

Utrecht University  
Master Applied Cognitive Psychology

THESIS

Visibility of Lecturers in Weblectures  
Will Visibility Increase Enjoyment and Attention?

Helen Korving, 0440418  
July 11th 2014

S.O. (Serge) Dumoulin

Utrecht University  
Project E-lectures  
M. (Mabelle) Hernandez & E. (Esther) De Groot

S.F. (Stella) Donker

# Visibility of Lecturers in Weblectures

## Will Visibility Increase Enjoyment and Attention?

### Abstract

*This study was conducted to see whether weblectures with audio and video of a lecturer would elicit more enjoyment and more attention than weblectures with only audio. The participant group consisted of 88 Dutch university students who saw two different web-lectures in two different view-conditions and gave their opinion. The view-conditions were: Large lecturer/small PowerPoint, Small lecturer/large PowerPoint and No lecturer/large PowerPoint. No difference was found between the conditions on enjoyment for the lecture. It is believed that other aspects of a lecture, such as lecturer appeal and story, have more influence on enjoyment than just the visibility of the lecturer. For attention a significant difference was found for the second weblectures the participants saw. Participants reported more attention in the view-condition with a large lecturer and small PowerPoint, than in the other two view-conditions, while controlling for lecturer appeal, story appeal, subject relevance, radio listening and attention in a lecture-hall. There was no significant trend of visibility and attention, and lecturer appeal did not moderate the relationship between visibility and attention. Implications for these results in light of other research are discussed.*

### Introduction

Although there is a growing demand for students in higher education to receive more contact hours with teachers, yet another growth is seen in the availability of education on the internet. More and more institutions for higher education are making course material available online, and not just for their own students (Gotthardt, et al., 2006; Coursera, 2014). The video- or audiotaped lecture, called a weblecture, is one of the aspects of online educative material. In this context a weblecture is considered a slide-based (PowerPoint), mostly one-way presentation given by an instructor to multiple students (Bligh, 1998; Day, 2008). Seeing that lectures are the primary means of knowledge transmission in higher education (Bligh, 1998; Risko, Anderson, Sarwal, Engelhardt, & Kingston, 2012) and a very effective method for the transfer of information and the personalization of the subject matter (Bligh, 1998), it is not surprising that lectures are being made available online. It is an attractive alternative for students with long travel times to reach their university, students who need or want more depth in their education or students who want to study at flexible times. The availability of lectures online opens the door to more alternatives, such as live chats with professors, online exams and an online feedback meeting. The many possibilities of online education make it attractive for both students and educational institutions to use.

There has already been much research about the use of online learning (or e-learning) tools, such as weblectures, in (higher) education. Following examples show the width of the research on e-learning; Paechter & Maier (2010) found that *online learning* was preferred by Austrian university students for distributing information, providing structure of the learning material and in acquiring and supporting self-regulated learning, while *face-to-face learning* was preferred for communication purposes, in which shared understanding or interpersonal relationships are important, and when application skills were to be acquired. Tzeng, Chiang and Li (2007) developed a hybrid MCDM (*multi-criteria decision making*) model to evaluate the effectiveness of e-learning programs on both quantitative and subjective criteria, while Van Raaij & Schepers (2008) developed a model explaining individual differences in acceptance of an e-learning environment by Chinese students. Granić, Mifsud, & Ćukušić (2009) studied a pedagogical framework for e-learning in secondary education in Europe and found that in their second validation phase, teachers became more confident in the application of e-learning and evaluated it more positive. Wang (2010) empirically tested the effectiveness of a web-based dynamic assessment system in elementary school, and found that it shows better results than a normal web-based test. These examples show the breadth of uses for e-learning and its tools for students of all ages.

While quantitative research discussed before focused on effectiveness, qualitative research was carried out to let users evaluate e-learning programs and their tools (i.e. Gilbert, Morton, & Rowley, 2007; Morales, García, Rego, Moreira, & Barbosa, 2005; Ozkan, & Koseler, 2009). In these studies, the programs and tools received mostly positive judgments from users, saying it boosted their engagement in the subject matter more than studying out of a book. Users enjoyed online chatting with teachers and other students, saying it increased their feeling of belonging to a learning community. The studies found that use of e-learning diminished after the first five to six weeks, probably due to novelty-adjustment, but use increased again around exam-times. These qualitative studies mostly reach students who already spend relatively more time on their education and are more motivated than their classmates. Not much is known of how e-learning is evaluated by the students who are less engaged to their education and spend less time studying.

Concurrent to the discussed literature, more quantitative and qualitative research was carried out to assess the effectiveness of e-learning, seeing that the use of e-learning keeps growing. Researchers evaluated e-learning programs and tools based on their effect on learning and study results (i.e. Boling, Hough, Krinsky, Saleem, & Stevens, 2011; Ćukušić, Alfirević, Granić, & Garača, 2010; Lin, 2011; Sun, Cheng, & Finger, 2009) or tried to provide learning institutions with a detailed list of which online learning tools should be provided and in what way (i.e. Chang, & Chen, 2009; Gaeta, Orciuoli, & Ritrovato, 2009; Johnson, Hornik,

& Salas, 2008; Krause, Stark, & Mandl, 2009; Liaw, Chen, & Huang, 2008; Shee, & Wang, 2008; Sun, Tsai, Finger, Chen, & Yeh, 2008). These studies are not specifically focused on weblectures, and therefore are not discussed in more detail in this thesis.

### *Research on weblectures*

In concordance with the research done on e-learning, other research has specifically focused on weblectures. Gorissen (2013) has written a dissertation on the use of weblectures by students in the Netherlands. His study focused on discrepancies between reported use and actual use of weblectures, and the use of *tagging*, placing bookmarks in a weblecture. Gorissen found that students like the thought of viewing every lecture online, and they will watch what they need, including the less interesting lectures. Students in this study mostly overestimate their use of weblectures, but around exam-times use becomes much more predictable. Gorissen found that students prefer live lectures, but they admit that, especially for lectures on Monday morning and Friday afternoon, watching a weblecture is very attractive. This study also found that tagging helped students to navigate through the lectures. The students who used tagging – either placed by other students or by experts – received better grades than the students who did not use tagging. This study gives a good overall review of weblecture-use and provides an addition (tagging) for future use.

In 2006, Day, Foley and Catrambone researched the direct effects of weblectures on learning. Four groups of participants were given 20 minutes to prepare for a test, using different study-materials. The first group could use a weblecture with video, audio and PowerPoint slides (VAP), the second group just had audio and PowerPoint slides, the third group got the same PowerPoint slides and a transcript of the presentation, whereas the last group used only the PowerPoint slides to study. The participants in the VAP group scored significantly higher on tests of remission and transfer of the subject, than the participants in the other three groups. The authors attribute this difference to the value added to video for multimedia learning, saying it increased the feeling of personalization of the message when a lecturer seems to be speaking directly to you. The weblectures used by these researchers was especially made for this study. It was not a video-recording of a live lecture, but a short clip of about 20 minutes where the lecturer sits at a desk and explains the material to the person behind the camera. Normal interference of lectures, like administrative announcements and student questions, could be left out, which made the lectures much shorter than they would be with interference. It would be interesting to find out if students will also prefer video-recorded lectures *with* these possible interferences.

A third study on effects of video-based learning was done by Choi and Johnson in 2005. These researchers let 16 American students consecutively experience a video-based instruction (audio & video) and a traditional text-based instruction (comparable to PowerPoint

slides) in that specific order. Participants were then asked about their perceptions of understanding (comprehension & retention) and motivation (attention, relevance, satisfaction & confidence) for both types of instruction. The participants in this study reported that the video-based instruction was more memorable than the text-based instruction, and it was found that reported attention was significantly higher in the video-based instruction than in the text-based instruction. While there was a non-significant difference in satisfaction between both types of instruction, the participants reported more satisfaction in the video-based instruction, and the non-significance ( $p=.078$ ) could be due to the small number of participants. The fact that all participants viewed both instructions in the same order could be a problem for generalization, but this study nevertheless shows that adding audio *and* video can improve attention and possibly satisfaction in this specific setting.

The discussed study by Choi & Johnson (2005) is based on a study by Baggett in 1984. In her study the researcher let participants watch a video version or listen to an audio version of the same narration of an assembly kit. A week later they were asked to write a summary of the narration. The summaries of the participants who watched the video version were deemed more complete than the summaries of the participants who listened to the audio version of the narration. Baggett suggested her results showed that mental models are easier derived from both auditory and visual symbol systems than just from auditory or linguistic information. She considered the improvement to be an aspect of attention, where both auditory and visual information lead to more attention than just the linguistic information.

#### *Current study*

As lectures are considered the primary means of knowledge-transmission in higher education, an online learning environment would be very poor without weblectures. A survey of studies by Bligh (1998) led to the conclusion, that live lectures are a very effective method for the transfer of information, for they can provide a subject framework and convey facts and concepts in a more personalized way than a book. The studies by Gorissen (2013) and Day, Foley & Catrambone (2006) discussed before show a tendency for participating students to prefer the videotaped lecture in general and over an audiotaped lecture. Based on these studies it can be hypothesized that a videotaped lecture will be preferred, because it will be more enjoyed by students. Choi & Johnson (2005) found more attention and maybe more satisfaction in a video-based lecture compared to a text-based lecture and Baggett (1984) found that participants who watched a videotape of a narration could later on write a more complete summary, than participants who only heard an audiotape of the narration. The researcher attributed this difference due to an attention-effect. These results can be said to suggest that adding a videotape of a lecture will lead to more attention during the lecture. The current study is set up to try and explain the preference for a visual lecturer by

suggesting that visibility leads to more enjoyment of and more attention for a weblecture. For the purpose of this thesis, weblectures are defined as multimedia presentations that integrate a talking head + torso video, audio, lecture slides, and navigation controls.

### Visibility and Enjoyment

The first part of this study is focused on the enjoyment of an online lecture by students and tries to answer the following question: "Will the visibility of the lecturer add to the enjoyment of watching an online lecture?" In this study the term visibility is used to represent the difference between seeing a lecturer when he or she is speaking and only hearing the lecturer during the lecture. Enjoyment of a lecture represents more 'liking' of the lecture and less 'boredom' during the lecture. These two feelings are considered equal to satisfaction during a certain occupation (watching a weblecture), for 'liking' will lead to satisfaction and 'boredom' to disliking and dissatisfaction (Choi & Johnson, 2005).

In this study more visibility is thought to be related to more enjoyment. This link is based on earlier research that found this link, both in studies on lectures and in studies on other subjects (Bell, Malm, Loomis, & McGlothin, 1985; Day, Foley, & Catrambone, 2006; Palys & Little, 1983) and also based on three theories. The first is the *persona effect*, proposed by Nass, Steuer & Tauber in 1994. The effect states that interaction with a computer can seem human-human like when the computer side is personified. The second theory that explains visibility might lead to more enjoyment is the *personalization effect* (Moreno and Mayer, 2000), which states that more personalized messages are preferred by addressees. A third theory is based on a proposed need for deeper and personal relationships in learning (Veletsianos & Miller, 2008), which would be more easily provided with a visible lecturer. In the next three paragraphs these links are further explained.

In the first place, the persona effect can explain why a visible lecturer might be related to more enjoyment. The study by Nass, Steuer, & Tauber (1994) that proposed this effect was conducted with 180 experienced computer users, who either talked to a computer or filled out a questionnaire. The researchers found that talking computers elicited more social responses from participants than the questionnaire. They attribute this result to the personification of the talking computer. According to Van Mulken, André & Müller (1998) personification of a computer leads to more engagement, and especially in a learning environment, can positively affect a student's perception of the learning experience. Participants in the study of Nass, Steuer & Tauber did not interact with a face on a computer, but just with a voice. Adding a face to a voice may augment the persona effect. Sproull, Subramani, Kiesler, Walker, & Waters (1996) found this in their experiment. The participants in their study who conversed with a *digital persona* – a digital face that could talk, smile and frown – reported to enjoy the entire experience more than the students who conversed with a

text-display on the same computer. This might suggest that personifying a task on a computer (like following a lecture) by adding a video of the lecturer might make the entire experience more enjoyable than by just listening to a lecture.

