more with videos with retrieval practice in the format of multiple-choice pop-up questions distributed along the video. Even though some participants felt worried during the videos with interaction, most participants stated their attention was higher in the presence of the questions. Educational videos with retrieval practice can be used prior, during, and after a lesson irrespective of its modality (online or face-to-face). Interactive videos change learners' behavior in a way it facilitates online learning. They promote higher attention, engagement, and motivation besides the usual benefits of retrieval practice. Further research needs to be carried out considering implications of cognitive psychology on learning.

**KEYWORDS:** Learning; Teaching; Interactive video; Retrieval Practice; Online learning.

**Introduction**

Online resources have been part of English language teaching for decades. Language has probably been one of the first areas in education to have a subarea specifically dedicated to the use of computers. Computer Assisted Language Learning (CALL) has produced several magazines, articles, and books since the 1950s (TAFAZOLI; HUERTAS ABRIL; GÓMEZ PARRA, 2019). However, many teachers and students had some resistance to online learning and teaching without any experience with it until everyone was forced to try it and experience its advantages and disadvantages. In order to overcome the difficulties imposed to teaching and learning during the Covid19 pandemic, online learning was a great possibility.

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Lack of access to the internet and technological devices is a fact for many Brazilians, but a great amount of effort was employed to try and minimize it. Being part of a public school that managed to deal with the barriers brought by socioeconomic inequalities, we faced other challenges. To deal with internet availability oscillation, we looked for ways to provide asynchronous learning. Keeping students focused on the lesson and learning from it required more effort than usual especially due to the lack of interaction. Knowledge from science, more specifically from Cognitive Psychology, can help us use technology in a more interactive and efficient way.

Besides helping students to keep focused, interactive videos can use strategies such as retrieval practice to improve learning. In fact, retrieval practice is the most powerful learning strategy known (ANDERSON, 2020). Contrary to what we feel works out when we learn, rereading a material is not as powerful as testing oneself after having studied something. Testing requires us to retrieve information from memory reinforcing traces and facilitating transfer to long-term memory (ANDERSON, 2020). Every time we remember something we modify traces and reinforce neural networks adding possibilities to retrieve it.

Retrieval right after learning has been proven to be effective (BJORK, 1988; LARSEN, 2018). Considering online teaching and the possibility of using interactive videos, we wanted to understand what the most appropriate moment for retrieval would be. The present study aimed at investigating effects of retrieval practice in the format of multiple choice pop-up questions with immediate feedback within interactive videos and learners' perceptions regarding the videos and the interactions. Therefore, we tested three conditions: interactions along the video (in an eight-minute video, each two minutes), at the end of the video, and without interaction.

Next, we briefly review the literature on retrieval practice and studies on interactive educational videos. Then we present the method and the results of our study followed by our final considerations.

## **1. Retrieval Practice and Learning**

Retrieval practice, also referred to as testing, is a learning strategy which consists in retrieving information from memory (ANDERSON, 2020). Even though people are used to read the same material repeatedly as the main form of study, it is not the most efficient learning strategy (ANDERSON, 2020). In fact, retrieval practice is not only more efficient than repetition as a learning strategy but is also one of the most efficient learning strategies for any type of content (GATES, 1917; ROEDIGER III; BUTLER, 2011; KARPICKE;

BLUNT; SMITH, 2016; LARSEN, 2018; ANDERSON, 2020). Bjork (1988, p. 433) stated that “A critical aspect of the maintenance of knowledge is maintaining access to that knowledge in memory. Bjork (1988) adds that by using information periodically, its access is maintained, and; thus, “retrieving an item from memory facilitates subsequent retrieval access to that item” (p.433).

