Bachelor thesis:

# What is the added value of relevant and non-relevant explanatory videos on comprehension of study materials?

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## Abstract

Current developments in technology give access to different kinds of online study materials which students use more frequently for exam preparation. However, little attention has been paid to the explanatory videos themselves and how students make use of them. Therefore, the current study investigated the added value of explanatory videos over written study materials and what effect the relevance of a video has on exam performance. A total of 38 students currently or previously enrolled at technical universities in Germany and the Netherlands participated in the experiment. Participants were randomly assigned to one of three different conditions (text only, text and relevant videos, text and non-relevant videos), and compared based on their scores on multiple-choice and open questions. In each condition, participants first started with studying the written study material. Results indicated that participants with text and non-relevant videos performed significantly worse than participants with text only and participants with text and relevant videos. Further, participants with text only did not significantly differ from participants with text and relevant videos. Thus, the results provide evidence that there is no added value of a relevant explanatory video over only a text. However, the study also provided evidence that when deciding to provide explanatory video materials, a non-relevant explanatory video has a detrimental effect on exam performance in comparison to providing a relevant explanatory video or only providing a text. For future research, the design should be longitudinal and involve post-tests to test whether memory or comprehension is investigated.


*Keywords:* explanatory videos, added value of videos, relevance of videos, comprehension, memory, memory interference, youtube

What is the added value of relevant and non-relevant explanatory videos on comprehension of study materials?

Current and previous developments in technology and the internet provide students with access to different tools, websites, videos, and online study materials that they can use to prepare themselves for exams or assessments at universities. However, these new opportunities do not imply that every student's academic performance is improving, as academic or exam performance also depends on whether the given material is appropriately stored and connected with previous knowledge. Little attention has been paid to the explanatory videos themselves, including the relevance of the videos and what influence it has on students' academic performance.

This thesis will start by pointing out the added value and relevance of explanatory videos and how these can be evaluated by users and for scientific purposes. Further, the cognitive mechanisms of memory involved in acquiring new information and connecting it with previous knowledge will be discussed. After that, possible interferences in the learning process, with the focus on retroactive interference and the consequences of this type of interference on the cognitive mechanisms will be explained. The Cognitive Theory of Multimedia Learning will then be used to explain both memory and interference processes when information is provided by multimedia sources. Next, multiple-choice and open questions will be introduced and opposed as two possible measurements of these memory and interference processes. Lastly, the relevance, of each aspect named above, for the current study will be specified and the research question as well as the hypotheses will be provided. .

**Added value and relevance of videos**

As internet access is nowadays widely spread over the world, so is the online platform for videos or streaming service called YouTube (YouTube, 2018). Besides, the streaming service offers more educational videos over the years, with an increasing rate from 22% in 2007 to 38% in 2009 (Purcell, 2010). Users spend one billion hours daily watching videos and they get further video suggestions by popularity from the video provider itself (YouTube, 2018). Previous research already indicated that when making use of online education and online learning, it is crucial to adapt existing online materials to the personal needs of students (Valenta, Therriault, Dieter, & Mrtek, 2001). For example, QR codes could be put into the study material to easily access with the help of a smartphone additional explanatory links, videos, websites, etc., connected to the theme.

Having access to a lot of different videos does not imply that the videos are very suitable or fitting to the user's actual needs in terms of whether the information in the video is relevant for the user. Relevance has been defined as "the perception that something is interesting and worth knowing" (Roberson, 2013, p. 1). In addition, relevance is also dependent on different individual and cultural aspects (Abdalla, Menezes, & Oliveira, 2019). To support relevance in videos, many websites and streaming services offer so-called video summarization with which users should get help to comprehend the most important parts of a video and help them navigate through the video (Nguyen, Niu, & Liu, 2012). In turn, users instinctively follow four separate, complementary criteria to judge the relevance of information in videos, namely conciseness, coverage, context and coherence (He, Sanocki, Gupta, & Grudin, 1999). For example, conciseness has to do with the length of the video and coverage with the abstraction level of information. According to Duncan, Yarwood-Ross and Haigh (2013, p.1576) YouTube is may be "a great 'time waster' but [also offers] a significant amount of educative material". However, they also mention that educative material needs to be appropriately checked for and selected by quality. With careful selection YouTube videos offer a new, fresh approach, enabling linking theory to practice and promotes critical thinking and discussions (Burke, Snyder, & Rager, 2009).

Criteria for video evaluation can differ in terms of conceptualization or wording, but the underlying goal stays the same for the users and assessors, namely evaluating the relevance or quality of a video. Thus, YouTube videos will be included in the current study due to the easy access, and the relevance of videos will be evaluated on similar criteria, which will be exemplified further throughout the article. According to Duncan, Yarwood-Ross and Haigh (2013, p. 1577), "there is a lack of research to determine how and in what ways YouTube impacts on learning and achievement outcomes". Due to this research gap, the current study intends to investigate the added value of explanatory videos of YouTube on learning. Before going more into depth of the current study, it is important to understand some of the underlying cognitive mechanisms during learning.

**Memory and representations**

Successfully memorizing materials or information involves a meaningful interpretation of the given information (Anderson, 2005). Anderson (2005) showed with previous work that repeating information aloud and fast is not very effective since it is only memorizing a meaningless verbal pair. In contrast, when making use of a simple mnemonic technique, one can more easily remember items by associating two elements with a meaningful interpretation.

During this technique, one converts a word into a sentence and then create meaningful connections between the sound-alike and the meaning itself. However, the review of Kroll and De Groot (2005) on the effectiveness of the keyword technique criticized that the retrieval time of items was slower when using an intermediate keyword than making use of a direct association.

There are two ways of how people process new information or facts into their memory, namely semantic networks and schemas. Semantic networks are thought to be built of various categories where people store properties and information on different levels (Quillian, 1966). According to the research of Conrad (1972), the strength of connections between concepts and facts as well as the distance between them affects retrieval time of memories. In other words, the more frequently a fact is encountered, the more likely it will be stored within a specific concept, which in turn has a strong, positive effect on the retrieval time of that fact.

Abstraction theories are "one type [that] holds that we have actually abstracted general properties from the instances we have studied" (Anderson, 2005, p. 140). Schemas are one type of abstraction theories, where we build, organize and interpret some aspect or information of the world into a mental framework (Rumelhart & Ortony, 1976). Schemas represent concepts, which are defined as "a perceived regularity in events or objects, or records of events or objects, designed by a label" (Novak & Cañas, 2006). A schema usually has a slot structure, "in which slots specify values of various attributes that members of a category possess" (Anderson, 2005, p. 134). Another description of schemas is that they are "abstractions from specific instances that can be used to make inferences about instances of the concepts they represent" (Anderson, 2005, p. 135).

As the rate of educational videos increases on YouTube, it must be ensured that speakers present the content to the user in way that they can identify with it (Adam, McMahon, Prober, & Bärnighausen, 2019). As mentioned in the beginning, students or users need to make a meaningful interpretation of the content to store it properly (Anderson, 2005), which sets the stakes for and expectations of the speaker even higher. Therefore, in connection with the research of Conrad (1972), the goal of an educational video should be the strengthening of semantic networks of the user. Most of the time, speakers intend to successfully map their schema on the content in a way that students or users will have the same schema of the content after watching the video. For instance, such videos highlight the most important aspects of a topic and usually also how the topic is connected to other topics and aspects.

The successful adoption of such a schema is likely to depend on how the user evaluates the video in terms of relevance (He, Sanocki, Gupta, & Grudin, 1999). Therefore, the current study investigates whether a video, that is evaluated as relevant with different criteria, helps to adapt and strengthen such a schema. Further, the current study investigates whether a non-relevant video influences previously acquired schemas or even weaken current schemas of a person. To get a more visual representation of how such schemas are organized, how they represent knowledge and differ between people, the graphical tool of a concept map will be used (Novak, & Cañas, 2006). In the current study participants will have to draw their schema of the content they read on paper and watched in a video as a concept map. By this, it is possible to see whether there are differences between schemas when presenting persons with materials differing in relevance and modality. As people do not only store new information and concepts, but also forget about existing ones, memory interference will be discussed in the upcoming paragraph.

**Retroactive memory interference**

Forgetting is referred to as the inability to "recall something now that could be retrieved on an earlier occasion" (Medina, 2018, p. 1). According to the inference theory of Postman and Underwood (1973), items can sometimes impair each other, which results in forgetting the to-be-retrieved information. Such a memory loss or absence can be either due to a temporary deficit in memory retrieval or due to more chronic, pathological inaccessibility, for example, chronic diseases or irreversible damage to the brain.