Another possible explanation that a visible lecturer relates to more enjoyment of a lecture is the personalization effect, proposed by Moreno & Mayer in 2000. This effect states that personal reference in a lecture has a positive effect on listeners. High self-referencing, for example directly addressing listeners and encouraging them to believe that they are active participants in the lecture, was found to lead to better problem solving performance across multiple experiments, compared to low self-referencing (Moreno & Mayer, 2000). The authors explain this finding by suggesting that personalization will help listeners feel more involved in the lecture. The researchers found this effect both in speech and in on-screen texts. It did not seem to matter whether the message was personalized by a live lecturer or a written text. Nevertheless, it can of course be claimed that lectures with a visual lecturer will seem more personal to the addressee, because they are accompanied by a person on screen. The earlier discussed research by Day, Foley and Catrambone (2006, see page 3) has found this as well. In addition to the tests of remission and transfer, the students were asked open-ended and closed questions about the material they used and how they rated it. The participants in the Video/Audio/PowerPoint (VAP) group reported higher likelihood to ever want to use these types of materials again, than participants in the groups that did not include video. Many participants in the VAP group also expressed strong positive opinions in favor of the video feed, expressively praising its ability to add to the feeling of engagement with the material. Across the three groups that did not include video, participants specifically suggested that adding video or audio/video would likely improve their learning experience. The researchers suggest that the positive opinions participants had of the video-lecture might be explained by Moreno and Mayers personalization effect (2000), saying that "*the familiarity of an embodied [...] human instructor speaking much like they would in a classroom [...] adds an element of personalization that could be helping learners identify with the presenter and actively relate personal experiences and knowledge to the presented material*" (p. 21). This personalization effect might explain that lectures with a visible lecturer will be enjoyed more.

The third theory that supports the link between visibility and enjoyment is suggested by Veletsianos & Miller in 2008. These researchers claim that learners in an online learning-environment elicit more positive learning experiences when a virtual teacher is present. They attribute this to the need for deeper and personal relationships in learning. In his socio-cultural theory of learning, Vygotski (1978) states that individuals learn by socially interacting and conversing with others. A virtual character may be able to act as such a conversational partner and aid learning. On the same line of thought, a visible lecturer may lead to a more

positive learning experience, because they solicit more social responses of the watching students. The previously mentioned study by Sproull, et al. (1996) substantiates this theory. Sproull and her colleagues found that the participants in the face-condition interacted more socially with the computer, than participants in the text-condition. They presented themselves more positively to their conversational partner (the computer) and they reported feeling more aroused by the interaction. This finding suggests that visible lecturers may elicit more social feeling from their listeners, who in their turn may enjoy a weblecture more than when they cannot see the lecturer.

### **Visibility and Attention**

The second part of this study focuses on the attention for an online lecture by students and tries to answer the following question: "Will the visibility of the lecturer increase participants' attention for the online lecture?" Again visibility is considered as the difference between seeing and not seeing a lecturer during a lecture. Specific psychological uses of attention are centered around concentration, specifically the concentration of the mind on a single object or thought and the capacity to maintain selective and/or sustained concentration on that object or thought. Focusing attention on an object or thought is considered to require attentional resources within the mind (i.e. Proctor & van Zandt, 2008). In this study attention is seen as concentration on a specific subject in a certain period of time, in other words focusing attentional resources on this subject during that time.

There are three reasons why it is hypothesized there is a link between visibility of the lecturer and attention for the lecture. The first reason that a visible lecturer will lead to more attention is the information a person's face and body can give to aid understanding of what is being said (e.g. Bruce, 1996). The second reason is that the human face is an attention-grabber. Humans cannot help looking at another person's face and social interaction norms cause especially addressees to look at the face to signal their attention (e.g. Kleinke, 1986). The third reason makes use of a *multiple resource model of attention*, by Wickens (2002). Wickens describes two input modalities by which a person can gain and process information; visual and auditory. By combining two input modalities, more information can be processed with less strain on attentional resources. All three reasons will be further explained hereafter.

When considering attention as a way of focusing the resources on one thing, to fully grasp and process that thing, it can be argued that something that aids understanding could also aid attention. Watching a person's face while he or she talks will give the one spoken to more information about what is being said and meant, than just hearing what is being said. An example of this comes from phonetic distinctions such as place of articulation, which are difficult to hear, but easy to see. This is demonstrated by the McGurk effect, where different speech information presented via the face and voice was heard in a way which combined the



information from both channels (McGurk & MacDonald, 1976). Facial expressions also give addressees information about emotions that are difficult to hear. Moreover, tone of voice might tell whether a person is pleased or disappointed, but the face gives additional information. The timing of each expression and the final posture of the face during an interaction make the perception of expressions easier to see than hear. Simple face perception also helps people decipher speech (Bruce, 1996). This is demonstrated by the fact that speech can be deciphered with much more background noise when the lecturer's face can be seen than when only an auditory channel is available (Summerfield, 1992). Vitkovich & Barber (1994) found that in a shadowing task, where participants were asked to repeat exactly what was said, and differentiate that from irrelevant background noise, the conditions where the target was accompanied by a video image produced better results than the conditions where only an audio-channel was available. The researchers contribute the gain in intelligence in the video-condition to a general attention effect. Recently, this was shown by the already discussed study of Day, Foley, & Catrambone (2006), who let participants make use of different types of material to study. The participants in the Video/Audio/PowerPoint group reported that this mode of presentation aided them significantly more in their focus on and their comprehension of the lecture than the students in the other conditions, where no video of the lecturer was present. It seems visibility and understanding work together to aid attention.

A second source of attention in interaction among people is the attention the human face has been shown to draw both on photographs (Yarbus, 1967) and in face-to-face interaction (Kleinke, 1986). Especially people that are *spoken to* look continuous and attentive at a lecturer's face (Argyle & Graham, 1976; Bavelas, Coates, & Johnson, 2002; Kendon, 1967; 1990). The face dominance in human interaction is thought to represent a social and cultural norm for maintaining eye contact in face-to-face interaction to signal attention, interest and engagement (Kleinke 1986). Gullberg and Holmqvist (2006) found in their study that by showing lecturers on video, these social rules of behavior could not be neutralized. Addressees in both conditions spent about the same amount of time focused on the speaker's face and were also more likely to fixate on gestures at which speakers themselves had looked. This result contributes to claims of how lecturers use their own gaze to direct their addressee's gaze to their gestures as a target of attention (Langton, Watt, & Bruce, 2000; Streeck, 1993; 1994). The findings aforementioned suggest that attention could be easier allocated to a lecture when the lecturer can be seen, and not only heard.

As a third explanation of why visibility of a lecturer will relate to attention to the lecture, a theory of *cross-modalities for multiple attentional resources* is used. The human information-processing system is thought to have two main input-channels, or *modalities*: an auditory/verbal channel and a visual/pictorial channel (Day, 2008; Wickens, 2002). Dividing

the input over these two modalities will minimize the risk of overloading one of the channels and will aid the system in processing the information it is given. When both input-modalities work together to process the information, less energy might be needed to focus attention on the lecture, which will make it easier to attentively follow what is being said and keep it in short-term memory. The use of a PowerPoint presentation, which also invokes attention from the visual channel, will not aid as much in dividing the input of information as a visual lecturer, because information on a PowerPoint sheet is constant; once the information on the sheet is read it will not attract visual attention anymore. A lecturer's face changes constantly and will keep attracting visual attention (e.g. Kleinke 1986). Again, Day, Foley & Catrambone (2006) confirm this in their study, as participants in the Video/Audio/PowerPoint group reported more focus on the lecture and more engagement with the material, than the participants in the condition with only audio. By presenting listeners with a video of the lecturer to accompany the auditory channel, more attentional resources are available to focus on the lecture, and these resources will not be allocated elsewhere.

### **Other aspects that relate to Enjoyment and Attention**

There are of course more aspects to be considered when doing research on enjoyment and attention for a weblecture. Not only visibility, but other factors might influence these aspects. Some of the factors that can also influence enjoyment and attention will be measured and used as covariates. These factors are:

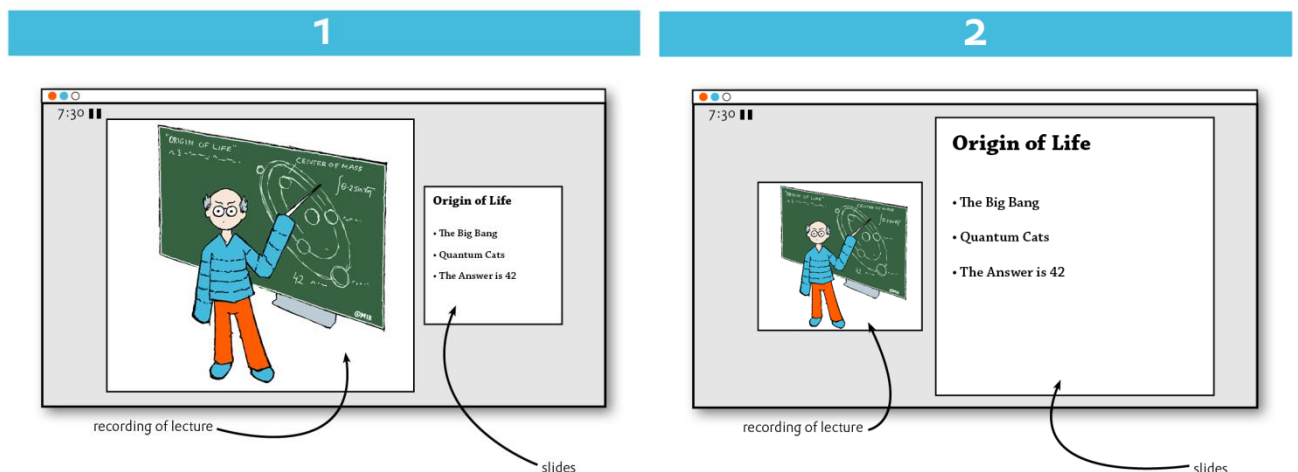
- The use of aural media (the radio, podcasts, books on tape, etcetera) by participants, as radio-listeners may differ in their attention to and enjoyment of lectures without a visible lecturer, compared to those that do not listen to the radio.
- The use of television (including YouTube, and other internet-video's) by participants, because this might explain another difference between attention to and enjoyment of lectures with and without a visible lecturer.
- The amount of elective lectures the participant follows at his or her institution, for being accustomed to following a lecture will relate to attention to a weblecture.
- The amount of attention the participant has for a weblecture compared to the amount of attention in a live lecture in a lecture hall, as participants might compare their attention for the weblecture to their attention in a lecture hall.
- Whether the participant likes the lecturer, for this can strongly relate to enjoyment.
- Whether the participant likes the story, because this also relates to enjoyment of the lecture and can aid attention to the lecture.
- Whether the subject of the lecture is of interest to the participant, because an interest in the subject aids enjoyment and attention.

- Whether the subject of the lecture is relevant for the participant's education, as relevant subjects will claim more attention and might be more enjoyed.

## Trends and Moderation

In addition to the mentioned positive links between visibility and enjoyment and attention other relations between these variables can be thought of. In this study two other relations are researched, the visibility-trends of Enjoyment and Attention, and the moderation of lecturer appeal. Both relations will be briefly explained and justified hereafter.

In this introduction, the positive links between the visibility of a lecturer and Enjoyment of and Attention to a weblecture have already been explained, but another variable has not been discussed; namely the variability in the visibility of the lecturer. Instead of comparing an Audio/Video&PowerPoint-condition to an Audio&PowerPoint-condition, the sizes of both video and PowerPoint can be varied to create more conditions (see Figure 1). A condition, where the video of the lecturer is small and the PowerPoint is large will answer *how much visibility* relates to Enjoyment of and Attention to a weblecture. The condition with the least visibility will show a large PowerPoint and have audio of the lecture (3). The condition with intermediate visibility has the large PowerPoint and a small video of the lecturer (2). The condition with the most visibility has a large video of the lecturer and a small PowerPoint (1). Trend analyses will define the exact relationship between visibility and Enjoyment and Attention between the view-conditions. As positive links are expected between visibility and both Enjoyment and Attention, significant trends are hypothesized that show that the more visible the lecturer is, more enjoyment and attention will be reported.