It is commonly stated that retrieval of an item reinforces that memory trace. According to Bjork (1988), besides reinforcing the memory trace, the process of retrieving, as any other skill, benefits from practice. Also, harder recall tests reflect in worse performance at the test, but more likelihood of later recall. The interval between being exposed to some information and trying to retrieve it also affects how efficient retrieval practice can be. A short interval between exposure to content and testing can facilitate later recall in comparison to immediate recall without further retrieval practice (BJORK, 1988). Optimal learning, though, would happen when content presentation is followed by immediate retrieval practice followed by additional periodical retrievals (BJORK, 1988; LARSEN, 2018). The period between each delayed retrieval practice must be longer than the previous interval, this is called expanding retrieval practice.

Learning is related to storing new information in long-term memory. For it to occur, interpretation, elaboration, and association of new and old knowledge (already in long-term memory) are required (BJORK, 1988). Question format for retrieval practice determines which of these strategies (interpretation, elaboration, association) takes place and the mechanisms by which learning occurs. Larsen (2018) states that different test formats would lead to “different degrees of schema activation” (LARSEN, 2018, p. 449). Schemas are “networks of related information” (LARSEN, 2018, p. 454) or memory traces.

Smith and Karpicke (2014) studied retrieval practice effects with different question formats on learning. They found no difference in learning considering answering short-answer and hybrid questions versus multiple-choice questions. It was only when retrieval success was improved in an initial short-answer question that multiple-choice questions had some disadvantage. There may be a retention advantage for short-answer questions when there is feedback, but the biggest advantages of multiple-choice questions lie on the practicality of providing immediate feedback and grading in large classrooms (SMITH; KARPICKE, 2014). Gay (1980) also found advantages for short-answer questions, but only when the final test condition was also short-answer questions, that is, it was a testing practice not generalizable to other test formats. Zaromb and Roediger III (2010) found positive effects of retrieval practice in its simplest format, free recall. Smith and Karpicke (2014)

consider retrieval difficulty and success as better predictors of retention effects than question format per se and state that both short-answer and multiple-choice questions produce long-term retention due to meaningful learning in both verbatim and inference question conditions.

Ariel and Karpicke (2018) conducted an experiment in which they aimed to teach students to use retrieval practice on their own and found positive results in comparison to a control group. Students benefit from being in control of their own learning, but teachers can also provide retrieval opportunities in the classroom. Agarwal and colleagues (2014) found that not only there is learning improvement but also test anxiety reduction due to retrieval practice in the classroom.

Considering previous study as well as their own, Larsen (2018) came up with a set of principles to consider if teachers expect to optimize the retrieval practice moments: (a) “different test formats lead to different degrees of schema activation” (p. 449); (b) “repeated acts of retrieval provide opportunities for schemas to be updated and strengthened” (p. 449); (c) “spacing of retrieval allows more consolidated schemas to be reactivated” (p. 449); (d) “feedback provides metacognitive monitoring to ensure retrieval accuracy and can lead to shifts from ineffective to effective retrieval strategies” (p. 449).

## 2. Interactive videos

Videos have long been praised by learners both in a cognitive and in an affective way (KAY, 2012; GEDERA; ZALIPOUR, 2018). Years before we could even imagine not being able to have face-to-face classes, online learning was seen as the future of education and interactive videos were already considered part of this future (p. ex. VURAL, 2013). Vural (2013) investigated effects of multiple-choice activities between short videos using the virtual learning environment called Moodle. With an experimental and a control group, the author found that participants with questions between videos spent more time on Moodle and achieved higher grades. Haagsman and colleagues (2020) inserted the questions in pop-ups within the videos and found learning effect was not restricted to the specific content questioned in the pop-ups, but to all video content. They found that the mere presence of the questions changed learners' behavior while watching the video by producing more engagement from students. The videos about Molecular Biology were used in a flipped-up classroom format and lasted around 16 minutes.