There are several types of forgetting, for instance, retroactive interference that "refers to the second-learned association disrupting performance that is based on the first-learned association" (Polack, Jozefowiez, & Miller, 2017, p. 129). In other words, newly learned information is interfering with the previous one. For example, the research of Martin (1971) and the review of Burton, Lek, Dixon and Caplan (2019) on associative interference has shown that, in terms of retroactive interference, participants struggled to accurately recall the first-learned association, which they called 'AB' pair. 'AB' means that participants had to learn a list, 'list 1', where 'A' items were paired with 'B' items. In contrast to retroactive interference, proactive interference involves testing on the second-learned information (Polack, Jozefowiez, & Miller, 2017, p. 129). This means that previously learned information interferes with newly learned information. Martin (1971) has explained in his research that participants had, in terms of proactive interference, more troubles to accurately recall the second-learned association, named 'AC'. 'AC' means that participants learned a second list, 'list 2', where 'A' items were

paired with ‘C’ items. The review of Bouton (1993) on interference paradigms showed that the retrieval of information or associated items depends on background contextual cues. According to Wixted (2005), interference occurs when new information is entered into the conversion from short-term memories into long-term memories. In contrast, Anderson and Neely (1996) suppose that once long-term memories are formed, the interference is caused by competition of retrieval cues. In this case, similar or identical retrieval cues can get associated with wrong memory or not enough or only weak retrieval cues are accessible.

In the current study, a similar structure as Burton, Lek, Dixon and Caplan (2019) and Martin (1971) will be used to test whether retroactive interference occurs by first presenting a text, then a video, differing in relevance and afterwards test the participant on the text that was learned first. For the current study, it will be predicted that the non-relevant video, here ‘B’ and second-learned, would retroactively interfere with the previously learned the text, here ‘A’ and first-learned, resulting in worse performance when testing participants on the text ‘A’. The current study will also test whether a relevant video, call it ‘A+’ and second-learned, retroactively interferes with the previously studied text ‘A’ or whether it actually strengthens by providing the relevant information to recall text ‘A’, first-learned. How these processes of meaningful learning and interference are involved when information is presented multimedia-based will be discussed in the next paragraph with the Cognitive Theory of Multimedia Learning.

**Cognitive Theory of Multimedia Learning**

The cognitive theory of multimedia learning (CMTL) focuses on the idea that “learners attempt to build meaningful connections between [spoken or written] words and pictures and that they learn more deeply than they could have with [spoken or written] words or pictures alone” (Sorden, 2019, p. 2). In this statement, the pictures can be any form of graphical imagery. According to Mayer (2005), the latter part of the definition can also be defined as the multimedia principle itself. The research paper on multimedia learning of Sankey, Birch and Gardiner (2011), has shown that there was no significant learning improvement when showing the content through multiple representations. In their research, the authors combined “text, video, aural and interaction to cater more effectively for different learning styles and modal preferences” (Sankey, Birch, & Gardiner, 2011, p.18). The authors concluded that their results are due to the sample that included higher-achieving students predominantly and was also in terms of learning styles or modalities very one-sided since most of the students were identified as multimodal learners.

Meaningful learning happens by engaging in five cognitive processes, starting with "selecting words refers to attending to important incoming spoken words for further processing in working memory" (Mayer, 2010, p. 545). The next step is selecting and processing relevant images into visual working memory and then organize a verbal model by the selected words. Further, the selected images get organized into a pictorial model and finally, verbal and pictorial representations get integrated with each other and prior knowledge.

There are three main assumptions in the Cognitive Theory of Multimedia Learning, starting with the existence of two separate channels, auditory and visual, to process information (Baddeley, 1986; Paivio, 1990; Clark & Paivio, 1991). These separate auditory and visual channels are thought to be representing two different primary senses of humans (Felder & Silverman, 1988). For example, visual stimuli such as sights, pictures or diagrams are perceived by seeing, auditory stimuli such as sounds, and words are perceived by hearing. Both visual and auditory study materials are important to consider in terms of comprehension to see whether processing information through one or several channels has an influence, for instance, on a test or exam results. Furthermore, it has been assumed that the two channels have limited, finite capacity (Sweller, 1988; Sweller, 1994).

Lastly, like the aspect of perception mentioned above, learning is seen as an active process, where one filters, selects, organizes and integrates new information based upon prior knowledge (Mayer, 1996; Mayer 1999). Referring back to the five cognitive processes, Sorden (2019, p. 5) states that these five "determine which information is attended to or selected, which knowledge is retrieved from long term memory and integrated with new information to construct new knowledge, and ultimately, which bits of new knowledge are transferred into long-term memory". In contrast, if some of these five cognitive processes are getting impaired, previous knowledge cannot be properly retrieved from long term memory and new information is unlikely to transfer to long-term memory successfully. The former part is likely to happen with retroactive interference when first-learned information must be retrieved. Further, the latter part is likely to happen with proactive interference when second-learned information must be retrieved.

According to the multimedia principle, more meaningful connections are made when information is acquired by words and pictures rather than only by one of them (Sorden, 2019). Words have been mentioned to be in written or spoken form, therefore the current study predicts that a relevant video, next to reading a text, will help persons to connect information more deeply in comparison to only reading a text. In turn, these deeper connections are possibly

visible within the concept map task, where people have to draw their schema of the content. The current study will investigate whether retroactive interference with a non-relevant video will impair some of the five cognitive processes by testing persons on the first-learned information. In the upcoming paragraph, two types of knowledge measurements will be explained and how they differ from each other.

**Measurement of comprehension**

Comprehension of study materials can be assessed through different measurements, where the most commonly used ones are open-ended and multiple-choice questions (Ozuru, Briner, Kurby, & McNamara, 2013). The study of Ozuru, Briner, Kurby and McNamara (2013) examined the difference between these two types of measurements by memory-based comprehension questions. In their study, participants had to study the content of a text and remember the most relevant information of the text, where the questions should be used as retrieval cues if they successfully comprehended the study material (Ozuru, Briner, Kurby, & McNamara, 2013). One of the main results of their study is that different retrieval processes are involved in answering open-ended and multiple-choice questions and therefore, a distinction between these two types of questions need to be made. According to Graesser, Ozuru and Sullins (2010), open questions usually involve cued-recall tasks, providing only limited retrieval cues, where goal-oriented active searching is required to find an answer to the question.

In contrast to open questions, answering multiple-choice questions involves mainly processes of familiarity or automatic retrieval, because the answer options provide many retrieval cues (Yonelinas, 2002). However, this does not imply that multiple-choice questions are easier since these can also be manipulated through “maximizing the conceptual and surface feature overlap between the target and distractor options” (Ozuru, Briner, Kurby, & McNamara, 2013, p. 2). Additionally, attributes of questions such as answer options, the content of the question or the type of text may lead to different performance between different individuals (Graesser, Ozuru, & Sullins, 2010; Magliano, Millis, Ozuru, & McNamara, 2007). In connection with the cognitive theory of multimedia learning (Mayer, 2005), research papers should be focused on how to enhance the comprehension of study materials based on these differences between comprehension measurements. For instance, Sorden (2019) refers to the issue of how instructional practices, in this case multimedia, should be structured and employed more effectively to enhance that people learn more efficiently. For the current study, we will therefore make use of both multiple-choice and open questions to measure the different retrieval processes involved in answering these questions.

**Current study**

Ainsworth (1999) explained that presenting key terms during an audio narration guides the interpretation students make on the narrated content. Applying this knowledge to the relevance of videos, it is expected that non-relevant videos have a detrimental effect of misleading students, while relevant videos will guide students towards the correct interpretation of the content. Research of Kalyuga, Chandler and Sweller (2004) has shown that participants with nonconcurrent spoken-written presentations recalled more information than participants with concurrent spoken-written presentations. Since attention has to be split up during a concurrent presentation of spoken and written study material, the cognitive load of the participants is increasing as well (Sweller, 1988). In the current study, relevant and non-relevant videos will be presented non-concurrently (Martin, 1971), because the focus will be on retroactive memory interference, which should be disentangled from a possible cognitive load effect. With the concurrent presentation of videos and text, it is likely that cognitive load maybe becomes a confounding variable and influence exam performance.

To sum up, the added value of explanatory YouTube videos will be investigated and whether these have different influences on exam performance due to their relevance. Further, the graphical tool of a concept map will be integrated as one question in the study to see whether schemas differ when only reading a text or watching a video, differing in relevance, next to it. Text and videos will be presented sequentially to test whether there is an effect of retroactive interference by the videos on the text. Regarding the Cognitive Theory of Multimedia, the current study investigates whether persons profit or forget aspects from watching an additional explanatory video that differs in relevance. Next to the concept map task, further open and multiple-choice questions about the content will be used to investigate differences in comprehension and retrieval of information.

The current study helps to understand what the added value of relevant and non-relevant explanatory videos is on the comprehension of study materials. More specifically, it will be hypothesized that the comprehension of study materials, indicated by scores on open and multiple-choice questions, will be lower for the condition with text and non-relevant videos compared to the condition with only text and the condition with text and relevant videos. Another prediction is that the comprehension of study materials, indicated by scores on open and multiple-choice questions, will be higher for the condition with text and relevant videos compared to the condition with only text.