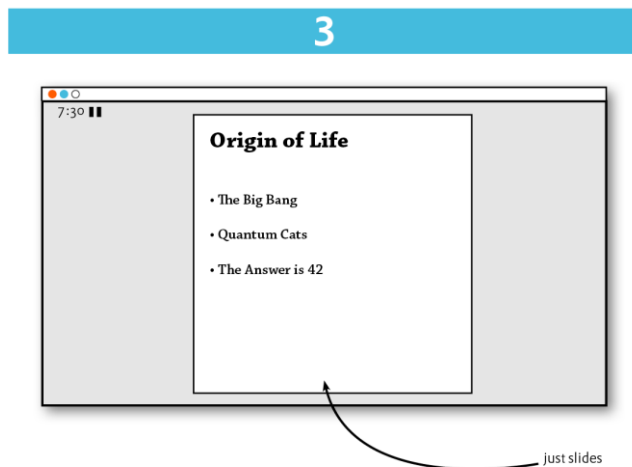


Figure 1 *The Three View-conditions Used in This Study (see also Appendix A)*

A final relation this study proposes and researches is the moderation of lecturer appeal in the relationship between visibility of a lecturer and enjoyment of a lecture. In this study a positive link is expected between visibility and enjoyment, based on literature stating that personalized interaction is more enjoyed (Day, Foley, & Catrambone, 2006; Moreno, & Mayer, 2000; Sproull, et al., 1996). This proposed link can depend on how much personalization a lecturer exhibits during a lecture. Seeing that lecturers have different lecturing styles, and students have different demands in a lecturer, a link between visibility and enjoyment may not be the same for different lectures. This study proposes that lecturer appeal moderates the relationship between visibility and enjoyment. The relationship is thought to be stronger for the better judged lecturers than for the lesser judged lecturers.

## Hypotheses

The main question this study tries to answer is: In what way can weblectures best be provided, to make them most attractive for the (future) students of higher education? Four hypotheses follow from the study described above.

H1: Adding a visual image of the lecturer (a videotape) in combination with an audio file of the weblecture and its PowerPoint slides will make students report more attention for the weblecture, than just offering an audio file in combination with the PowerPoint slides.

H2: Adding a visual image of the lecturer in combination with an audio file and its PowerPoint slides will make the weblecture more enjoyable for students, than just offering an audio file in combination with the PowerPoint slides.

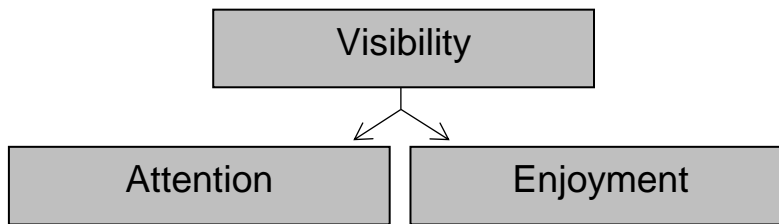


Figure 1 Hypotheses 1 and 2 Represented Graphically

H3: The relationship between visibility of the lecturer and the Enjoyment of and Attention for the lecture will follow a trend from high to low, where the most enjoyment will be reported when the lecturer-visibility is highest and the least enjoyment will be reported when the lecturer is least visible.

**For Enjoyment and Attention:**

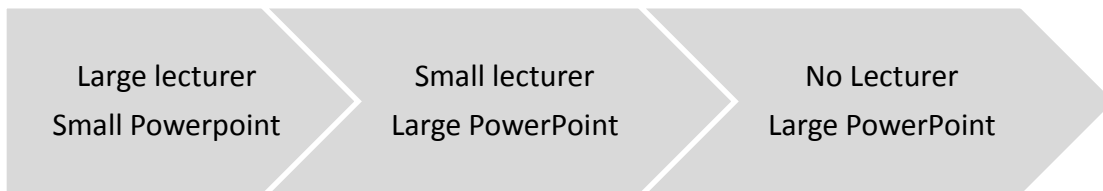


Figure 2 Hypothesis 3 Represented Graphically, with Trend from High to Low

H4: The relationship between lecturer-visibility and Enjoyment of the weblecture will be moderated by how the lecturer is judged by the watcher of the weblecture. Expected is that this relationship will be strong for the best judged lecturers and weak to non-existent for the least judged lecturers.

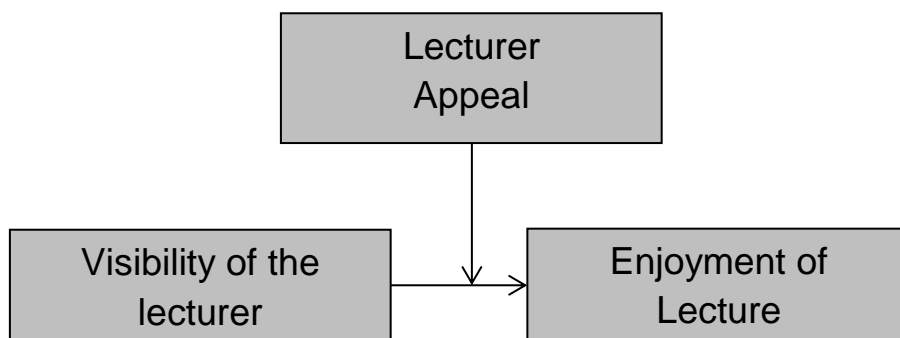


Figure 3 Hypothesis 4 Represented Graphically, with Lecturer Appeal as Moderator

**Methods**

**Participants**

The group of participants consisted of 91 students between 18 and 38 years old ( $M_{age} = 21,63$  yrs,  $SD_{age} = 4.16$  months), all studying at either Utrecht University (UU) or Leiden University

(LU) in the Netherlands. Of the participants 76% was female, 68% were students from the faculty of social sciences and 18% students of computer science. Participants were university bachelor-students (76%), master students (19%) or *inflow*-students (students from Higher Vocational Education taking a fast trajectory to qualify for a university master). Three of the participants took more than 3 hours to complete the entire study (which should have taken no more than 45 minutes). As it is not possible to know the reason for this delay, and it might influence the results, it was decided to remove these from the study and conduct all analyses with the remaining 88 participants.

Participants were invited to participate in the study in three different ways. An email was sent to 300 students from the UU-faculty of social sciences and 60 students of LU-computer science by the researcher to ask them to participate in the study. The study was posted on a UU-website where students of psychology could get study participation credit (10 hours of study participation is a requirement to receive a bachelor's degree in psychology at the UU). And posters with information about the study were placed at the university buildings and libraries around the cities of Utrecht and Leiden. Participants were rewarded 2 euros or 30 minutes of study participation credit.

## Procedure

Participants could register themselves by going to the site <http://lie.fss.uu.nl> and filling out their e-mail-address, after which they received an e-mail with a link to the questionnaire. The link contained a unique participant-ID which consisted of the condition the participants were randomly assigned to. On the site of the questionnaire participants were given a briefing about the goal of the study and its content and duration. They had to consent to participating afore they could start with the questionnaire. First some background-questions were asked, like sex, age and education. Then the participants were asked how many elective lectures they followed, and how much they listened to the radio, podcasts and books on tape and watched television, including YouTube and internet-movies during a week.

Every participant watched two different videos of college lectures in two different conditions (Table 1). Both videos lasted for about 7:30 minutes. This duration was chosen, because attention and arousal factors are less effective after 20 minutes (Day, Foley, & Catrambone, 2006). After the first video the participant responded to questions pertaining to their enjoyment, attention, lecturer appeal, story appeal, interest of the subject and relevance of the subject. After the second weblecture participants were asked to respond to the same questions, but they had to compare the second weblecture to the first weblecture.

The study ended with another round of questions. Participants were asked how much attention they had for the weblectures compared to their attention in a lecture-hall, whether they wanted their faculty to provide lectures online for them and what they thought of the

audio/video-material of the study. Then they were asked to fill out their student-id, so their reward could be paid. The study concluded with a debriefing, thanking the participants, giving them the email-address of the researcher, and again telling them that their data would be handled confidentially and anonymous. The total study lasted between 25 and 35 minutes ( $M_{\text{duration}}=28\text{m}51\text{s}$ ,  $SD_{\text{duration}}=13\text{m}50\text{s}$ ).

Table 1 *Conditions of the Study with their According Visibility of the Lecturer and the Visibility of the PowerPoint Presentation (PP)*

|           | <b>First Weblecture</b>  | <b>Second Weblecture</b> |
|-----------|--------------------------|--------------------------|
| <b>AB</b> | Lecturer large, PP small | Lecturer small, PP large |
| <b>BC</b> | Lecturer small, PP large | No lecturer, PP large    |
| <b>CA</b> | No lecturer, PP large    | Lecturer large, PP small |
| <b>AC</b> | Lecturer large, PP small | No lecturer, PP large    |
| <b>BA</b> | Lecturer small, PP large | Lecturer large, PP small |
| <b>CB</b> | No lecturer, PP large    | Lecturer small, PP large |

## Materials

### *Video-materials*

The videos that were used in the study originated from the Mediasite server of Utrecht University, recorded by the Lecture.net service (Lecture.net.nl). This site consists of a multitude of college-lectures, and other talks that were video recorded. Six lectures were chosen, based on their subjects, their frame-rate (as high as possible), their surroundings (a lecture-hall), and whether there were students present in the hall (to make it feel more like a real lecture). Three of the lecturers were male and three were female.

The six lectures originated from different faculties and the male and female lecturers had different speaking styles, so the results of the study could be generalized to more than just one type of lecturer. The lectures consisted of the following subjects: physics in primary education, biology & philosophy, law, separation & mediation, developmental psychology, and construction & environment. Two of the lecturers (one male, one female) were very dynamic and informal while lecturing. They moved around the lecture-hall, used the blackboard and informally addressed the students present. Two other lecturers (one male, one female) were slightly dynamic, and semi-formal while lecturing. They moved around some and somewhat personalized their message for the addressees. The last two lecturers (one male, one female) were more static and formal than the other lecturers. They stood still while lecturing and formally addressed their audience.

A clip between 7 and 8 minutes of each lecture-video was screen captured from Lecture.net ( $M_{\text{time}} = 7\text{m}28\text{s}$ ,  $SD_{\text{time}} = 9,5$  seconds), which approximated a beginning and an end of a story. The lectures with male lecturers had an average of 7m33s and the lectures

with female lecturers 7m23s. The sound was not adjusted, only a fade-in at the beginning and a fade-out at the end were added. The video was transformed to three different formats:

- A H.264 codec in a mp4 container, which is the standard used in Internet Explorer;
- A VP8 codec in a WebM container, which Google Chrome likes to advertise; and
- A Theora codec in an OGG container, an open source format for use in Mozilla Firefox.

The video player used was a HTML5 player, for the use of Flash or Silverlight resulted in not being able to watch the videos on iOS devices (iPad, iPhone). The controls were removed from the video, except for the pause-button. Participants could see how long the lecture would last, but they could not rewind or fast-forward the lecture. This was done to make sure every participant watched the entire video at normal speed. The frame rate and resolutions of each video were adjusted to the smallest video, which had a frame rate of 15 frames per second and a resolution of 320 x 240 pixels.

PowerPoint-slides were downloaded separately and saved in big (683x512 pixels) and small (341x265 pixels) jpegs. For each lecture the exact timing of every new slide was recorded and coded. The program used to administer the questionnaire emulates LectureNet in placing the video and slides correctly in the browser window, but it uses different proportions. It uses a 'stretch-to-fit', which means it makes sure that the video and slides are always 100% visible, adjusted to the browser-space, in the most optimal fashion. In Appendix B, technical drawings show details about this 'stretch-to-fit' function in the browser.

### *Questionnaire*

The questionnaire administered was designed by the researcher and checked by colleagues. In Appendix C the entire translated questionnaire is added. Participants were asked about their enjoyment of the lecture in 4 questions and about their attention during the lecture in 3 questions. After the 1<sup>st</sup> lecture, they could answer on a 7-point Likert-scale, which ranged from "totally not" (1) via "neutral" (4) to "totally" (7). After the 2<sup>nd</sup> weblecture questions were the same as after the 1<sup>st</sup> weblecture, with the addition of "[...], compared to the first lecture". Answers after the 2<sup>nd</sup> weblecture ranged from "much less than the first lecture" (1), via "about the same as the first lecture" (4), to "much more than the first lecture" (7). Examples of questions and answer-possibilities are shown in Figure 4.

In addition to questions about their enjoyment of and attention to the lecture, participants were asked about their judgment of the lecturer in 4 questions, and their judgment of the story in 3 questions. Answer-possibilities were the same as for the questions that measure enjoyment and attention. These two scales will be used as covariates in the final analyses, together with the following list of variables:

Radio: How many hours a week participants listen to the radio, podcasts, books on tape.

Television: How many hours a week participants watch television, YouTube, etc.



Lecture\_Visits: How many elective lectures participants follow.

Interest: How interesting participants thought the subject of the lecture was.

Relevance: How relevant the subject was for participants' education.