Brame (2016) mentions three important elements to be considered when using educational videos: cognitive load; student engagement; and promotion of active learning. The

pop-up questions afore mentioned trigger student engagement and, as a retrieval practice moment, promotes active learning. For this to happen, cognitive load must be leveled regarding both content and stimuli to allow for success, in that, as previously stated, success in retrieval is a predictor of learning (SMITH; KARPICKE, 2014). Brame adds that videos should bring conversational language, interactive questions, segmenting of information, and auditory and visual elements. Too much information – relative to both content and different stimuli – should be avoided and videos should be kept shorter than six minutes (BRAME, 2016). Guo, Kim and Rubin (2014) also advocate for shorter videos setting their duration between six to nine minutes. They found that learners interacted only 50% when videos were between nine and twelve minutes and 20% when videos were between 12 and 40 minutes.

Besides length of the videos, the moments of interaction also play a role in learning. Wachtler and colleagues (2016) investigated positioning and intervals of pop-up questions within videos. The authors found that questions asked earlier are usually more often mistakenly answered than later questions. They suggest waiting until one-quarter of the video has been played to insert the first pop-up question. Also, the authors claimed there is a minor role of the interval between questions in shorter videos.

### **3. Method**

The present study reports two experiments conducted with the administration of three interactive videos about biographies of famous English literature writers. All participants were Brazilians with a minimum B1 level of proficiency in English according to the Common European framework of reference for languages (CEFR) which corresponds to an independent language user. The data-gathering happened in August 2021 during the Covid19 pandemic. The institution where the research was conducted had been in isolation since March 2020. The videos and data gathering instruments were the same for both experiments.

#### **The videos**

The videos were recorded using either cell phone videorecorders in the horizontal position or with Open Broadcaster Software (OBS Studio) (64 bit) on a laptop computer. The narrator was one of the researchers and her face appeared throughout the whole video. The narration was entirely in English. Videos were pre-edited with the Video Editor available on Windows (Video Editor) and finalized with the free, open-source, cross-platform video editor called Shotcut. The video script was a chronological short biography of three famous authors of English literature: Edgar Allan Poe, Arthur Conan Doyle, and Agatha Christie.

The three writers wrote detective stories which is a style of great interest for teenagers and young adults who are the audience to whom the videos were designed. All three videos had the same type of information: data and place of birth, travels, education, life problems, important pieces of work, love life, and death. The duration of the three videos was similar. Poe's video was the longest one with eight minutes and fifty-one seconds, Doyle's video had eight minutes and thirty-eight seconds, and Agatha's video lasted eight minutes and eleven seconds. There were insertion of visual illustrations, English subtitles, segmentation, and transition sounds.

After the edition of the videos, they were uploaded on a virtual learning platform and the interactions were added using a free and open-source content collaboration framework named HTML5 Package (H5P). Besides a web-based content editor, H5P is a website, a set of plugins, and a file format for wrapping up HTML5 resources. H5P has plugins for a few platforms including Moodle which is the virtual learning environment used in the institution where the researchers work. The interaction consisted of pop-up multiple choice questions in two conditions, at the end of the video or along the video. When interaction happened only at the end of the video, the same questions of the condition along the video were asked all at once with feedback after each question. When the interaction happened along the video, there were four blocks of three or four questions with intervals close to 2 minutes. The questions asked similar contents for the three videos.

### **Data-gathering instruments**

A questionnaire was developed and administered on Google Forms. It contained a consent form and permission for use of the data gathered for educational and scientific purposes and four parts with questions: 'Perception' with one open and three closed questions; 'Behavior' with two open questions; 'Knowledge' with four knowledge questions for each video; and, 'Suggestions' with one optional open question.

### **Experiment 1**

The first experiment (Experiment 1) aimed at investigating learners' perceptions about retrieval practice presence and positioning within the video. Participants were 24 teachers of English in Brazil enrolled in a teacher development course for teachers of English who had previously obtained an undergraduate degree and were in-service teachers. There were eight males and sixteen females aged between 23 and 55 years old – mean age: 32,8 years old and median: 29 years old. The 24 participants were split into three conditions to watch the videos

online. Eight participants were assigned to each of the three conditions according to the presence and the positioning of the pop-up questions.