# Method

## Participants

Thirty-nine students currently or previously enrolled in study programs, with little or no human or social focus, at technical universities in Germany and the Netherlands participated in the experiment. For the experiment, participants needed a sufficient understanding of English and also needed to be able to answer questions in written form in English. This was checked by including participants who completed their A-level with English courses taken until the final A-level year. This meant that their English level was somewhere between B2 and C1, which universities usually required for enrolment. Participants with an educational background in Psychology or from a similar-focused program such as Communication Science were excluded, as these would have been biased due to the psychological text they needed to read. One student turned out to be invalid for the current study, due to not meeting the study program requirements, leaving 38 valid cases for the current study. Regarding gender, 21 (55.3 %) of the participants were female, 16 (42.1 %) were male and 1 (2.6 %) person had another gender. In total, the age ranged between 19 and 33 years, with a mean age of 23,1 years (SD = 3.534). Further, 32 (84.2 %) of the participants had a German nationality, 2 (5.3 %) had a Dutch nationality and 4 (10.5 %) had another nationality. Regarding educational background, 20 (52.6 %) were currently enrolled in a Bachelor study program, 6 (15.8 %) in a Master study program, 6 (15.8 %) were in their Ph.D. phase and 6 (15.8 %) indicated a different kind of education. A request was submitted to the BMS ethics committee in February, who approved to execute this experimental research. Participants were recruited and technical universities were chosen through convenience sampling. Before the experiment, participants signed an informed consent (see Appendix A for the informed consent).

## Materials

An abstract of the Introduction, namely three pages, of a research paper about positive stress, ‘Eustress’, was selected as the learning material (see Appendix B for the study material), due to the familiarity of students with the concept of negative stress, ‘Distress’. Additionally, relevant and non-relevant videos were chosen from the online streaming service YouTube, focusing on the themes of positive stress, called Eustress and the transactional model of stress and coping of Lazarus (1987). Criteria for evaluating videos have been chosen and each video was rated with the help of a second rater (see Appendix C and D for the criteria and scores on the videos). For example, the relevant video about Eustress was very precise in wording, repeated and highlighted the most important characteristics of Eustress but also added new

examples and further characteristics. In contrast, the non-relevant video about Eustress had some distracting background music, changed the texts too quickly and added a lot of information about Distress and the consequences of it which is not relevant for answering the questions.

The relevant video about the transactional model of stress explained each concept of the model very precisely and also explained the model with help the of a real-life example. In contrast, the non-relevant video about the transactional model of stress brought up a lot of history about the model and stressors. The video was quite hard to understand in terms of tone quality and the speaker himself used a very monotone voice. The Spearman rank order correlations between the two raters were for the Eustress videos, relevant and non-relevant, 0.829 and for the Transactional model videos, relevant and non-relevant, 0.771 (see Appendix E for the hyperlinks to the videos). For two out of the three conditions, participants also needed a mobile phone with a functioning internet connection and a QR code App, since they needed to scan two QR codes to watch the explanatory videos.

**Design**

The current study made use of a between-subjects design since the scores on multiple-choice and open questions of participants in the three conditions were compared with each other. The independent variable Condition was divided into one control condition with only text (Condition Text Only), one experimental condition with text and relevant videos (Condition Text and Relevant Videos) and one experimental condition with text and non-relevant videos (Condition Text and Non-relevant Videos). Participants in the control condition only received the written study material and then answered questions about the content. In the experimental condition Text and Relevant Videos, participants first read the written study material, had to watch a relevant explanatory video and then answered questions about the content. Participants in the second experimental condition Text and Non-relevant Videos first read the written study material, watched a non-relevant explanatory video and then answered questions about the content. These two sequences can be seen in Table 1.

Table 1

*Summary of the experimental structure*

| | First sequence (Eustress) | Second sequence (TSC model) |
|---|---|---|
| Group 1<br>Text Only | 1. First Text<br>2. Open Question<br>3. Multiple-choice Questions | 1. Second Text<br>2. Open Questions<br>3. Multiple-choice Questions |
| Group 2<br>Text and Relevant Videos | 1. First Text<br>2. First Relevant Video<br>3. Open Question<br>4. Multiple-choice Questions | 1. Second Text<br>2. Second Relevant Video<br>3. Open Questions<br>4. Multiple-choice Questions |
| Group 3<br>Text and Non-relevant Videos | 1. First Text<br>2. First Non-relevant Video<br>3. Open Question<br>4. Multiple-choice Questions | 1. Second Text<br>2. Second Non-relevant Video<br>3. Open Questions<br>4. Multiple-choice Questions |

**Procedure**

Students first answered in written form some demographic questions (see Appendix F for the demographic questions). After being randomly assigned to a condition, students read and studied the first part of the study material, for which they had 20 minutes. Participants assigned to the experimental conditions also had to watch the first video in these 20 minutes, with an approximate length of two minutes. In these two experimental conditions, the participants had to watch the videos twice without pausing it and could also take notes next to it. Students could take notes on the text sheet itself or on an additional sheet, however, after a maximum of 20 minutes they had to turn in all the study materials.

After the participants handed in the materials, they first answered in written form one open question asking about the characteristics of Eustress and then three multiple-choice questions, with four answer options but only one right answer, about other aspects of Eustress (see Appendix G for the questions about Eustress). On the open question, participants could get a maximum score of eight points, where one characteristic mentioned from the text counted as one point. Giving further examples, definitions or aspects not named as characteristic in the text did not receive a point. For example, describing Eustress as short-term, motivating and improving performance would bring three points. Participants in the condition with relevant

videos also could receive an extra score of four points by mentioning additional characteristics mentioned in the video but not in the text. For example, if they described Eustress as exciting or inspiring and manageable, they would get two points. When they completed these, the second part of the text, namely two pages, was handed out and they had a maximum of 35 minutes to study these pages and watch the second video, if applicable. After studying the second part of the text, participants first had to draw a concept map about the first and second parts of the text (Appendix H for the concept map question). For each keyword and description of that key word, or similar wording, participants could get one point, with 16 points in total. For example, naming Eustress as the opposite of Distress and writing down the definition of each would bring already four points in. To make an equal and fair distribution of scores, a second rater rated participants' answers and all scores were compared.

Then, they answered three open questions about the transactional model of stress and coping and afterwards six multiple-choice questions about further aspects of the model and coping styles (see Appendix I for the questions about the transactional model of stress). One open question was about naming three examples of emotion-focused coping, one about filling in the given words into the transactional model of stress and coping. The last open question involved a more creative or practical exercise, namely explaining the transactional model of stress and coping with a real-world example. For the first open question, participants could get a maximum of three points. Possible answer options were drug therapy, distraction, emotional disclosure or similar examples. In the second open question, participants could get a maximum of six points by writing the right words in the right empty blanks of the model. For example, naming Stressors in the first blank and Appraisal in the second one, seen from left to right, would bring two points. When answering the last open question, participants could receive a total of 17 points by naming each concept and give an example-related description of it. For instance, writing down that the stressor in the situation is the work itself or the high expectations of her boss would give two points.

The grades for all open questions and the concept map were calculated by dividing the individual score of the question through the total score of the question and multiplying it with the number ten. Based on that, the maximum score or grade one could get on each task was a ten. After that, as an appreciation for the participation, the students received a reward and were debriefed about the condition they were assigned to and what the current study was about.

### Data Analysis

The data were analyzed using IBM SPSS 24 using independent t-tests and Mann-Whitney tests for independent samples. Descriptive statistics were calculated for the scores on open and multiple-choice questions of participants and compared between the three conditions. Data were checked for normality with the Shapiro-Wilk Test for sample sizes smaller than 50. The test showed that the scores of participants in the three conditions on open questions were normally distributed while the scores on multiple-choice questions were not normally distributed.

For the first hypothesis, the scores on open questions were compared with an independent t-test between participants in the Condition Text and Non-relevant Videos and participants in the Condition Text Only. Then, the scores on open questions were compared with an independent t-test between participants in the Condition Text and Non-relevant Videos and participants in the Condition Text and Relevant Videos. Afterwards, a Mann-Whitney test for independent samples was used to compare the scores on multiple-choice questions between participants in the Condition Text and Non-relevant Videos and participants in the Condition Text Only. Next, another Mann-Whitney test for independent samples was conducted to compare the scores on multiple-choice between participants in the Condition Text and Non-relevant Videos and participants in the Condition Text and Relevant Videos.

For the second hypothesis, the scores on open questions were compared with an independent t-test between participants in the Condition Text Only and participants in the Condition Text and Relevant Videos. Next, the scores on multiple-choice questions were compared with a Mann-Whitney test of independent samples between participants in the Condition Text Only and participants in the Condition Text and Relevant Videos. Lastly, a summary was provided for the status of the two hypotheses. The statistical significance level was set at 0.05.