Attention\_Hall: Comparison of attention for the weblectures to a lecture in a lecture-hall.

Means and standard deviations of all covariates are displayed in Table 2.

Answers for Enjoyment, Attention, Lecturer and Story after the 1<sup>st</sup> and 2<sup>nd</sup> weblecture were recoded. While the range of both answers was the same, the meaning of the answers differed, so to make a good comparison between both weblectures they were altered. To make the value 0 equal to a neutral answer 4 was subtracted from the answers after the 1<sup>st</sup> lecture (Answer<sub>1</sub>'). For the answers after the 2<sup>nd</sup> weblecture the following formula was used:

$$\frac{Answer_1' + sign(Answer_2 - 4) * (Answer_2 - 4)^2}{4}$$

This resulted in a range between -3 and 3 for the answers after both weblectures for Enjoyment, Attention, Lecturer and Story, where the value 0 was neutral.

Table 2 Means and Standard Deviations for all Covariates Used in the Analyses

| Covariates             | N  | Mean  | St. Dev | Range  |
|------------------------|----|-------|---------|--------|
| Radio                  | 88 | 7.67  | 8.72    | 0 – 50 |
| Television             | 88 | 11.59 | 7.12    | 0 – 30 |
| Lecture_Visits         | 88 | 5.88  | 1.52    | 1 – 7  |
| Interest1              | 88 | 3.99  | 1.91    | 1 – 7  |
| Interest2              | 88 | 4.28  | 1.91    | 1 – 7  |
| Relevance1             | 88 | 2.91  | 1.96    | 1 – 7  |
| Relevance2             | 88 | 3.07  | 1.93    | 1 – 7  |
| Lecturer1              | 88 | 0.25  | 1.33    | -3 – 3 |
| Lecturer2              | 88 | 0.21  | 0.89    | -3 – 3 |
| Story1                 | 88 | 0.39  | 1.18    | -3 – 3 |
| Story2                 | 88 | 0.26  | 0.76    | -3 – 3 |
| Attention_Lecture-hall | 88 | 3.97  | 1.61    | 1 – 7  |

Note: A '1' after a variable represents the 1<sup>st</sup> weblecture, a '2' represents the 2<sup>nd</sup> weblecture

| How attentive did you follow the story of the weblecture?  | How attentive did you follow the story of this weblecture, compared to the 1 <sup>st</sup> weblecture?  |
|--|---|
| <ul style="list-style-type: none"> <li>○ 1. Totally not</li> <li>○ 2.</li> <li>○ 3.</li> <li>○ 4. Neutral</li> <li>○ 5.</li> <li>○ 6.</li> <li>○ 7. Totally</li> </ul> | <ul style="list-style-type: none"> <li>○ 1. Much less attentive than the first weblecture</li> <li>○ 2.</li> <li>○ 3.</li> <li>○ 4. About the same as the first weblecture</li> <li>○ 5.</li> <li>○ 6.</li> <li>○ 7. Much more attentive than the first weblecture</li> </ul> |

Figure 4 Examples of Questions and Answer-possibilities after the 1st and 2nd Weblecture

### *Web-application*

The web-application used to let participants watch the videos and administer the questionnaire was designed and implemented by M.E. Faas from the Leiden Institute of Advanced Computer Science (Leiden University). The application had four parts. The *client-side* is what was seen in the browser of the participant. It was written in JavaScript and html5 and contained the interface, the video player and the main part of the program-logic. The client-side determined the condition of the videos and whether the answers satisfied the criteria set (for example: An age can only be a number, and all questions must be answered).

Then there were the *resources*. These consisted of the videos & PowerPoint slides, the file with the questionnaire and a file with the description of the videos and when in the video what slide should be seen. Resources assumed a *session*, which is a current state of a participant. The first time participants visited the site, they filled out their email-address, and an empty session opened. This empty session contained the participants' email-address and a session-ID. This ID was sent in a link to the participants' email-address and could be used at any time to enter the site at the place where the participant had last stopped the session.

The *server-side* of the questionnaire was written in PHP and made use of a SQLite database. The server stored any request of the client-side, like answers to the questions, and the session-ID. The server was also responsible for the security of the site, to make sure no weird requests could be made, email-addresses could only be used once, and no SQL injections entered the application. The server also carried out the requests of the backend and made a log every time an error was given on the client-side.

The *backend* of the web application contained a list of SQL queries the researcher could carry out on the database, for example to find out how many questionnaires were finished, and which reward the participants chose to receive. On the backend the data could not be manipulated for safety of the research, and it was password protected.

### *Randomization*

To give each participant two of the six possible videos to watch in two of the three possible view conditions, in a random order, a computerized random permutation was used. This permutation was based on the Fisher-Yates algorithm, with a small adjustment. The Fisher-Yates principle works as follows: When you want a random permutation of six numbers, you put the numbers in a row from 1 to 6. You take the first number, and you switch that with any of the other numbers, or itself. Then you take the second number and you switch that with any of the other numbers, or itself, excluding the first number. Then you go on to the other four numbers in the same fashion as before. In this algorithm, each possible order of the six numbers has the same chance to be chosen. This should also be true for just the first two numbers, so just the first two numbers were used to randomly choose the two videos each

participant would watch. The same was done for the conditions, which resulted in a random sequence of  $\frac{n!}{(n-k)!}$  permutations, where  $n$  stands for the amount of videos (6), or the amount of conditions (3) and  $k$  is the number of times you choose an  $n$  (Fisher & Yates, 1953).

### *Data-Analysis*

The program SPSS 20.0 was used to analyze the data gathered in this study. Multiple analyses were performed to ascertain whether the data reliably and validly reflected the intention of the researchers. The following analyses were carried out:

1. For identifying the categories in the questionnaire *principal axis factor analyses* with oblimin rotation and Kaiser Normalization were calculated. This showed whether the questions asked on the four subjects (enjoyment, attention, lecturer and story) after the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture could be combined into factors.
2. To see whether the subject-scales reliably predicted the outcome, *Reliability analyses* were calculated on the four scales after the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture.
3. To see whether answers after the 2<sup>nd</sup> weblecture are the same as answers after the 1<sup>st</sup> weblecture, *t-tests for dependent groups* were administered for all question-pairs (for example question Enjoyment1\_1 after the 1<sup>st</sup> weblecture was compared to question Enjoyment2\_1 after the 2<sup>nd</sup> weblecture). Significant t-tests meant that on average the answers after the 2<sup>nd</sup> weblecture were different from the answers after the 1<sup>st</sup> weblecture, and this should not be the case, because the videos and conditions do not differ. This possible difference could suggest a time-effect, where judgments were based on the time a participant has spent on the questionnaire.
4. To answer the question whether answers after the 1<sup>st</sup> weblecture influenced answers after the 2<sup>nd</sup> weblecture, *Correlation analyses* between the questions after the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture. When the answers correlate significantly, it meant that judgments of the 2<sup>nd</sup> weblecture could be related to judgments of the 1<sup>st</sup> weblecture.
5. To see if there were differences in judgments between the male and the female speakers on Attention, Enjoyment, Lecturer, Story, Relevance and Interest, *Independent t-tests* were calculated. When the male and female speakers differed significantly on either Enjoyment or Attention separate analyses were done for the two sexes.
6. To ascertain if there were differences between the six lecturers on Attention, Enjoyment, Lecturer, Story, Relevance and Interest, *ANOVAs* are performed. When the lecturers differed significantly on Enjoyment or Attention subsets were made for the analyses.
7. To answer the research-questions, separate *MANCOVAs* are calculated for each weblecture with view-condition as independent variable, Enjoyment and Attention as outcome-variables, and significant covariates for Enjoyment, Attention or both.

- Possible covariates were: Radio, Television, Lecture-visits, Lecturer, Story, Interest, Relevance and Attention compared to a lecture-hall.
  - In the MANCOVA for the effect of visibility on Enjoyment and Attention after the 2<sup>nd</sup> weblecture, Enjoyment and Attention for the 1<sup>st</sup> weblecture were added as covariates.
- When significant results were found, simple contrast analyses were done to ascertain which of the conditions differed significantly on Enjoyment or Attention.
8. To see whether the relationship between visibility and Enjoyment and visibility and Attention followed the trend proposed (the more visibility of the lecturer, the more Enjoyment and Attention), *Trend analyses* were administered.
  9. To see whether lecturer appeal would moderate the relationship between visibility and Enjoyment, an *ANCOVA* was administered, where the interaction between lecturer appeal and visibility was tested.

## Results

This study was conducted to see if lecturer visibility is positively related to enjoyment of and attention for a weblecture. Weblectures were shown in three view-conditions; condition1 showed a large lecturer and a small PowerPoint, condition2 showed a small lecturer and a large PowerPoint, and condition3 showed only a large PowerPoint. Participants were shown two weblectures in two different view-conditions, and these will be analyzed separately. In addition to their enjoyment and attention, participants also judged the lecturer and the story.

The factor-analysis resulted in four factors with eigenvalues higher than 1. These four factors corresponded to the four subjects of the questionnaire (enjoyment, attention, lecturer and story). For both weblectures all subject-scales had medium to high reliabilities (COTAN, 2000). Eigenvalues and Cronbach's alpha's are shown in Table 3. The results of the reliability analyses for the subscale Enjoyment both for the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture suggested one item did not fit well. This item was removed, leaving three questions in this scale.

Table 3 *Results from Factor Analysis (Eigenvalue) and Reliability Analyses (Cronbach's Alpha) for the Four Subject-Scales in the Questionnaire*

|           | First Weblecture |              | Second Weblecture |              |
|-----------|------------------|--------------|-------------------|--------------|
|           | Eigenvalue       | Cornbach's α | Eigenvalue        | Cornbach's α |
| Enjoyment | 1.515            | .832         | 1.904             | .935         |
| Attention | 2.390            | .861         | 2.751             | .919         |
| Lecturer  | 4.940            | .904         | 5.122             | .941         |
| Story     | 1.315            | .791         | 1.330             | .763         |

The t-tests for independent groups revealed no differences between the answers after the 1<sup>st</sup> and 2<sup>nd</sup> weblecture,  $p > .05$ . The four subject-scales (attention, enjoyment, lecturer and

story) also revealed no significant differences,  $p > .05$ . The correlation-analyses between the questions after the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture were non-significant,  $p > .05$ . The four subject-scales of the questionnaire (attention, enjoyment, lecturer and story) after the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture also correlated non-significantly,  $p > .05$ .

The t-tests for independent groups revealed no difference between the male and the female lecturers on Attention, Enjoyment, Lecturer, Story and Relevance in both the 1<sup>st</sup> and the 2<sup>nd</sup> web lecture. For the 2<sup>nd</sup>, but not the 1<sup>st</sup> weblecture, participants reported significantly more Interest in the subjects of female lecturers, than in those of male lecturers:  $t(86)=2.340$ ,  $p=.022$ , Cohen's  $d = 0.560$ . As Interest is a covariate, separation of male and female lecturers is not deemed necessary in the final analyses.

The ANOVAs for differences between lecturers after the 1<sup>st</sup> weblecture revealed significant differences on Attention for the weblecture and Relevance of the subject of the weblecture for the education of the participant, which are shown in Table 4. Post-hoc Tukey tests revealed the difference in Attention to have been reported between two lecturers. In case of significant differences between conditions on Attention two subsets will be made and MANCOVAs will be administered for both subsets. The ANOVAs for differences between lecturers after the 2<sup>nd</sup> weblecture revealed significant between-group differences on Attention, Lecturer and Story, also shown in Table 4. Post-hoc Tukey tests revealed that the difference in Attention was reported between the same two lecturers as in the 1<sup>st</sup> weblecture. When significant results are found on Attention for the 2<sup>nd</sup> weblecture different subsets for Attention will be made and MANCOVAs will be administered on the subsets.