The sequence of the videos was the same for all participants following the chronology of the writers' birthdays: Edgar Allan Poe followed by Arthur Conan Doyle and then Agatha Christie. The conditions varied according to when interaction (retrieval practice) occurs in the video: without interaction (WI), interaction during the video (ID), and interaction at the end of the video (IE). The three conditions were:

Condition A – Poe WI; Doyle ID; and, Agatha IE;

Condition B – Poe ID; Doyle IE; and, Agatha WI;

Condition C – Poe IE; Doyle WI; and, Agatha ID.

Participants were instructed in Portuguese. First, during a meeting on Google Meet, they were subscribed to a page on the Institutional Moodle and were told which condition they were assigned to. They were instructed to use the controls to rewind videos 10 seconds each time (ten in ten seconds, being possible to rewind to the start of the video). They could also pause and watch the video at a maximum speed of twice the normal one. If they had any doubts or problems while watching the videos, they could reach the researchers either by returning to the Google Meet they had been before watching the videos or through the private WhatsApp number of the researchers. After watching the videos, participants were asked to answer the questionnaire on Google Forms which began by a consent to use the information collected in scientific publications. The link was provided on Moodle right below the videos.

## **Experiment 2**

The second experiment (Experiment 2) was a case study intended to investigate effects of retrieval practice presence and positioning within the video and was a quasi-experimental investigation with a proxy pretest design with quantitative and qualitative analysis. The use a proxy pretest was based on the participant having to identify, after watching the video, what she knew about each author before the video had been played. We opted for a proxy pretest because we did not have the opportunity of carrying out a pretest for time constraints during the pandemic. The participant was a ten-year-old girl at the B1 level of English proficiency; therefore, an independent user. Experiment 2 consisted of the participant watching the three videos in the presence of one of the researchers and answering a questionnaire afterwards. All reactions of the participant while watching the videos were observed and registered by one of the researchers.

She was instructed in Portuguese and was told that she would be able to use the controls to rewind videos 10 seconds each time (ten in ten seconds, being possible to rewind it till the start of the video). She could also pause and watch the video at a maximum speed of twice the normal one if she wanted it. Data-gathering was carried out through the observation just mentioned and the completion of the questionnaire. The participant of Experiment 2 carried out an additional task, exclusive for Experiment 2. The task was a free recall task in which she was supposed to write down everything she remembered about each biography. The participant in Experiment 2 attended Condition A.

#### 4. Results

Results are presented for each experiment beginning with Experiment 1 and finishing with the case study in Experiment 2.

##### 4.1 Experiment 1

Twenty-four participants answered seven questions stating their perceptions and identifying their behavior while watching the videos. The first question was about participants' preferences regarding the presence and positioning of the pop-up questions. One participant (4.2%) preferred the videos without questions and three participants (12.5%), one from each condition, stated they prefer questions only at the end of the video. Twenty participants (83.3%) preferred videos with questions distributed along the video. In the case of the present study, it corresponded to retrieval practice happening around each two minutes of the eight to nine-minute videos.

The second question required participants to identify which of the three formats they think facilitated learning more: without questions, questions only at the end of the video, or questions along the videos. Twenty-one participants (87.5%) chose videos with retrieval practice along the videos as the format which favored learning more. Three participants (12.5%) considered questions at the end of the video as the best option for learning and no participant chose videos without questions as favoring learning.

The third question was related to number of question blocks. The videos with spaced questions were designed with four blocks of three questions each, three blocks along the video and one at the end. Nine participants (37.5%) selected the option of four blocks as occurred in the videos they watched, five participants (20.8%) selected five blocks, five participants (20.8%) selected three blocks, two participants (8.3%) selected eight blocks corresponding to one each minute (for the eight-minute videos), two participants (8.3%) selected



the option with questions only once positioning them at the end, and one (4.2%) selected without questions.