## Results

Descriptive statistics for the independent variable (Condition) and dependent variables (Grade OQ, Grade MC) were calculated and shown in Table 2. The dependent variable Grade OQ was an average number of correct answers participants gave on one open question about Eustress, one about drawing a concept map and three further open questions about the theory of stress and coping (TSC) model. The dependent variable Grade MC was calculated by the

average number of correct answers on three multiple-choice questions about Eustress and five multiple-choice questions about the TSC model.

Participants in the Condition with Text and Relevant Videos were also instructed to write down what complementary, additional information they remembered from the video. However, of the four possible answers or additions that they should name, participants only remembered around 43% of these. That means that participants only remembered on average two out of the four answers from the relevant explanatory videos.

Table 2

*Descriptive statistics of scores on open questions (Grade OQ) and scores on multiple-choice questions (Grade MC) in the Conditions Text Only, Text and Relevant Videos and Text and Non-relevant Videos*

| Condition | | Grade OQ | Grade MC |
|---|---|---|---|
| Text Only | Mean | 7.09 | 8.42 |
| | N | 15 | 15 |
| | Std. Deviation | 1.08 | 1.10 |
| Text and Relevant Videos | Mean | 7.23 | 8.64 |
| | N | 11 | 11 |
| | Std. Deviation | 0.89 | 1.33 |
| Text and Non-relevant Videos | Mean | 5.58 | 7.08 |
| | N | 12 | 12 |
| | Std. Deviation | 1.45 | 2.04 |

The two dependent variables were checked for normality through the Shapiro-Wilk test, indicating that Grade OQ is normally distributed with p-values larger than 0.05, while Grade MC is not normally distributed with p-values smaller or marginally smaller than 0.05 in the three conditions. Since Grade MC is not normally distributed and the number of participants in each condition is relatively small, the non-parametric Mann-Whitney test for independent samples will be used to test the first and second hypotheses in terms of Grade MC.

**First hypothesis**

Two independent t-tests were conducted, comparing the means of Grade OQ of the Condition Text and Relevant Videos and Condition Text Only with the means of Grade OQ of the Condition Text and Non-relevant Videos. Based on the first independent t-test, it was revealed that there is a statistically significant difference between Condition Text Only and Condition Text and Non-relevant Videos in terms of the average Grade OQ ($t$ (25) = 3.13, $p$= .002). In other words, scores on open questions were significantly worse for participants in the condition with text and non-relevant videos compared to participants in the condition with text only since the p-value is smaller than the significance level 0.05. The second independent t-test revealed that there is a statistically significant difference between Condition Text and Relevant Videos and Condition Text and Non-relevant Videos in terms of the average Grade OQ ($t$ (21) = 3.326, $p$= .001). Participants in the condition text and non-relevant videos performed worse than participants in the condition text and relevant videos since the p-value is smaller than the significance level 0.05.

Further, two Mann-Whitney tests for independent samples were conducted, comparing the means of Grade MC of the Condition Text and Relevant Videos and Condition Text Only with the means of Grade MC of the Condition Text and Non-relevant Videos. The first Mann-Whitney test for independent samples revealed that there is a marginally significant difference between Condition Text Only and Condition Text and Non-relevant Videos in terms of the average Grade MC (U=60.0, $Z$= -1.526, $p$= .064). Further, the second Mann-Whitney test for independent samples revealed that there is a statistically significant difference between Condition Text and Relevant Videos and Condition Text and Non-relevant Videos in terms of the average Grade MC (U=37.5, $Z$= -1.796 $p$= .035). Based on these results, the first hypothesis is supported, namely that the comprehension of study materials, indicated by scores on open and multiple-choice questions, is lower for the condition with text and non-relevant videos compared to the condition with only text and the condition with text and relevant videos.

**Second hypothesis**

An independent t-test revealed that there is no statistically significant difference between Condition Text Only and Condition Text and Relevant Videos in terms of the average Grade OQ ($t$ (24) = - 0.357, $p$= .362). The Mann-Whitney test for independent samples revealed that there is no statistically significant difference between Condition Text Only and Condition Text and Relevant Videos in terms of the average Grade MC (U=71.5, Z= -0,595, $p$= .276). Based on these results, the second hypothesis is rejected, which predicted that the

comprehension of study materials, indicated by scores on open and multiple-choice questions, will be higher for the condition with text and relevant videos compared to the condition with only text.

**Summary**

In Table 3, one can find an overview of the status of each hypothesis.

Table 3

*Summary of hypotheses status per condition*

| Hypotheses | | Condition | Status |
|---|---|---|---|
| (H1) Comprehension of study materials, will be lower for participants with text and non-relevant videos compared to participants with only text and participants with text and relevant videos. | (H1a) The comprehension of study materials, indicated by **scores on open questions**, will be lower for participants with text and non-relevant videos compared to participants with only text and participants with text and relevant videos. | Text Only vs. Text and Non-relevant Videos | **Accepted*** |
| | | Text and Relevant Videos vs. Text and Non-relevant Videos | **Accepted*** |
| | (H1b) The comprehension of study materials, indicated by **scores on multiple-choice questions**, will be lower for participants with text and non-relevant videos compared to participants with only text and participants with text and relevant videos. | Text Only vs. Text and Non-relevant Videos | Marginally accepted |
| | | Text and Relevant Videos vs. Text and Non-relevant Videos | **Accepted*** |

| | | |
|---|---|---|
| (H2) The comprehension of study materials, indicated by scores on open and multiple-choice questions, will be higher for participants with text and relevant videos compared to participants with only text. | Text Only vs. Text and Relevant Videos | Rejected |

*Note.* * p < .05 ** p < .01 *** p < .001

## Discussion

The purpose of the current study was to investigate the added value of non-relevant and relevant explanatory videos on comprehension of study materials. A control condition was added next to two experimental conditions, where participants only read the text.

Based on the results, the first hypothesis was supported by the data, meaning that scores on multiple-choice and open questions did significantly differ between the condition with only text and the condition with text and non-relevant videos. The first hypothesis is further supported by the result that there was a statistically significant difference in scores on open and multiple-choice questions between the condition with text and relevant videos and the condition with text and non-relevant videos. Summarizing these results, it means that participants in the condition with the text and non-relevant videos scored or performed significantly worse on multiple-choice and open questions than participants in the other two conditions. Next, the second hypothesis was rejected, meaning that there was no statistically significant difference between the condition with only text and the condition with text and relevant videos in terms of scores on multiple-choice and open questions. In other words, this means that there was no significant added value of a relevant explanatory video over reading only the text.

### Theoretical reflection

Regarding the first hypothesis, the results may be explained by the literature on retroactive memory interference (e.g. Postman & Underwood, 1973; Polack, Jozefowiez, & Miller, 2017). In the current study, students in the condition with text and non-relevant videos

created first a schema of the text and then likely built a different one after watching the video with the non-relevant information. As mentioned in the results, scores of these participants were significantly worse than in the other two conditions which had likely to do with the non-relevant information of the video retroactively interfering with the information of the text, which the participants got tested on.

This kind of interference may also be related to one or more of the five cognitive processes of Sorden (2019). As mentioned in the introduction, these five cognitive processes "determine which information is attended to or selected, which knowledge is retrieved from long term memory and integrated with new the information to construct new knowledge, and ultimately, which bits of new knowledge are transferred into long-term memory" (Sorden, 2019, p. 5)". Participants in the condition with text and non-relevant videos acquired or transferred the new knowledge probably not fully or successfully from short-term memory into long-term memory.

Next, it has been mentioned before, that retrieving information for answering open questions usually involves goal-oriented active searching (Graesser, Ozuru, & Sullins, 2010). The non-relevant video may have interfered with this goal-oriented searching since important information or cues may have got lost during the transfer to long-term memory. In terms of multiple-choice questions, retrieval cues are provided that enhance recognition rather than recall (Yonelinas, 2002).

Since there were no significant differences in terms of multiple-choice grades between the three conditions, participants in the condition with text and non-relevant videos probably could still access their previous mental framework with enough cues. However, since their scores on open questions were significantly worse, it can be concluded that the non-relevant video did not strengthen their representations, because they could not generate cues properly on their own to answer the open questions. In comparison, people that watched a relevant video had probably sufficient numbers of cues for themselves to generate when answering the open questions. This result complements the review of Bouton (1993), who stated that the retrieval of information is dependent on background contextual cues, which differ in this case between multiple-choice and open questions.

Regarding the second hypothesis, the results partly contradict the finding that frequently encountering facts are strengthening the connections between concepts and therefore reduce retrieval time (Conrad, 1972). It was expected that participants would have significantly higher scores in the condition with text and relevant videos than in the condition with text only because

they encountered the important facts of the themes more frequently than the control condition. However, since retrieval time was not directly measured within the current study, no clear indications can be made whether there was a difference between the condition text only and the condition with text and relevant videos at all. One possible explanation for this result may be that since there was no retroactive interference in these conditions, it was only a matter of strengthening connections between concepts. If students in both conditions created already a relatively stable and strong network of concepts from the text alone, then the relevant video probably just confirmed what they already knew or built up.