Table 4 *Significant Results of ANOVAs for Differences between Lecturers*

|           | First Weblecture    |                 |         | Second Weblecture   |                 |         |
|-----------|---------------------|-----------------|---------|---------------------|-----------------|---------|
|           | <i>F</i> -statistic | <i>p</i> -value | $n_p^2$ | <i>F</i> -statistic | <i>p</i> -value | $n_p^2$ |
| Enjoyment | 0.989               | <i>ns</i>       |         | 1.603               | <i>ns</i>       |         |
| Attention | 3.675               | .046            | .130    | 2.973               | .023            | .150    |
| Lecturer  | 1.779               | <i>ns</i>       |         | 2.684               | .003            | .190    |
| Story     | 0.883               | <i>ns</i>       |         | 1.895               | .004            | .190    |
| Relevance | 2.958*              | .024            | .170    | 1.400               | <i>ns</i>       |         |

Note: Degrees of Freedom for all ANOVAs are 5,82, except: \* Welch's  $F$ ,  $df=5,36.549$

*Multivariate ANCOVA analyses to Answer the Research Questions*

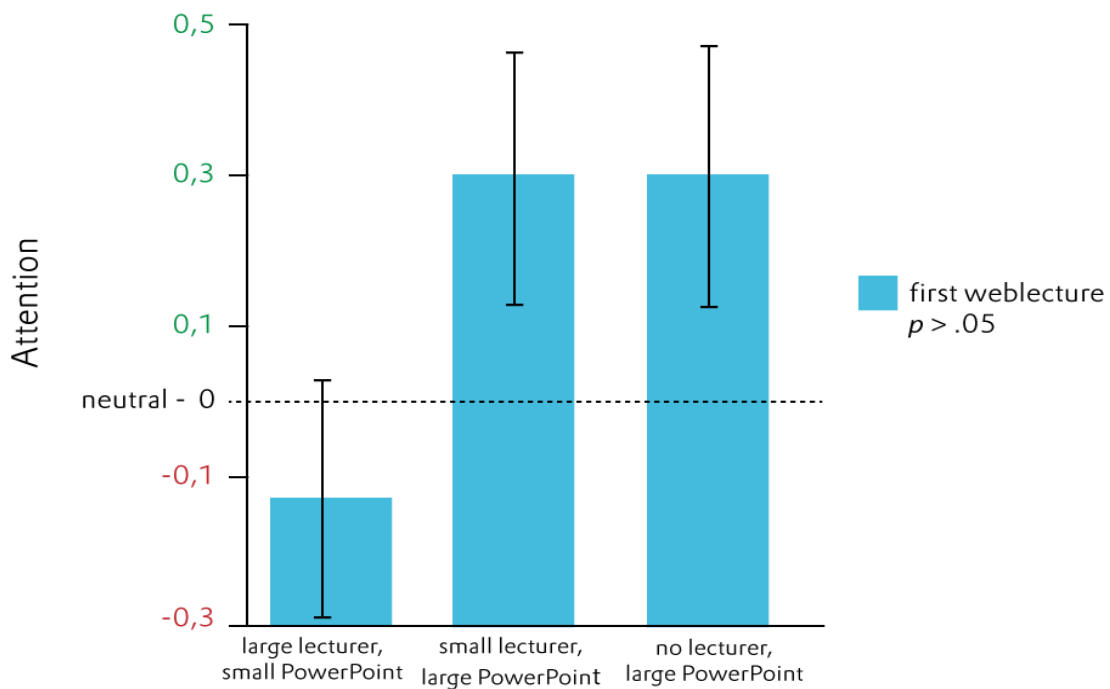
The first two hypotheses of this study propose a positive relationship between the visibility of a lecturer and the *Enjoyment* of and *Attention* for a weblecture. Using multivariate analyses of covariance both variables will be tested together, with significant covariates Radio, Relevance, Lecturer, Story and Attention\_Lecture-hall, and – only for the MANCOVA of the 2<sup>nd</sup> weblecture – Enjoyment of and Attention for the 1<sup>st</sup> weblecture.

For the 1<sup>st</sup> weblecture Pillai's Trace was used to assess the outcome of the MANCOVA. It showed no significant effect of view-condition on Enjoyment of the lecture and Attention to the lecture,  $V=0.101$ ,  $F(4,164)=2.171$ ,  $p=.075$ . Separate univariate ANCOVA's on the outcome variables revealed no significant effects for condition on *Attention* and on *Enjoyment*. The overall effect of condition on *Enjoyment* was not significant  $p=.145$ . The overall effect of the view conditions on *Attention* was also not significant  $p=.102$ . Adjusted means and standard errors for the view-conditions on Enjoyment and Attention are displayed in Table 5. Seeing that the adjusted means for *Attention* for the three view-conditions are quite different, a simple contrast analysis was done. This revealed no significant difference between all three conditions  $p's > .05$ . Figure 5 shows this non-significant difference between the view-conditions on Attention for the 1<sup>st</sup> weblecture.

Table 5 *Adjusted Means and Standard Errors for the Three View-conditions on Enjoyment of the 1<sup>st</sup> Weblecture en Attention for the 1<sup>st</sup> Weblecture.*

|           | Enjoyment  |            |            | Attention  |            |            |
|-----------|------------|------------|------------|------------|------------|------------|
|           | Condition1 | Condition2 | Condition3 | Condition1 | Condition2 | Condition3 |
| Adj. Mean | 0.042      | 0.338      | -0.080     | -0,137     | 0.312      | 0.309      |
| St. Error | 0.145      | 0.152      | 0.157      | 0.164      | 0.172      | 0.178      |

Note. Condition1= Lecturer large/PowerPoint small, Condition2= Lecturer Small/PowerPoint Large, Condition3= No Lecturer/PowerPoint Large



Note: Error bars show standard errors. Note2: The value 0 is equal to an average/neutral answer

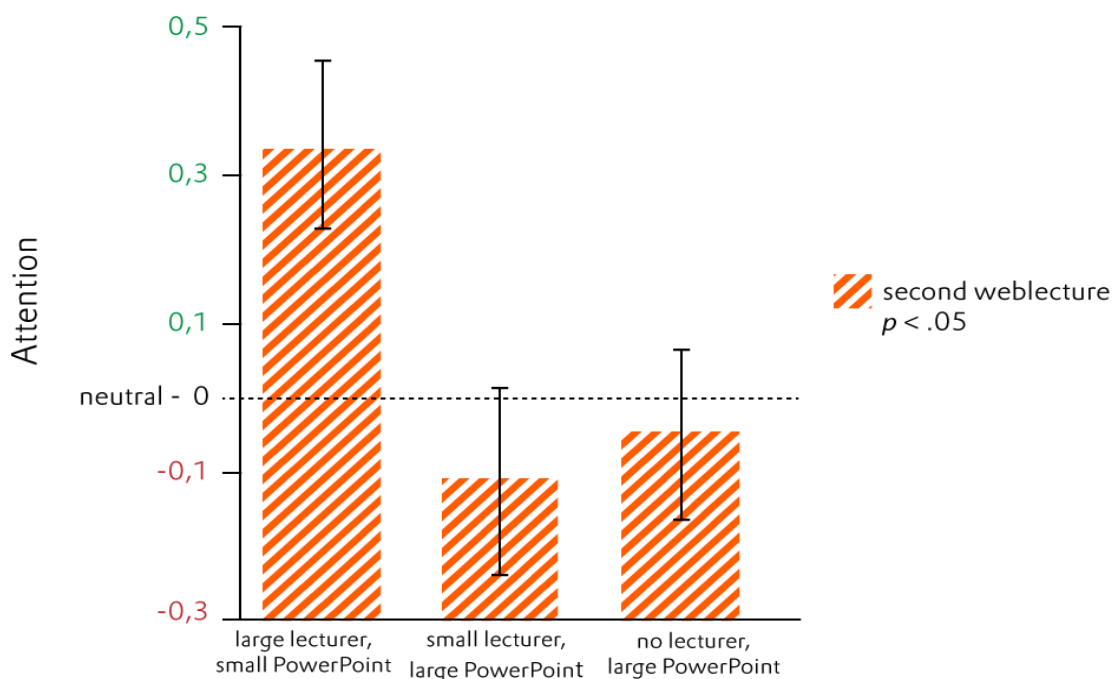
Figure 5 *Estimated Marginal Means for Reported Attention during the First Weblecture*

For the 2<sup>nd</sup> weblecture Pillai's Trace was again used to assess the outcome of the MANCOVA. It showed a significant effect of view-condition on Enjoyment of the lecture and Attention for the lecture,  $V = 0.116$ ,  $F(4,158)=2.429$ ,  $p=.050$ ,  $\eta_p^2=.058$ . Separate univariate ANCOVA's on the outcome variables revealed significant effects for condition on *Attention*, but not on *Enjoyment*. The overall effect of condition on *Enjoyment* was not significant  $p=.610$ , and the overall effect of condition on *Attention* was significant  $F(2,79)=4.059$ ,  $p=.021$ ,  $\eta_p^2=.093$ . Adjusted means and standard errors for the three view-conditions on Enjoyment of the 2<sup>nd</sup> weblecture and Attention for the 2<sup>nd</sup> weblecture are displayed in Table 6.

Table 6 *Adjusted Means and Standard Errors for the Three View-conditions on Enjoyment of the 2<sup>nd</sup> Weblecture en Attention for the 2<sup>nd</sup> Weblecture.*

|           | Enjoyment  |            |            | Attention  |            |            |
|-----------|------------|------------|------------|------------|------------|------------|
|           | Condition1 | Condition2 | Condition3 | Condition1 | Condition2 | Condition3 |
| Adj. Mean | 0.246      | 0.236      | 0.108      | 0,333      | -0.107     | -0.047     |
| St. Error | 0.108      | 0.118      | 0.106      | 0.116      | 0.127      | 0.114      |

Note. Condition1= Lecturer large/PowerPoint small, Condition2= Lecturer Small/PowerPoint Large, Condition3= No Lecturer/PowerPoint Large



Note: Error bars show standard errors. Note2: The value 0 is equal to an average/neutral answer

Figure 6 *Estimated Marginal Means for Reported Attention during the Second Weblecture*

A simple contrast analysis revealed no significant difference between condition2 and condition3, a significant difference between condition1 and condition2 (Contrast Estimate =

-0.440,  $p=.013$ ), and a significant difference between condition1 and condition3 (Contrast Estimate = -0.380,  $p=.023$ ). The significant differences consist of *more reported attention* in condition1 compared to condition2 and condition3. As shown in Figure 6, participants reported significantly *more attention* in condition1, where the lecturer is large and the PowerPoint was small, than in the other two conditions with either a small or no lecturer.

*Analyses with Subsets for Visibility Effects on Attention for the 2<sup>nd</sup> Weblecture*

Seeing that participants reported significant differences in Attention between two of the lecturers, two subsets were made to ascertain whether and how the effect of visibility on attention differs in these two groups. The subsets consisted of one group without the lecturer who elicited significantly more attention (Subset A) and another group without the lecturer who elicited significantly less attention (Subset B). For both subsets the same MANCOVA's were administered, with visibility as independent variable, Enjoyment and Attention as outcome-variables and the significant covariates (Attention 1<sup>st</sup> weblecture, Enjoyment 1<sup>st</sup> weblecture, Attention\_lecture-hall, Relevance, Lecturer and Story).

For Subset A Pillai's Trace was used to assess the effect of view-condition on Enjoyment and Attention for the 2<sup>nd</sup> weblecture. For this subset there was no effect of view-condition on Enjoyment of and Attention for the weblecture,  $V=0.060$ ,  $F(4,122)=0.939$ ,  $p=.444$ . Separate univariate ANCOVA's on the outcome variables revealed no significant effects for condition on *Enjoyment* and on *Attention*,  $p$ 's > .05.

For Subset B Pillai's Trace was again used to assess the effect of view-condition on Enjoyment of and Attention for the 2<sup>nd</sup> weblecture. This revealed a significant effect of view-condition on Enjoyment of and Attention for the weblecture,  $V=0.150$ ,  $F(4,130)=2.635$ ,  $p=.037$ ,  $\eta_p^2=.075$ . The univariate effect of view-condition on *Attention* is significant  $F(2,65)=1.931$ ,  $p=.010$ ,  $\eta_p^2=.131$ . Adjusted means and standard errors for the three view-conditions on Attention for subsets A and B are displayed in Table 7.