Considering behavior while watching the video, participants were asked whether they used the return button. Fifteen participants (62.5%) stated they used it and nine participants (37.5%) didn't. Among the reasons for returning the video are (a) the questions made me lose the train of thought, (b) I got distracted and missed information, (c) I wanted to check information after I answered the questions incorrectly, (d) I returned to listen to the information again.

The fifth question was related to the use of the speed button. Seventeen participants (70.8%) did not use it and eight (29.2%) did it. Three participants who used it said they did it because they were in a hurry and wanted to finish the videos faster. One of them stated, he used it at speed 1.25 and only with the video without interaction. Another said she used it only during the second time she watched the video because she wanted to watch it again and did not have eight more minutes to do it.

Participants' feelings when watching the videos were investigated in the sixth question. The idea of attention enhancement was represented by the words: attention, focus and concentration. It appeared in the discourse of twenty participants (83.3%). The idea of worry was represented by the words: nervousness, preoccupation, anxiety, and apprehension. It appeared in the discourse of seven participants (29.2%). Four out of the seven participants (57.1%) who expressed the idea of worry also expressed the idea of attention enhancement. Motivation, happiness, and curiosity were also mentioned.

Participants also had twelve more questions about the content of the videos. Their answers were not analyzed because many of them stated they looked up for answers on Google or rewatched the video looking for the answers. Therefore, effects of retrieval practice were only considered for the participant in Experiment 2 whose data-gathering happened in the presence of the researchers. Experiment 2 is analyzed in 4.2.

The final question analyzed was optional and requested commentaries and suggestions. Twenty participants answered it and all of them either congratulated the researchers or stated how much they liked and learned with the videos. Two participants suggested asking fewer specific questions and more open questions in the follow-up questionnaire. In Experiment 2, the additional free recall had this intention. We agree that with purely instructional videos, questions which require more reflection would be positive for learning, especially when they require elaboration by associating new knowledge with old one. They are recommended after short videos and not during them to avoid distraction.

## 4.2 Experiment 2

The participant of Experiment 2 watched the videos in Condition A: Poe WI; Doyle ID; and, Agatha IE. The goal of the experiment was to investigate both effects of retrieval practice in interactive videos and learners' perceptions about the insertion of the pop-up questions. As mentioned in the method, the ten-year-old girl watched the videos in the presence of the researchers.

Regarding her perceptions about the retrieval practice opportunity, she agreed with the majority of the participants in Experiment 1. She prefers and considers having learned more when the questions were spread during the video. She stated she prefers four blocks of questions as happened with Doyle's video in Condition A rather than the other options give which varied from zero to eight blocks.

Her behavior was assessed by both the researchers' observation and the answers given in the questionnaire. From the questionnaire, we learn that she used the return button once, when she had connection problems, and she did not use the speed button because she considered she wouldn't be able to learn as much as she could if she had doubled the speed. About her feelings, she stated that even though the questions made her a little worried, they also made her pay more attention to the video. By observing the participant, we could notice she was very excited and interested. After the videos, she asked additional questions about the authors and stated she was looking forward to reading the authors' works. During the videos, she expressed her surprise and enthusiasm using facial and verbal expressions.

Considering effects of retrieval practice on learning, there were four open questions about each of the three videos. The questionnaire was answered after the participant had watched the three videos. The first video the participant watched was about Edgar Allan Poe and it had no interaction. The participant answered with 'I don't know' to all four questions and she seemed disappointed at herself for not remembering the information required to answer the questions. The second video watched was about Arthur Conan Doyle and it had four blocks of pop-up questions. The participant answered correctly three out of four questions (75%). The third video watched was about Agatha Christie and the questions were all placed at the end of the video. The participant got three questions completely wrong and one question with the answer closer to the correct one.

The additional task in Experiment 2 was a free recall task of all the three videos. The participant wrote around one page about each of the authors with information from the videos. The participant showed surprise about the amount of information she could remember and stated that having to try and remember information from the videos helped her learn.