Looking at the multimedia principle described in the study of Sorden (2019, p. 2), the current study results contradict the assumption that "learners attempt to build meaningful connections between [written or spoken] words and pictures and that they learn more deeply than they could have with words or pictures alone". This has been tested in the experiment with the help of open questions where students had to expand their theoretical knowledge to practical examples and a concept map. However, there was no significant difference between participants in the control condition and the condition with relevant videos, in terms of scores on the open question and the concept map. In addition, open and multiple-choice questions do not only ask for the participants' comprehension of the study material but also how much they remember of the study material. Therefore, it could be that the unexpected effect or rejection of the second hypothesis is due to the nature of the task, which is rather a memory- than comprehension-based.

A similar result has been found by the study of Sankey, Birch and Gardiner (2011), showing that there was no significant learning improvement when showing the content through multiple representations. This supports the results of the current study that there is no added value of a relevant explanatory video over only text since it represents almost the same or similar content. Lastly, the results contradict the study of Ainsworth (1999), stating that presenting key terms during an audio narration may help to guide the interpretation students make on the narrated content. Participants in the control and relevant video conditions probably interpreted the content in the same way since there was no significant difference between the answers on open questions.

**Limitations**

One potential problem or pitfall of the current study is that some measurements such as retrieval time were missing to make clearer inferences about the added value of a relevant, explanatory video over text only. In the current study, the possible confounding effect of

cognitive load with memory interference has been disentangled by presenting the written study material and explanatory videos non-concurrently, however, the variable of retrieval time has not been accounted for. Retrieval time may have been one confounding variable that leads to the unexpected non-significant effect of the second hypothesis. It could have been the case that participants in the condition with text and relevant videos retrieved information or memories faster since their representations or network has been strengthened through the relevant video. Since this has not been tested in the current study, no clear inferences about retrieval times and differences between the control condition and the condition with text and relevant videos can be made.

During the experiment, it was also observed that some participants in the condition with text and relevant videos seemingly did not regard the relevant explanatory video as relevant, as they did not take any notes even though they took many notes of the text and were instructed to pay attention to the video or take notes. It may have been that the relevant explanatory video did not have as much relevant or interesting information for the participants as expected, which is mentioned in the definition of Roberson (2013).

Similar to the study of Sankey, Birch and Gardiner (2011), no clear statistical inferences can be made about the second hypothesis since the sample sizes, around 15 participants per condition, were too small to do so. This could be due to a ceiling effect between participants in the condition with only text and participants in the condition with text and relevant videos. For instance, questions may have been too easy to answer or the students in these two conditions were generally high achieving. However, an overall ceiling effect in terms of multiple choice and open questions between participants in the three conditions seems unlikely, since participants in the condition with text and non-relevant performed significantly worse.

Another potential limitation is that the experiment and testing took place just at one point in time. Therefore, no inferences about long-term differences between the conditions in terms of memory can be made. Also, it cannot be concluded for sure if it is a long-term memory task and if there will be possible differences in memory over some time. For instance, it could be that participants in the condition with text and relevant videos recall more information and correct answers when taking the test a few weeks later than the other two conditions. According to Adam, McMahon, Prober and Bärnighausen (2019), the effectiveness and long-term impact of health education videos depend on how well the user can identify with the presented content, which may be applicable for this set-up as well.

The direct testing of participants' knowledge may also be seen as a limitation since the consolidation of information takes time. Since there was no interval of time between studying the text and testing the knowledge, no clear inferences about long-term memory can be made. However, the results of the direct testing are still crucial for memory consolidation since statistically significant differences have been found between participants in the condition with text and non-relevant videos in comparison to the other two conditions.

Lastly, the non-relevant videos were mainly chosen on the criteria of relevance of information, however, other factors of the videos could have influenced the final scores of students. For instance, the first non-relevant video had quick visuals and background music, which may have been distracting for some students. This, in turn, may influenced the exam performance on the questions later on. Further, the speaker of the second non-relevant video used a very monotone voice and the tone quality was not very good, which probably influenced the students' performance later on. For example, students could have performed worse on the questions because they could not properly understand the speaker or got bored by his voice.

**Future research**

Regarding the first limitation, future research should include more time measurements, for instance, measuring the retrieval time or task completion time that participants need for answering the open questions. The quality of the answer has to be compared or associated as well then with the retrieval time. For example, if a participant answers or completes a question very quickly while writing only a few answers of all possible answers down, it does not imply that that participant has a better retrieval time than other participants since they did not answer the question fully.

In future research, more subjective measurements of participants could be added next to the experimental testing on comprehension of study materials such as interviews or feedback questions on the explanatory videos and their relevance. Through this, inferences can be made whether the videos have been perceived by participants as relevant or non-relevant as they were expected to. Additionally, possible confounding variables, such as tone quality or distractive music, can be eliminated by asking participants' opinions about the videos. With the participants' answers in mind, new criteria could be added or extended from the existing ones to more accurately evaluate the relevance of explanatory or educational videos in the future. Next, a larger sample size should be used to test whether there is any significant added value of a video with relevant information over only a text in terms of comprehension and memory.

Furthermore, future research should conduct a longitudinal study or experiment. This also includes a larger time interval between the studying of material and testing of knowledge, because consolidation of information takes time. For instance, there should be one day delay between studying and testing. With this type of research, it is possible to see how much participants can remember of the text and videos and whether there is a difference between long-term memory for text and text plus video. This may also help to have some more support on whether it is only a memory task, for instance, that everyone decreases in correct answers on multiple-choice and open questions over some period or whether it is about comprehension. In the case of comprehension, it could be that participants with text plus video may remember more by identifying more deeply with the content of a relevant video (Adam, McMahon, Prober, & Bärnighausen, 2019).

**Practical Implications**

In the current study, watching a video without any pausing should represent sitting in and listening to a lecture, which can also not just be paused. Based on the results of this study, it would imply that there is no need for students to watch additional explanatory videos next to a text, as exam preparation. It would also mean that students may not profit from sitting in lectures that provide non-relevant information, any more than just reading the text or content of the lecture themselves at home.

However, if teachers should decide to provide video material, it is important to choose a video with relevant information based on similar criteria mentioned in Appendix C and D. As technology is still developing and online materials are used more frequently, the importance of evaluating the relevance of these materials is increasing as well. This can be seen in the current study since a video with non-relevant information had a detrimental effect on students' exam performance. Applying this further to lectures, it is important that the lecturer her- or himself does not provide students with non-relevant material or information since this could lead to this detrimental effect as well.

## Conclusion

The current study provided important insights into the added value and relevance of explanatory videos. To sum it up, the current study showed that there is no added value of a relevant explanatory video over a text alone. However, if an explanatory video is chosen or provided, then the relevance of that video has a crucial effect on the students' comprehension. The current study helped to realize that videos from online services, such as YouTube, are getting increasingly used in the educational context, which requires not only the user but also the lecturer to evaluate consciously whether the information is relevant to prevent negative effects on exam performance.

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# Appendices

## Appendix A: Informed consent

Informed consent

'I hereby declare that I have been informed in a manner which is clear to me about the nature and method of the research as described in the aforementioned information brochure as described by the researcher. My questions have been answered to my satisfaction. I agree of my own free will to participate in this research. I reserve the right to withdraw this consent without the need to give any reason and I am aware that I may withdraw from the experiment at any time. If my research results are to be used in scientific publications or made public in any other manner, then they will be made completely anonymous. My personal data will not be disclosed to third parties without my express permission. If I request further information about the research, now or in the future, I may contact Lea Berkemeier, l.berkemeier@student.utwente.nl.'

If you have any complaints about this research, please direct them to the secretary of the Ethics Committee of the Faculty of Behavioural, Management and Social Sciences at the University of Twente, Drs. L. Kamphuis-Blikman P.O. Box 217, 7500 AE Enschede (NL), telephone: +31 (0)53 489 3399; email: l.j.m.blikman@utwente.nl).

Signed in duplicate:

…… ……

Name subject Signature

I have provided explanatory notes about the research. I declare myself willing to answer to the best of my ability any questions which may still arise about the research.'

…… ……

Name researcher Signature

**Appendix B: Study material**

Study material: Research paper about Eustress

In nowadays society, humans are getting increasingly confronted with stress in their daily work or study field, for instance through job demands (Costa & Neves, 2017). Based on that, workers often experience job insecurity or feelings like they are not capable of fulfilling the job demands (Stavroula, Griffiths, & Cox, 2004). In turn, this job insecurity harms not only the individual itself, but also the organization and the society.