Table 7 *Adjusted Means and Standard Errors for Both Subsets for the Three View-conditions on Attention for the 2<sup>nd</sup> Weblecture.*

|           | Subset A   |            |            | Subset B   |            |            |
|-----------|------------|------------|------------|------------|------------|------------|
|           | Condition1 | Condition2 | Condition3 | Condition1 | Condition2 | Condition3 |
| Adj. Mean | 0.074      | -0.075     | -0.194     | 0,496      | -0.056     | 0.096      |
| St. Error | 0.132      | 0.149      | 0.132      | 0.123      | 0.140      | 0.128      |

Note. Condition1= Lecturer large/PowerPoint small, Condition2= Lecturer Small/PowerPoint Large, Condition3= No Lecturer/PowerPoint Large

For the effect of view-condition on Attention for the 2<sup>nd</sup> weblecture for subset B a simple contrast analysis was done. It revealed the same results as the main MANCOVA, namely no significant difference between condition2 and condition3, a significant difference between



condition1 and condition2 (Contrast Estimate =  $-0.552$ ,  $p=.005$ ), and a significant difference between condition1 and condition3 (Contrast Estimate =  $-0.400$ ,  $p=.029$ ). The significant differences consist of *more reported attention* in condition1, compared to condition2 and condition3. This finding is consistent with the earlier found results, that participants report significantly *more attention* in the condition where the speaker is large and the PowerPoint small, compared to the other two conditions. The results of the analyses for the different subsets show that the effect of visibility on attention is not present in subset A, in which the lecturer for whom participants reported more attention was removed, but the effect is present in subset B, where the lecturer for whom participants reported less attention was removed.

### 8. Trend Analyses

The third hypothesis of this research-study states that the effect of visibility on Enjoyment will follow a trend from high to low, where the most enjoyment will be reported when the video of the lecturer is large, and the least enjoyment will be reported when the lecturer is not visible. The condition in which the video of the lecturer is small was hypothesized to produce intermediate Enjoyment-scores. As no difference of Enjoyment is found between all view-conditions in the 1<sup>st</sup> and the 2<sup>nd</sup> weblecture, no trend analyses were done for Enjoyment.

The effect of visibility on Attention is significant for the 2<sup>nd</sup> weblecture viewed, but the trend-line for the effect of condition on Attention does not follow the hypothesized pattern from high to low. The first condition – where the video of the lecturer was largest – evoked the most reported attention, but there was no difference between the other two view-conditions. Seeing that these results do not indicate the existence of a significant trend line, no trend-analysis was done for the effect of visibility on Attention.

### 9. Moderator Analysis

The last hypothesis in this study states that lecturer appeal will moderate the relationship between visibility of the lecturer and enjoyment of the weblecture. It was thought that the relationship between visibility and enjoyment would be stronger for lecturers who are more positively judged than for lecturers who are less positively judged. As the view-conditions did not have any effect on Enjoyment in both weblectures, no moderator analyses were done. The results indicate that lecturer appeal cannot be considered to moderate the relationship between visibility of the lecturer and Enjoyment of the weblecture.

## Discussion

### Implications

This research study was initiated to see if there is an advantage for students, measured in Attention and Enjoyment, for placing lectures online *with* a video-file, instead of just an audio-file. This was researched in two ways: First participants got to see a clip of a weblecture in

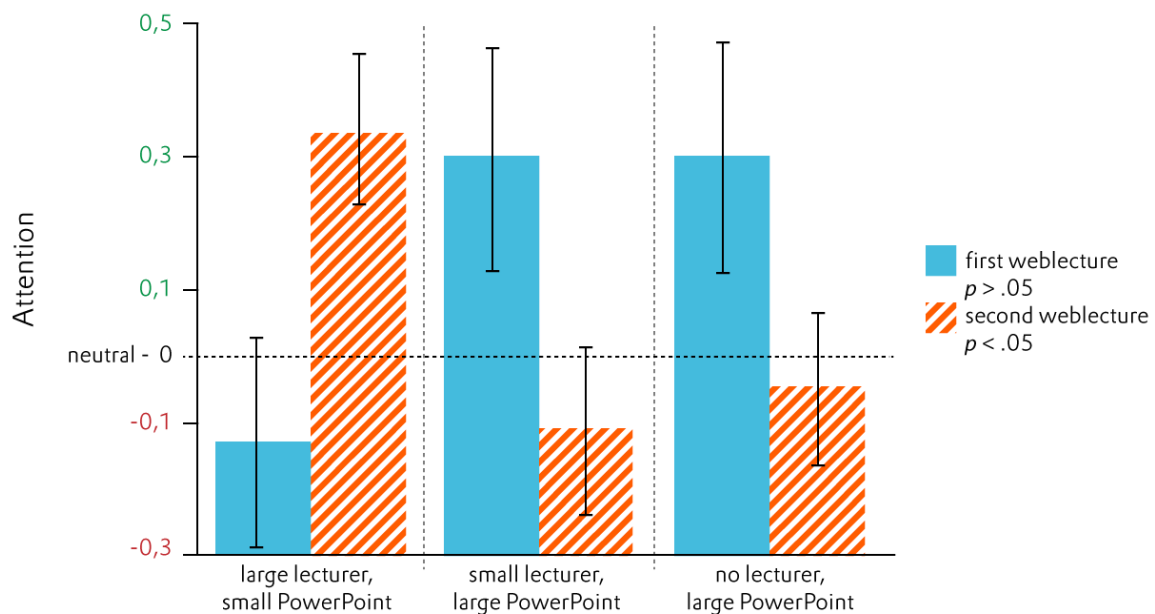
one of three view-conditions, after which their opinion was asked about their enjoyment and the amount of attention they had for the weblecture. This can be seen as an unbiased judgment of the weblecture and the view-condition. Second, participants got to see another clip of another weblecture in another view-condition, on which they were asked to compare to the 1<sup>st</sup> weblecture. This was seen as a comparison of view-conditions.

In contrast to what was hypothesized about the effect of a visible lecturer on the *enjoyment* of the lecture, no significant difference between the view-conditions on enjoyment was found, both in the first and in the second weblecture. The results might indicate that other aspects, like lecturer characteristics, have more influence on enjoyment than just visibility of a lecturer. In this study the effects of visibility on Enjoyment were only analyzed in combination with lecturer appeal and story appeal as control variables, so it can be said that while controlling for these aspects, and also relevance of the subject and attention compared to a lecture-hall, visibility has no influence on enjoyment.

These results on the effects of visibility on Enjoyment are not in line with previous research, like the study of Day, Foley, and Catrambone (2006), where participants indicated they enjoyed the lectures with a visible lecturer more than lectures without a visible lecturer. This difference can be considered due to the different stimuli used in the studies. Day, Foley and Catrambone used specially organized weblectures recorded in a studio, whereas this study used videotaped lectures in lecture-halls. The mentioned *personalization effect* could be present in weblectures where a lecturer looks straight into the camera and talks to the viewer, and not present when a lecturer speaks to a live audience (and not to the person behind the camera). The influence of students in the lecture-hall and the movements of the lecturer could influence the results as well, in a way that the effect of visibility on Enjoyment is too small to lead to a significant difference in combination with all covariates used.

The results for the effects of visibility on *Attention* found in this study are surprising and seem to be contradicting each other (Figure 7). Where participants report effects of visibility on Attention during the 2<sup>nd</sup> weblecture which confirm the hypothesis that more visibility will lead to more attention, the effects of visibility on Attention during the 1<sup>st</sup> weblecture are completely reversed (albeit not significant). One of the explanations for this could be found in the order the weblectures were watched. As is already said, the 1<sup>st</sup> weblecture participants watched can be seen as an unbiased judgment of the condition in which they viewed the lecture and the 2<sup>nd</sup> weblecture as a comparison of view-conditions of both weblectures. This might indicate that if students can compare the view-conditions between two weblectures, the visibility of the lecturer would suddenly become more important for attention than other aspects, like the appeal of the lecturer and the story. This might indicate that lecturer visibility will only be important for students when they are given a

choice in the matter. When they are not given this choice their interest in the subject of the weblecture or their judgment of the lecturer might be more important for their attention for the weblecture. Of course, the difference in reported attention between weblectures can also be explained by stating that during the 2<sup>nd</sup> weblecture participants could guess what the goal of the study was and they acted accordingly. This is always a risk in social science research and this effect cannot easily be neutralized.



Note: Error bars show standard errors. Note2: The value 0 is equal to an average/neutral answer

Figure 7 *The Effect of Visibility on Attention During the 1<sup>st</sup> and 2<sup>nd</sup> Weblecture*

Another explanation for the difference of the effect of visibility on Attention found in the first and the second lecture can be thought to lie in the attention span of the participants. During the 1<sup>st</sup> weblecture the participant is fresh and the study has not yet claimed much from his or her attentional resources. During this weblecture participants might use a strategy to gather as much information as possible from the weblecture. Reading the PowerPoint slides gives extra information on top of what the lecturer is saying. Seeing a large lecturer does not improve their information gathering and this might be why their attention is heightened when they can make use of both an easier readable PowerPoint and the audio of the lecturer, but lowered when the lecturer is large and the PowerPoint is small and not that easy to read. During the 2<sup>nd</sup> weblecture the participants have spent approximately 15 minutes on the study and their concentration will have degenerated. At this time seeing a large lecturer might make it easier to keep their attention on the lecture, because the lecturers face claims their attention and seeing the face makes it easier to understand what he or she is saying. Seeing and reading the PowerPoint may claim too much of their attentional

resources at this time. This may suggest that all lectures that take more than 10 to 15 minutes are eventually better followed when a visible lecturer accompanies the lecture, but that concentration is easier held in lectures shorter than 10 minutes when the PowerPoint slides are large and easily readable. If this is the case then the best strategy for educational institutions will be to make it possible for students watching a weblecture to choose between more than one view-option, and to switch freely between these options during the lecture.

It can also be thought that the differences found in the 1<sup>st</sup> and 2<sup>nd</sup> weblecture are due to knowledge of the questions during the 2<sup>nd</sup> weblecture. During the 2<sup>nd</sup> weblecture, participants could guess which questions would be asked, and they would be triggered to be aware of their attention during this lecture. This could explain differences in reported attention for both weblectures. However, if knowledge of the questions would result in different answers, then participants would show a lot of variance in their answers after the 2<sup>nd</sup> weblecture – when they were aware of their attention – but none or very little variance in their attention after the 1<sup>st</sup> weblecture – for they could not specify their attention. Seeing that the variances of answers after the 1<sup>st</sup> weblecture are not smaller, but actually a little bigger than those for the 2<sup>nd</sup> weblecture, it is thought that knowledge about the questions cannot explain the differences found on reported attention.

Another hypothesis in this study was that the effect of visibility on enjoyment and attention will follow a trend from high to low, where the most enjoyment and attention would be reported for the weblectures with the most lecturer-visibility. Not only was this trend not found in this study, the effects of visibility on attention for the 1<sup>st</sup> weblecture seem to be quite the opposite of what was hypothesized (Figure 7). Even though the results for attention for the 2<sup>nd</sup> weblecture were significant and more in line with this hypothesis, again no trend-analyses was done, for two of the view-conditions did not differ in their reported attention. Again this could be explained by the importance of lecturer appeal, interest in the subject, etcetera, which could influence the effect of visibility on attention for weblectures. In this study it was not possible to split the participant-group by lecturer, or by the amount of interest, for that would result in the loss of Power, considering the size of the participant-group. It would be interesting for future research to consider the possible differences lecturers, interest, stories and relevance will elicit in attention for a weblecture.

A last hypothesis in this study was the moderation of lecturer appeal in the relationship between visibility and enjoyment. Different lecturers have different lecture styles and elicit different responses from their audience. Seeing that visibility did not have any significant effect on enjoyment, no moderation analyses were done. In this study no differences were found in enjoyment of the weblectures between the six lecturers (see Table 4 on page 21), although they were found for attention to the 2<sup>nd</sup> weblecture. Possibly these

six lecturers were too similar in their lecturing styles to elicit differences in enjoyment. In the future, research could use completely different lecturers (possibly actors) to see whether these can elicit the proposed responses from their addressees.

### **Limitations**

There are of course limitations to this study that influence its results. Using six different lecturers was done for generalization purposes, but it meant that the same lecturer in the same view-condition could be seen by as little as 8 participants. Even though results can be generalized to only that lecturer, using the same lecturer for all participants will increase power and make more analyses possible. The quality of video-material in this study was not as great as hoped, which could influence its results. Watching the weblectures on large screens (>20 inch) could make the video very pixelated and the PowerPoint slides hardly readable. This could possibly undo the positive effects a visible lecturer has on enjoyment and attention. Of course, a video file with a better quality will be larger than a video file of a lesser quality, and file size also needs to be considered when making weblectures available. Future research could compare attention and enjoyment in weblectures on different screens, with different resolutions and different frame rates, to compare and contrast qualities.