She could remember more information about Arthur Conan Doyle (questions along the video) followed by Agatha Christie (questions at the end and her favorite video) and, then, by Edgar Allan Poe (first video and without interaction).

### **Final Considerations**

The present study aimed at investigating participants' perceptions about interactive videos with pop-up questions as retrieval practice (Experiment 1 and 2) as well as effects of such interaction (Experiment 2). Participants stated they prefer and consider having learned more with videos with retrieval practice in the format of multiple-choice pop-up questions distributed along the video. They varied in what they consider as the ideal number of question blocks though. Even though some participants felt worried during the videos with interaction, most participants stated their attention was higher in the presence of the questions. Since attention is a requisite for learning, retrieval practice seems to facilitate learning not only by enhancing memory traces with information recall but also by changing learners' behavior corroborating Haagsman and colleagues (2020). Such attention trigger promoted by the material design has an extra relevance considering online learning.

For Experiment 2, retrieval practice seemed to have an important effect on learning. Considering recency, it would be expected that Agatha Christie's video, the last video watched, would have more correct answers and considering primacy, it would be expected that Poe's video, the first video watched, would have more correct answers. However, the second video watched (the one with spaced retrieval practice) was the one with more correct answers pointing to a positive effect of retrieval practice on learning. Also, the free recall at the end of the questionnaire served not only as a test but also as an additional retrieval practice to optimize learning.

It is not possible to know from the results found whether learning was a consequence of recall or of higher attention, but it is possible to state that the presence of pop-questions within an educational video facilitates learning. Educational videos with retrieval practice can be used prior, during, and after a lesson irrespective of its modality (online or face-to-face). However, their role in asynchronous online learning deserves to be emphasized in that the material design needs to make up for the absence of a teacher in this learning modality. The interactive videos produced considering length, student engagement and cognitive load seem to fulfill their role by promoting higher attention, engagement, and motivation besides the usual benefits of retrieval practice. Further research with control of more variables, individual face-to-face data-gathering assessing a variety of content such as vocabulary and episodic

facts must be carried out in order to better understand how interactive videos can promote learning. Also, replications of the study must be carried out for generalization of the results.

### PSICOLOGIA COGNITIVA EM AULAS ONLINE DE INGLÊS: USANDO VÍDEOS INTERATIVOS PARA PRÁTICAS DE EVOCÇÃO DE MEMÓRIA

**RESUMO:** O presente estudo teve como objetivo investigar as percepções dos participantes sobre vídeos interativos com perguntas em pop-ups como uma prática de recuperação (Experiência 1 e 2), bem como os efeitos de tal interação (Experiência 2). Foram produzidos três vídeos interativos sobre biografias de escritores famosos da literatura (Edgar Allan Poe, Arthur Conan Doyle e Agatha Christie) com diferente distribuição das perguntas e 25 participantes os assistiram e responderam a um questionário. A coleta de dados aconteceu durante o período de isolamento desencadeado pela pandemia de Covid19 quando falta de interação e distância física impuseram barreiras adicionais à educação. Os participantes declararam que preferem e consideram ter aprendido mais com vídeos com prática de recuperação no formato de perguntas pop-up de múltipla escolha distribuídas ao longo do vídeo. Embora alguns participantes tenham se sentido preocupados durante os vídeos com interação, a maioria dos participantes afirmou que sua atenção foi maior na presença das perguntas. Vídeos educativos com prática de recuperação podem ser usados antes, durante e depois de uma aula, independentemente de sua modalidade (*on-line* ou presencial). Vídeos interativos mudam o comportamento dos aprendizes facilitando a aprendizagem *on-line*. Eles promovem mais atenção, engajamento e motivação além dos benefícios comuns da prática de evocção de memória. Pesquisas adicionais precisam ser realizadas considerando as implicações da psicologia cognitiva no aprendizado.

**PALAVRAS-CHAVE:** Aprendizagem; Ensino; Vídeo interativo; Prática de evocção de memória; Aprendizagem online

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