Furthermore, the impact of job insecurity or stress in general depends on different factors which in turn can have a positive or negative effect on the person's wellbeing. Positive effects can occur with moderate stress levels, because performing in this optimal level facilitates resilience (Dooley, Slavich, Moreno, & Bower, 2017). In contrast, (high) chronic stress has a negative impact not only on the work performance itself, but also on the physical and psychological health of the individual (Bhagya, Srikumar, Veena, & Rao, 2017). The study of Sirgy & Lee (2018) underlines the importance of this so-called work-life balance with regard to work-related, nonwork-related and stress-related outcomes. Stress is a multifaceted concept which will be defined more in detail in the upcoming paragraph.

On the one hand, Simmons (2000, p.42) defined distress as "a negative psychological response to a stressor". […] On the other hand, Simmons (2000, p.42) defined eustress as "a positive psychological response to a stressor". Eustress is short-term, can help to focus attention and energy, improves performance, and motivates. […] Possible positive personal stressors can be receiving a promotion, learning a new hobby or taking a vacation (Fritz & Sonnentag, 2009). The positive effects of eustress occur when there is a positive balance or discrepancy between wishes and perception (Edwards & Cooper, 1988). As mentioned above, this would mean that eustress positively affects a person if he or she is having a balanced work-life for instance. Eustress is therefore also called 'good stress', meaning that it enhances performance until reaching a certain level of stress (Le Fevre et al., 2003, p. 729). When the intensity of the stressor is perceived as strong and the characteristics as difficult, the person will not feel able to cope with that stress, leading to distress (Le Fevre et al., 2003). For Lazarus (1993) eustress is "a positive cognitive response to a stressor". It means that a person is using cognitive and behavioral efforts, trying to prevent possible encounters with this stressor in the future. When actively and successfully using this positive coping, eustress is associated with a healthy physical state and positive feelings, for instance joy.

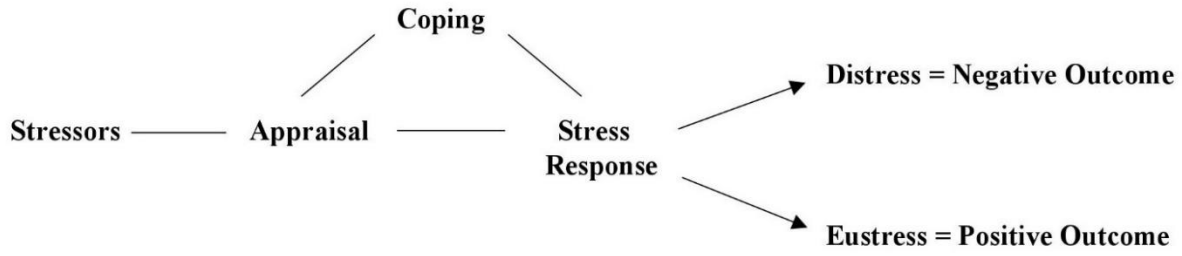



Figure 1. *The Transactional Model of Stress adopted from Lazarus & Folkman (1987)*

According to the transactional model of stress by Lazarus & Folkman (1987), several factors are playing a crucial role in the coping with stress. First, there are different type of stressors, for instance positive and negative ones as mentioned above. More in detail, Lazarus & Folkman (1987) described stressors as demands that are given by the internal or external environment upsetting the balance. Therefore, people are actively responding to stressors and the decision of a specific stress response depends on the individual appraisal of potential stressful events. Additionally, this appraisal can be divided in primary and secondary appraisal (Lazarus & Folkman, 1987). Primary appraisal is mainly about the significance or meaning of the event to the individual. Moreover, secondary appraisal is about the ability to be able to cope with the consequences of the event (Lazarus & Folkman, 1987). Furthermore, when the stressor is classified as dangerous and the individual feels like he or she is not able to cope with it, stress will be resulting. This stress can be overcome by the usage coping strategies which can be according to Lazarus & Folkman (1987) categorized into problem-focused or emotion-focused. Depending on the available resources and the type of coping, the outcome will be either a positive (eustress) or a negative (distress) one.

For Lazarus (1993) problem-focused coping is when "[…] a person's relationship with the environment is changed by coping actions [and] the conditions of psychological stress may also be changed for the better". Additionally, Lazarus & Folkman (1987) describe this type of coping as targeting the causes of stress in practical ways to tackle the problematic situation. The intention of this coping strategy is to directly reduce the stress, including for instance problem-solving, time-management or obtaining instrumental social support (Compas, Champion & Reeslund, 2005). As Chao (2011) states, one can expect that "problem-focused coping would buffer the impact of stress by influencing individuals' accurate appraisals of available coping resources and using specific coping efforts that mitigate stress". This influence on accurate appraisals and coping efforts is closely connected to eustress, because eustress can be seen as the extent to which cognitive appraisal of an event benefits the well-being of the

individual (Quick & Tetrick, 2003). Problem-focused coping focuses on the root of the problem and aims at directly reducing stress, whereby increased positive effects or the presence of positive psychological states, namely eustress, are expected to occur (McGowan, Gardner & Fletcher, 2006). In other words, positive psychological responses to stressors, like optimism, persistence or hope, should be occurring with problem-focused coping (Sarid, Anson, Yaari, & Margalith, 2004).

However, problem-focused strategies are not always available for instance, if a close relative died. In this case, emotion-focused coping is probably a more useful way of coping. Moreover, Lazarus (1993) defined emotion-focused coping as "other coping processes [that] change only the way we attend to or interpret what is happening.". Lazarus & Folkman (1987) characterized this type of coping as reducing emotional responses associated with possible stress situations. Moreover, emotion-focused coping is often the only realistic option when the person has no control over the source of stress. For instance, drug therapy, distraction, emotional disclosure, wishful thinking, meditation or eating more can be ways of emotion-focused coping strategies (Compas, Champion & Reeslund, 2005). In contrast to problem-focused coping, emotion-focused strategies are often less successful or effective since they ignore the root cause of stress. Emotion-focused coping does not provide a long-term solution since it often just delays the problem of the person. […]

The main research question of this paper is *how eustress is related to emotion-focused and problem-focused coping*.

The first hypothesis is that Eustress is significantly positively associated with problem-focused coping.

The second hypothesis is that Eustress is significantly negatively associated with emotion-focused coping.

**Appendix C: Criteria and scores on the explanatory videos, first rater**

Choice of videos based on different criteria (first rater):

**Eustress video:**

1 = no, 2 = partly, 3 = yes

| Video | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| Criteria | | | | | | | |
| **Linguistic material** | | | | | | | |
| Current | 3 | 3 | 2 | 2 | 2 | 2 | |
| Accurate | 3 | 3 | 2 | 3 | 2 | 3 | |
| Useful | 3 | 1 | 2 | 2 | 2 | 2 | |
| **Audio/visual correlation** | | | | | | | |
| Video essential to understanding | 2 | 1 | 3 | 2 | 2 | 2 | |
| Facilitates comprehension of text | 3 | 1 | 2 | 1 | 1 | 2 | |
| Visuals stand alone without text | 1 | 2 | 1 | 3 | 3 | 3 | |
| **Multiple Layers** | | | | | | | |
| Encourage repeated viewings (to understand paralinguistic elements such as gestures) | 2 | 1 | 3 | 2 | 1 | 2 | |
| **High production values** | | | | | | | |
| Complete discrete segment (beginning, middle, end) | 2 | 3 | 3 | 3 | 2 | 2 | |
| Compelling/entertaining | 2 | 1 | 3 | 1 | 1 | 1 | |
| Maintain interest of native speaker | 3 | 1 | 2 | 2 | 2 | 1 | |
| | | | | | | | |
| **Total** | 24 | 17 | 23 | 21 | 18 | 20 | |
| **Ranking** | **1** | **6** | **2** | **5** | **4** | **3** | |
| | | | | | | | |

1. Desirable linguistic material
    - (current, accurate, useful) – not prescriptive
2. High audio/visual correlation
    - (video track essential to complete understanding, facilitates comprehension of text, visuals may stand alone without text)
3. Multiple "layers"
    - (encourage (if not require) repeated viewings to understand paralinguistic elements (gestures, proxemics, body language, etc.))
4. High production values
    - (present a complete discrete segment (beginning, middle, end) (compelling/entertaining, maintain interest of a native speaker/viewer)

Choice of videos based on different criteria (first rater):