The design of this study was matched to the way students will watch a weblecture, namely online and at a place and time they themselves choose. This was done to make the experience of watching a weblecture as real as possible, to hopefully make the answers as close to the real experience as possible. However, concepts like enjoyment and attention could mean different things for different people and no extensive explanation of what is meant by these words were given to participants. They probably based their answers on their own interpretation of what enjoyment and attention are. Because of this, this study shows results on subjective measures on enjoyment and attention that may differ from objective measured results. Of course, subjectively measured attention and enjoyment for weblectures are probably more useful for institutions for (online) education, for this shows how much attention and enjoyment students have for weblectures, based on their interpretation of these concepts. And the interpretation of students' enjoyment and attention can make the difference between a successful and an unsuccessful online program.

In this study male and female lecturers were analyzed together, even though research has shown that people can have preference for interacting with a woman compared to a man (e.g. Sproull, et al., 1996; Veletsianos & Miller, 2008). The only differences this study found between the sexes of lecturers was the different interest participants had for the subjects of male and female lecturers. This can partly be explained by the participant-group. More than two-third of participants were students of social sciences, and two of the female lecturers discuss a subject that can be considered relevant to social sciences (developmental

psychology and separation & mediation). Both the choice for these two female lecturers and the choice for the large group of participants from social sciences fuel this limitation. The choice to use two female lecturers with social subjects is due to the small supply of female lecturers *in general* that are not related to social sciences, and the small supply of female lecturers *on Lecture.net*, who are not related to social sciences. The choice for a large group of participants that study social sciences is also easily explainable. Participating in a study is probably more attractive for a student of social sciences compared to students of other faculties. It teaches them about doing research on people, which is very important in social sciences, it is sometimes necessary for receiving a bachelor's degree, and most social science research is done by student-colleagues or professors of social sciences, so students of social sciences are the most easily reached. Of course, this limitation is present in a lot of social science research, and especially research done on universities is affected by it. Changes will have to come from the universities as well, for example by making it mandatory for students from all programs to collect study participation credit before graduating. This will make participating more attractive, and the participant-group a lot more varied.

## Conclusion

This study was conducted to see whether adding a video-recording to a weblecture would increase enjoyment and attention. No effects of visibility of the lecturer on enjoyment of the lecture were found, but an effect of visibility on attention was found. However this effect was not as clear-cut as hoped. Participants reported no differences between the different view-conditions on attention during the 1<sup>st</sup> weblecture they saw, but significant differences between the conditions on attention during the 2<sup>nd</sup> weblecture. This can be explained in different ways, from which the easiest is the duration of the study and the attention-span of the participants. Research has shown that attention and arousal become less effective after 20 minutes, which for this study means that attention is probably waning during the 2<sup>nd</sup> weblecture. This can make participants use a different strategy to keep their focus on the weblecture, in which a large video of the lecturer aids them more than a small video or no video. Of course, this is an assumption that should be researched more thoroughly. For now, it can be concluded that students are probably most accommodated with a choice on how they would want to see a weblecture, with or without a visible lecturer.

## References

- Argyle, M., & Graham, J. A. (1976). The Central Europe experiment: Looking at persons and looking at things. *Journal of Environmental Psychology and Nonverbal Behavior*, 1 (1), 6-16. Doi: 10.1007/BF01115461
- Baggett, P. (1984). The role of temporal overlap of visual and auditory material in forming

- dual media associations. *Journal of Educational Psychology*, 76 (3), 408-417.  
Doi: <http://dx.doi.org/10.1037/0022-0663.76.3.408>
- Bavelas, J. B., Coates, L., & Johnson, T. (2002). Listener responses as a collaborative process: the role of gaze. *Journal of Communication*, 52 (3), 566-580.  
Doi: 10.1111/j.1460-2466.2002.tb02562.x
- Bell, P. A., Malm, W., Loomis, R. J., & McGlothlin, G. E. (1985). Impact of impaired visibility on visitor enjoyment of the Grand Canyon. A test of an ordered logit utility model. *Environment and Behavior*, 17 (4), 459-474.  
Doi: <http://dx.doi.org/10.1177/0013916585174003>
- Bligh, D. (1998). *What's the Use of Lectures?* (5<sup>th</sup> ed.). Bristol, UK: Intellect Books.
- Boling, E. C., Hough, M., Krinsky, H., Saleem, H., & Stevens, M. (2011). Cutting the distance education: Perspectives on what promotes positive, online learning experiences. *The Internet and Higher Education*, 15, 118-126. Doi: 10.1016/j.iheduc.2011.11.006
- Bruce, V. (1996). The role of face in communication: implications for videophone design. *Interacting with Computers*, 8 (2), 166-176. Doi: 10.1016/0953-5438(96)01026-0
- Chang, T., & Chen, Y. (2009). Cooperative learning in E-learning: A peer assessment of student-centered using consistent fuzzy preference. *Expert Systems with Applications*, 36, 8342-8349. Doi: 10.1016/j.eswa.2008.10.050
- Choi, H. J., & Johnson, S. D. (2005). The effect of context-based video instruction on learning and motivation in online courses. *The American Journal of Distance Education*, 19 (4), 215-227. Doi: [http://dx.doi.org/10.1207/s15389286ajde1904\\_3](http://dx.doi.org/10.1207/s15389286ajde1904_3)
- COTAN, (2000). Through <http://www.cotandocumentatie.nl.proxy.library.uu.nl/> on may 21<sup>st</sup> 2014
- Coursera inc. (2014). Through <https://www.coursera.org/about/> on july 8<sup>th</sup> 2014.
- Ćukušić, M., Alfirević, N., Granić, A., & Garača, Ž. (2010). E-Learning process management and the e-learning performance: Results of a European empirical study. *Computers & Education*, 55, 554-565. Doi: 10.1016/j.compedu.2010.02.017
- Day, J.A. (2008). *Investigating learning with web lectures*. Gvu Technical Report GIT-GVU-06-25, Georgia Institute of Technology, GA.  
<http://smartech.gatech.edu/handle/1853/22627>
- Day, J. A., Foley, J. D., & Catrambone, R. (2006). *Investigating multimedia learning with web lectures*. Gvu Technical Report GIT-GVU-06-25, Georgia Institute of Technology, GA. <http://smartech.gatech.edu/handle/1853/13141>
- Fisher, R.A., & Yates, F. (1953). *Statistical Tables*. ( 4<sup>th</sup> ed.). Edinburgh: Oliver & Boyd.

- Found in Good, I. J. (1958). The interaction algorithm and practical Fourier analysis. *Journal of the Royal Statistical Society. Series B (Methodological)*, 20 (2), 361-372.  
Doi:
- Gaeta, M., Orciuoli, F., & Ritrovato, P. (2009). Advanced ontology management system for personalized e-learning. *Knowledge-based Systems*, 22, 292-301.  
Doi: 10.1016/j.knosys.2009.01.006
- Gilbert, J., Morton, S., & Rowley, J. (2007). e-Learning: The student experience. *British Journal of Educational Technology*, 38 (4), 560-573. Doi: 10.1111/j.1467-8535.2007.00723.x
- Gorissen, P. (2013). *Facilitating the use of recorded lectures: Analysing students' interactions to understand their navigational needs*. Eindhoven University of Technology.  
Obtained on march 21st at <http://www.weblectures.nl/content/promotie-onderzoek-pierre-gorissen>
- Gotthardt, M., Slegert, M. J., Schlieck, A., Schneider, S., Kohnert, A., Groß, M. W., Schäfer, C., Wagner, R., Hörmann, S., Behr, T. M., Engenhardt-Cabillic, R., Klose, K. J., Jungclas, H., Glowalla, U. (2006). How to successfully implement E-learning for both students and teachers. *Academic Radiology*, 13, 379-390.  
Doi: 10.1016/j.acra.2005.12.006
- Granić, A., Mifsud, C., & Čukušić, M. (2009). Design, implementation and validation of a Europe-wide pedagogical framework for e-Learning. *Computers & Education*, 53, 1052-1081. Doi: 10.1016/j.compedu.2009.05.018
- Gullberg, M., & Holmqvist, K. (2006). What lecturers do and what addressees look at. Visual attention to gestures in human interaction live and on video. *Pragmatics & Cognition*, 14 (1), 53-82. Doi: 10.1075/pc.14.1.05gul
- Johnson, R. D., Hornik, S., & Salas, E. (2008). An empirical examination of factors contributing to the creation of successful e-learning environments. *Human-Computer Studies*, 66, 356-369. Doi: 10.1016/j.ijhcs.2007.11.003
- Kendon, A. (1967). Some functions of gaze direction in two-person conversations. *Acta Psychologica*, 26, 22-63. Doi: 10.1016/0001-6918(67)90005-4
- Kendon, A. (1990). *Conducting Interaction*. Cambridge: Cambridge University Press. In Gullberg, M., & Holmqvist, K. (2006). What lecturers do and what addressees look at. Visual attention to gestures in human interaction live and on video. *Pragmatics & Cognition*, 14 (1), 53-82. Doi: 10.1075/pc.14.1.05gul
- Kleinke, C. L. (1986). Gaze and eye contact: A research review. *Psychological Bulletin*, 100 (1), 78-100. Doi: 10.1037/0033-2909.100.1.78
- Krause, U., Stark, R., & Mandl, H. (2009). The effects of cooperative learning and feedback



- on e-learning in statistics. *Learning and Instruction*, 19, 158-170. Doi: 10.1016/j.learninstruc.2008.03.003
- Langton, S. R. H., Watt, R. J., & Bruce, V. (2000). Do the eyes have it? Cues to the direction of social attention. *Trends in Cognitive Sciences*, 4 (2), 50-59. Doi: 10.1016/S1364-6613(99)01436-9
- Liaw, S., Chen, G., & Huang, H. (2008). Users' attitudes toward web-based collaborative learning systems for knowledge management. *Computers & Education*, 50, 950-961. Doi: 10.1016/j.compedu.2006.09.007
- Lin, K. (2011). E-learning continuance intention: Moderating effects of user e-learning experience. *Computers & Education*, 56, 515-526. Doi: 10.1016/j.compedu.2010.09.017
- McGurk, H., & MacDonald, J. W. (1976). Hearing lips and seeing voices. *Nature*, 264, 126-130. Doi: 10.1038/264746a0
- Morales, E., García, F., Rego, H., Mereira, T., & Barbosa, H. (2005) Knowledge management for e-learning based on learning objects: A qualitative focus. *ITHET 6<sup>th</sup> Annual International Conference, F4B-12*, July 7-9, 2005, Juan Dolio, Dominican Republic.
- Moreno, R., & Mayer, R. E. (2000). Engaging students in active learning: the case for personalized multimedia messages. *Journal of Educational Psychology*, 92 (4), 724-733. Doi: 10.1037//00224)663.92.4.724
- Nass, C., Steuer, J., Tauber, E. R. (1994), Computers are Social Actors, in B. Adelson, S. Dumais, J. Olson (eds.), *Proceedings of CHI'94: Human Factors in Computing Systems*, ACM Press, pp. 72–78.
- Ozkan, S., & Koseler, R. (2009). Multi-dimensional students' evaluation of e-learning systems in the higher education context: An empirical investigation. *Computers & Education*, 53, 1285-1296. Doi: 10.1016/j.compedu.2009.06.011
- Paechter, M., & Maier, B. (2010). Online or face-to-face? Students' experiences and preferences in e-learning. *The Internet and Higher Education*, 13, 292-297. Doi: 10.1016/j.iheduc.2010.09.004
- Palys, T. S., & Little, B. R. (1983). Perceived life satisfaction and the organization of personal project systems. *Journal of Personality and Social Psychology*, 44 (6), 1221-1230. Doi: <http://dx.doi.org/10.1037/0022-3514.44.6.1221>
- Proctor, R.W., & Van Zandt, T. (2008). *Human factors in simple and complex systems*. Boca Raton, FL: CRC Press, Taylor & Francis Group.
- van Raaij, E. M., & Schepers, J. J. L. (2008). The acceptance and use of a virtual learning environment in China. *Computers & Education*, 50, 838-852. Doi: 10.1016/j.compedu.2006.09.001