**Transactional model video:**

1 = no, 2 = partly, 3 = yes

| Video | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| Criteria | | | | | | | |
| **Linguistic material** | | | | | | | |
| Current | 2 | 3 | 2 | 2 | 2 | 2 | |
| Accurate | 3 | 3 | 3 | 3 | 3 | 3 | |
| Useful | 3 | 3 | 3 | 2 | 3 | 2 | |
| **Audio/visual correlation** | | | | | | | |
| Video essential to understanding | 3 | 3 | 3 | 2 | 3 | 2 | |
| Facilitates comprehension of text | 3 | 3 | 3 | 2 | 2 | 2 | |
| Visuals stand alone without text | 3 | 2 | 3 | 3 | 3 | 3 | |
| **Multiple Layers** | | | | | | | |
| Encourage repeated viewings (to understand | 2 | 2 | 3 | 1 | 2 | 1 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| paralinguistic elements such as gestures) | | | | | | | |
| **High production values** | | | | | | | |
| Complete discrete segment (beginning, middle, end) | 2 | 2 | 3 | 2 | 2 | 3 | |
| Compelling/entertaining | 1 | 2 | 2 | 1 | 2 | 1 | |
| Maintain interest of native speaker | 3 | 3 | 2 | 2 | 2 | 2 | |
| | | | | | | | |
| **Total** | 25 | 26 | 27 | 20 | 24 | 21 | |
| **Ranking** | **6** | **2** | **1** | **5** | **3** | **4** | |
| | | | | | | | |

**Appendix D: Criteria and scores on the explanatory videos, second rater**

Choice of videos based on different criteria (second rater):

**Eustress video:**

1 = no, 2 = partly, 3 = yes

| Video | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| Criteria | | | | | | | |
| **Linguistic material** | | | | | | | |
| Current | 3 | 3 | 1 | 1 | 2 | 2 | |
| Accurate | 3 | 2 | 3 | 2 | 1 | 2 | |
| Useful | 3 | 1 | 2 | 2 | 2 | 2 | |
| **Audio/visual correlation** | | | | | | | |
| Video essential to understanding | 3 | 1 | 2 | 1 | 2 | 2 | |
| Facilitates comprehension of text | 2 | 1 | 2 | 2 | 2 | 2 | |
| Visuals stand alone without text | 3 | 1 | 3 | 2 | 1 | 2 | |
| **Multiple Layers** | | | | | | | |
| Encourage repeated viewings (to understand paralinguistic elements such as gestures) | 3 | 1 | 2 | 1 | 2 | 2 | |
| **High production values** | | | | | | | |
| Complete discrete segment (beginning, middle, end) | 2 | 1 | 3 | 2 | 2 | 3 | |
| Compelling/entertaining | 3 | 1 | 2 | 2 | 2 | 1 | |
| Maintain interest of native speaker | 3 | 1 | 2 | 2 | 2 | 1 | |
| | | | | | | | |
| **Total** | 28 | 13 | 22 | 17 | 18 | 19 | |
| **Ranking** | **1** | **6** | **2** | **3** | **5** | **4** | |
| | | | | | | | |

1. Desirable linguistic material
    - (current, accurate, useful) – not prescriptive
2. High audio/visual correlation
    - (video track essential to complete understanding, facilitates comprehension of text, visuals may stand alone without text)
3. Multiple "layers"
    - (encourage (if not require) repeated viewings to understand paralinguistic elements (gestures, proxemics, body language, etc.))
4. High production values
    - (present a complete discrete segment (beginning, middle, end) (compelling/entertaining, maintain interest of a native speaker/viewer)

Choice of videos based on different criteria (second rater):

**Transactional model video:**

1 = no, 2 = partly, 3 = yes

| Video | 1 | 2 | 3 | 4 | 5 | 6 | |
|---|---|---|---|---|---|---|---|
| Criteria | | | | | | | |
| **Linguistic material** | | | | | | | |
| Current | 1 | 3 | 2 | 2 | 2 | 2 | |
| Accurate | 3 | 2 | 3 | 3 | 3 | 2 | |
| Useful | 2 | 3 | 3 | 2 | 2 | 2 | |
| **Audio/visual correlation** | | | | | | | |
| Video essential to understanding | 2 | 2 | 2 | 1 | 1 | 2 | |
| Facilitates comprehension of text | 3 | 3 | 3 | 2 | 2 | 3 | |
| Visuals stand alone without text | 1 | 3 | 2 | 2 | 2 | 2 | |
| **Multiple Layers** | | | | | | | |
| Encourage repeated viewings (to understand | 2 | 2 | 2 | 2 | 3 | 2 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| paralinguistic elements such as gestures) | | | | | | | |
| **High production values** | | | | | | | |
| Complete discrete segment (beginning, middle, end) | 2 | 2 | 3 | 2 | 3 | 3 | |
| Compelling/entertaining | 1 | 2 | 2 | 1 | 2 | 2 | |
| Maintain interest of native speaker | 2 | 2 | 3 | 1 | 1 | 2 | |
| | | | | | | | |
| **Total** | 19 | 24 | 25 | 18 | 21 | 22 | |
| **Ranking** | **3** | **2** | **1** | **6** | **4** | **5** | |
| | | | | | | | |

**Appendix E: Hyperlinks of explanatory videos**

Relevant explanatory video about Eustress: What is positive stress – Eustress?
https://www.youtube.com/watch?v=5bjTRlLHbzQ

Non-relevant explanatory video about Eustress: Stress: Distress and Eustress
https://www.youtube.com/watch?v=SzNJNk6USy0

Relevant explanatory video about transactional model of stress: Theory of Stress and Coping

https://www.youtube.com/watch?v=zZxU-agpzM4

Non-relevant explanatory video about transactional model of stress: Theories of stress and coping

https://www.youtube.com/watch?v=sXsM4ksfebA

**Appendix F: Questions about Eustress**

Open question:

1. In the research paper, several characteristics have been mentioned about the concept of eustress. Write down as many aspects as you can remember that characterize eustress.

Multiple-choice questions:

1. In the previous text, there have been mentioned several definitions of eustress and distress. What is the **correct** definition of eustress, according to Simmons (2000)?
    a. Eustress is a positive psychological response to a stressor (X)
    b. Eustress is a negative psychological response to a stressor
    c. Eustress is a positive cognitive response to a stressor
    d. Eustress is positive stress that comes from positive challenges or exciting experiences

2. Which of the following statements are examples of experiencing eustress?
    a. Receiving a promotion or raise at work
    b. Starting a new job, school program or relationship
    c. Making big life transitions such as having a child
    d. All of the answers are examples of eustress (X)

3. In the text the concepts of Eustress and Distress have been defined. Which statement is **true** about these two concepts when drawing them in a graphic?
    a. Eustress and Distress are exclusive concepts, one can only experience one completely or nothing
    b. Eustress and Distress can be shown in a graph: if performance is low and level of stress is high, distress is likely to occur, and eustress is the optimum of performance and level of stress (X)
    c. Eustress and Distress can be shown in a graph: if level of stress is low and performance is low, distress is likely to occur, and eustress is the optimum of performance and level of stress
    d. Eustress and Distress can be shown in a graph: if performance is low and level of stress is low or if both are high, distress is likely to occur and eustress is the optimum of performance and level of stress

Please indicate with crosses your FINAL answers to the multiple-choice questions

| | A | B | C | D |
|---|---|---|---|---|
| 1 | (X) | | | |
| 2 | | | | (X) |
| 3 | | (X) | | |

**Appendix G: Demographic questions**

Demographic question (to be answered by participant in the end)

What is your gender?

- Male
- Female
- Other

What is your age?

_____

What is your nationality?

- Dutch
- German
- Other

What is your current level of education (not completed yet)?

- Bachelor
- Master
- PhD
- Other

What is your study program?

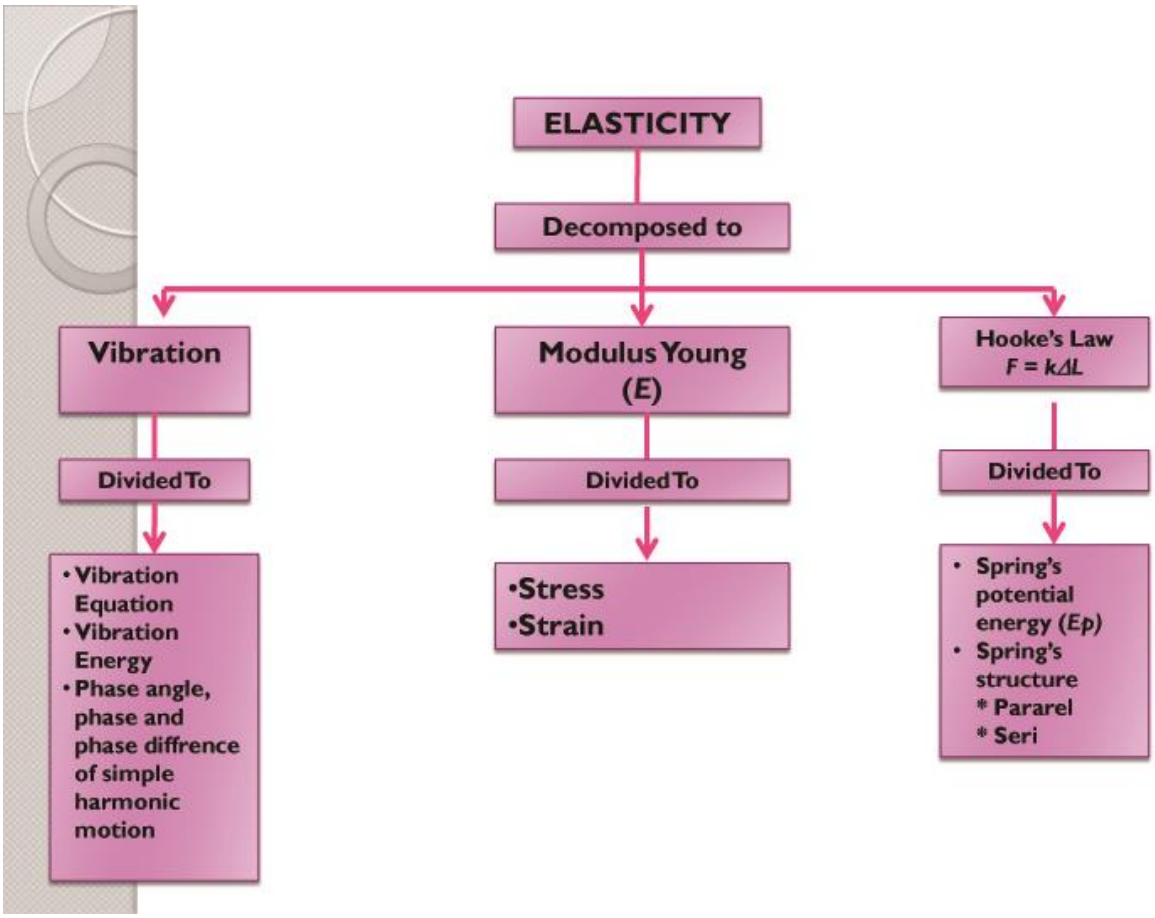
_____

**Appendix H: Concept map question**

Concept map

Based on what you have read and learned so far, you should now draw a concept map. Concept maps are in their general structure very similar to mind maps. The difference between these two maps is that concept maps have tree structures with many branches and clusters while a mind map has a more radial structure. With a mind map, one is focusing only on one concept, but a concept map connects multiple ideas or concepts. Start with the word/concept "Eustress" in the beginning/middle and make connections with other concepts that you associate or connect with eustress, based on the research paper. For instance, you should indicate with arrows or lines that concepts are not the same (write opposite above arrow/line), are positively or negatively correlated/associated (write that above arrow/line) with each other or just add additional information to the concepts.

An example of a concept map can be found below, created on the theme of "elasticity":



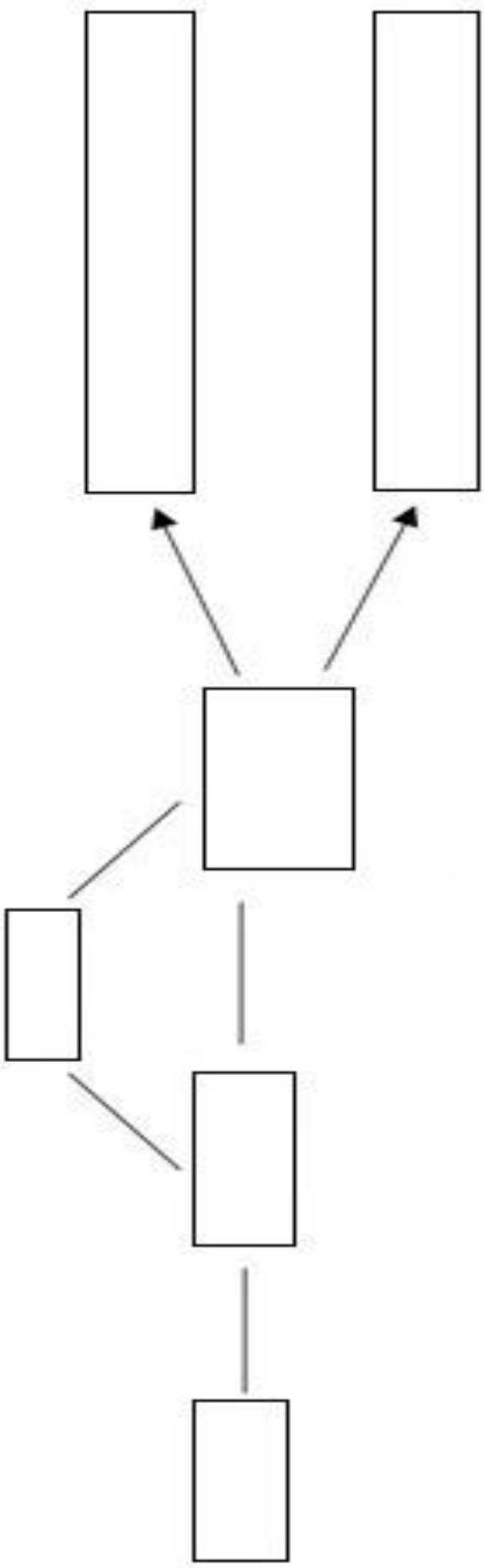
Please draw your concept map on this page:

**Appendix I: Questions about transactional model of stress**

Open questions:

1. Lazarus has distinguished between two types of coping, namely problem-focused coping and emotion-focused coping. Name three examples of how emotion-focused coping strategies could look like.

2. The transactional model of stress by Lazarus and Folkman (1987) has been used in the text to explain how stress develops and possible reactions on or outcomes of different stressors.
    a. Below (next page) you can find an empty version of the transactional model. Try to fill in the blanks with these given words:
    Coping, Eustress, Stress Response, Appraisal, Distress, Stressors



b. Use the given example to explain ALL the concepts or aspects of the transactional model. Example: A business woman is getting after 2 years of hard work a promotion to become co-manager of the company she is working for. Her boss has high expectations of her, including her ability to combine her normal life with her work life in terms of time management.

Problem- and emotion-focused coping

Multiple-choice questions:

1. In the transactional model of stress by Lazarus and Folkman (1987), there has been made a distinction between types of appraisal, namely primary and secondary appraisal. Which **one** of the following statements is **true**?
    a. Primary appraisal is about the ability to be able to cope with the consequences of the event
    b. Secondary appraisal is about the significance or meaning of the event to the individual
    c. Primary appraisal is about the significance or meaning of the event to the individual (X)
    d. None of the statements is true

2. The research paper introduced at the beginning two hypotheses that were going to be tested with a survey. Which interpretation is **NOT true** about the types of coping?
    a. Emotion-focused coping is often used when the person has no control over the source of stress
    b. Problem-focused coping is seen as a more long-lasting and effective solution than emotion-focused coping
    c. Emotion-focused coping includes strategies like time-management or obtaining instrumental social support to directly reduce the stress (X)
    d. Eustress is expected to occur more likely when making use of problem-focused coping

3. Lazarus (1993) categorized coping strategies into either problem-focused or emotion-focused coping. According to Lazarus, which statement about problem-focused coping is **true**?
    a. Problem-focused coping would buffer the impact of stress by influencing individuals' accurate appraisals of available coping resources and using specific coping efforts that mitigate stress
    b. Problem-focused coping is when a person's relationship with the environment is changed by coping actions and the conditions of psychological stress may also be changed for the better (X)
    c. Problem-focused coping is less effective and successful than emotion-focused coping
    d. Problem-focused coping provides a short-term solution since it only delays the problem of a person

4. Which of the following statements is **NOT** an example of emotion-focused coping?
    a. Lucy is afraid to fail the upcoming exam and decides to practice some meditation to calm herself and her mind down
    b. George has troubles with some of his colleagues and blocks out the stress by convincing himself that it is not important what his colleagues think
    c. Carl has troubles with his girlfriend to decide where to go on vacation, so he decides to sit down with her and discuss about similar interests (X)
    d. Leonie experiences currently a lot of stress at her home, so she decides to go out with a friend into the city

5. Please imagine the following situation: A business man is walking down the street and getting threatened by a man with a gun. The man with the gun wants to steal the money of the business man. He decides to give the gun man his money, because his health is more important to him than money and both go their own ways.
   According to the transactional model of stress and coping, the business man went through several steps before making a final decision about his situation. Which of the following orders of steps is **correct** when looking at the outcome of the situation?

a. Appraisal of stressor as challenging, problem-focused coping to give gun man the money, resulting in eustress that he got not hurt himself
b. Appraisal of stressor as threatening, problem-focused coping to give gun man the money, resulting in distress that he lost his money
c. Appraisal of stressor as threatening, emotion-focused coping to talk with the gun man about it, resulting in eustress that he could keep his money
d. Appraisal of stressor as threatening, problem-focused coping to give gun man the money, resulting in eustress that he got not hurt himself (X)

Please indicate with crosses your FINAL answers to the multiple-choice questions

| | A | B | C | D |
|---|---|---|---|---|
| **1** | | | **(X)** | |
| **2** | | | **(X)** | |
| **3** | | **(X)** | | |
| **4** | | | **(X)** | |
| **5** | | | | **(X)** |