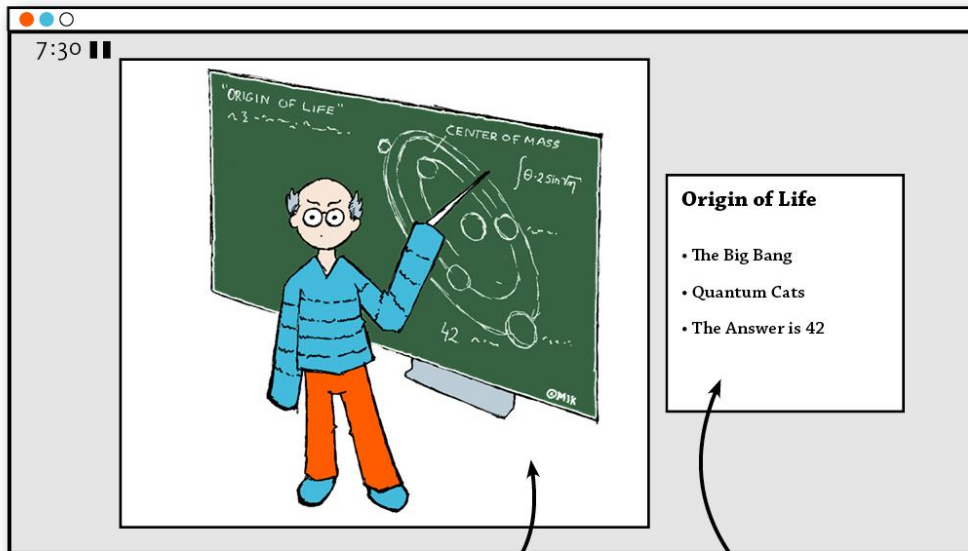
- Risko, E. F., Anderson, N., Sarwal, A., Engelhardt, M., & Kingstone, A. (2012). Everyday attention: Variation in mind wandering and memory in a lecture. *Applied Cognitive Psychology, 26*, 234-242. Doi: 10.1002/acp.1814
- Shee, D. Y., & Wang, Y. (2008). Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its applications. *Computers & Education, 50*, 894-905. Doi: 10.1016/j.compedu.2006.09.005
- Sproull, L., Subramani, R., Kiesler, S., Walker, J., & Waters, K. (1996). When the interface is a face. *Human-Computer Interaction, 11*, 97-124.  
 Doi: [http://dx.doi.org/10.1207/s15327051hci1102\\_1](http://dx.doi.org/10.1207/s15327051hci1102_1)
- Streeck, J. (1993). Gesture as communication I: its coordination with gaze and speech. *Communication Monographs, 60* (4), 275-299. Doi: 10.1080/03637759309376314
- Streeck, J. (1994). Gesture as communication II: the audience as co-author. *Research on Language and Social Interaction, 27* (3), 239-267. Doi: 10.1207/s15327973rlsi2703\_5
- Summerfield, Q. (1992). Lip-reading and audiovisual speech perception. *Philosophical Trans. Royal Society of London, B335*, 71-78. Doi: 10.1098/rstb.1992.0009
- Sun, P., Cheng, H. K., & Finger, G. (2009). Critical functionalities of a useful e-learning system – an analysis from instructors' cognitive structure toward system usage. *Decision Support Systems, 48*, 293-302. Doi: 10.1016/j.dss.2009.08.007
- Sun, P., Tsai, R. J., Finger, G., Chen, Y., & Yeh, D. (2008). What drives a successful e-learning? An empirical investigation of the critical factors influencing learner satisfaction. *Computers & Education, 50*, 1183-1202.  
 Doi: 10.1016/j.compedu.2006.11.007
- Tzeng, G., Chiang, C., & Li, C. (2007). Evaluating intertwined effects in e-learning programs: A novel hybrid MCDM model based on factor analysis and DEMATEL. *Expert Systems with Applications, 32*, 1028-1044. Doi: 10.1016/j.eswa.2006.02.004
- Van Mulken, S., André, E., & Müller, J. (1998). The persona effect: How substantial is it? In Johnson, et al (eds.). *People and Computers XIII*, London: Springer-verlag
- Veletsianos, G., & Miller, C. (2008). Conversing with pedagogical agents: A phenomenological exploration of interacting with digital entities, *British Journal of Educational Technology, 39* (6), 969-986.  
 Doi: <http://dx.doi.org/10.1111/j.1467-8535.2007.00797.x>
- Vitkovich, M., & Barber, P. (1994). Effect of video frame rate on subjects' ability to shadow one of two competing verbal passages. *Journal of Speech and Hearing Research, 37*, 1204-1210. Doi: 10.1044/jshr.3705.1204
- Vygotski, L. (1978). *Mind in society. The development of higher psychological process*. Cambridge & London: Harvard University Press.

- Wang, T. (2010). Web-based dynamic assessment: Taking assessment as teaching and learning strategy for improving students' e-Learning effectiveness. *Computers & Education, 54*, 1157-1166. Doi: 10.1016/j.compedu.2009.11.001
- Wickens, C.D., (2002). Multiple resources and performance prediction. *Theoretical Issues in Ergonomics Science, 3* (2), 159-177.  
Doi: <http://dx.doi.org/10.1080/14639220210123806>
- Yarbus, A. (1967) *Eye Movements and Vision*. New York: Plenum Press. In Gullberg, M., & Holmqvist, K. (2006). What lecturers do and what addressees look at. Visual attention to gestures in human interaction live and on video. *Pragmatics & Cognition, 14* (1), 53-82. Doi: 10.1075/pc.14.1.05gul

# Appendix A

## The three View-conditions

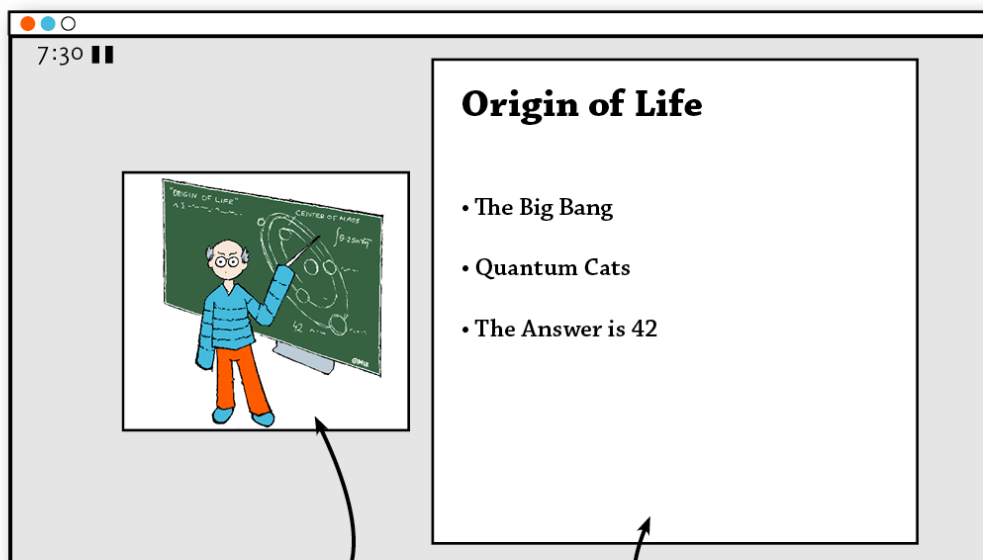
1



recording of lecture

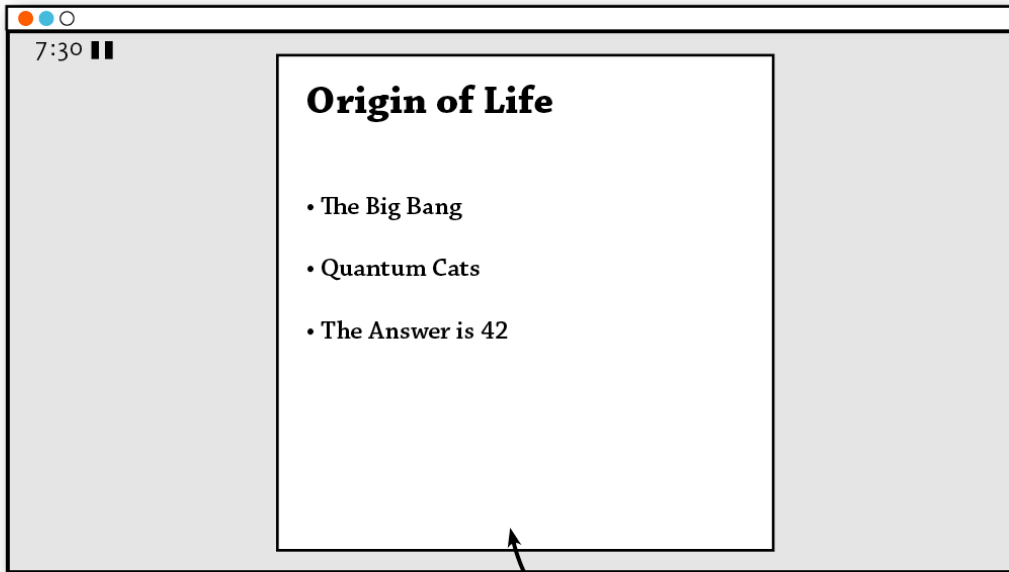
slides

2



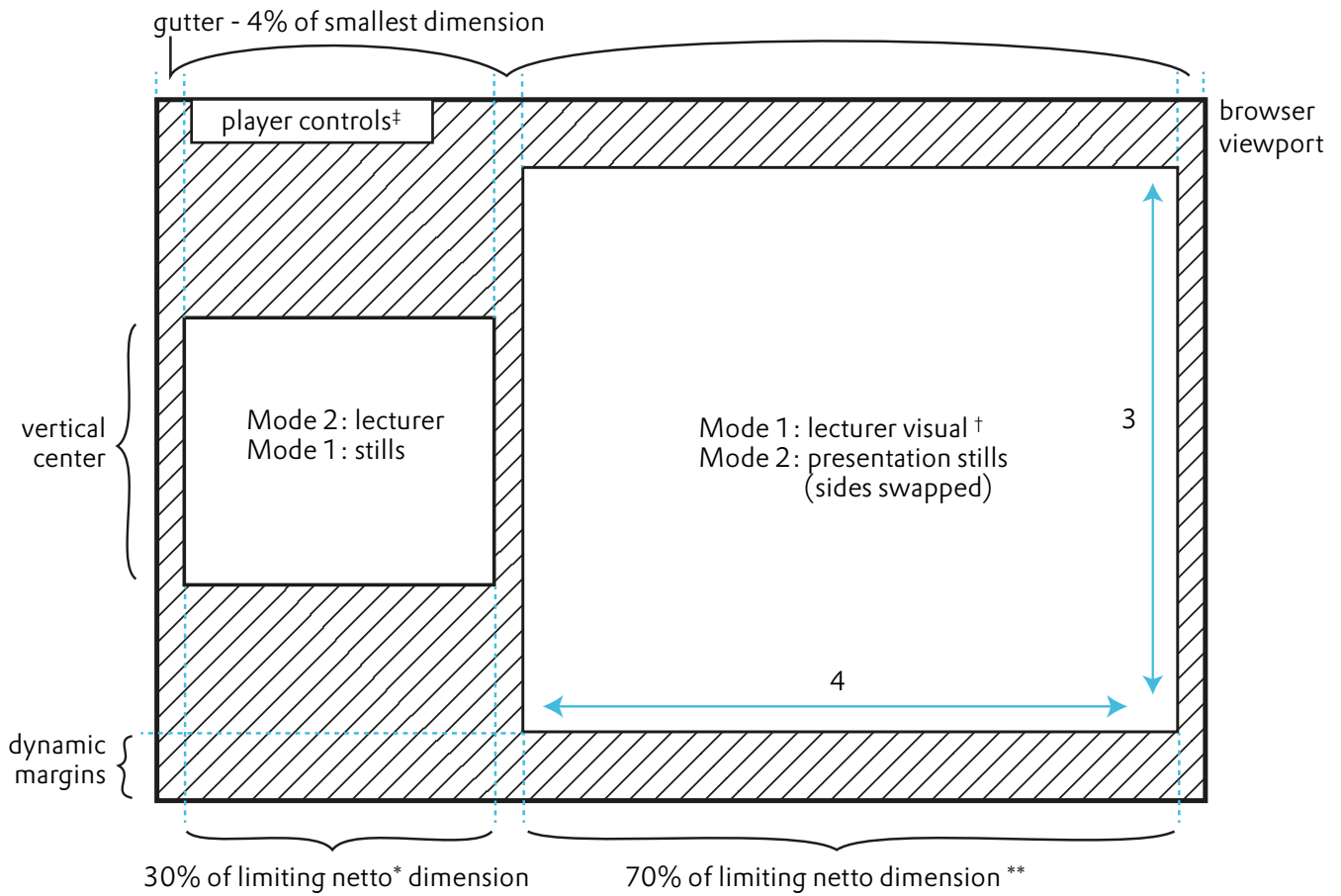
recording of lecture

slides

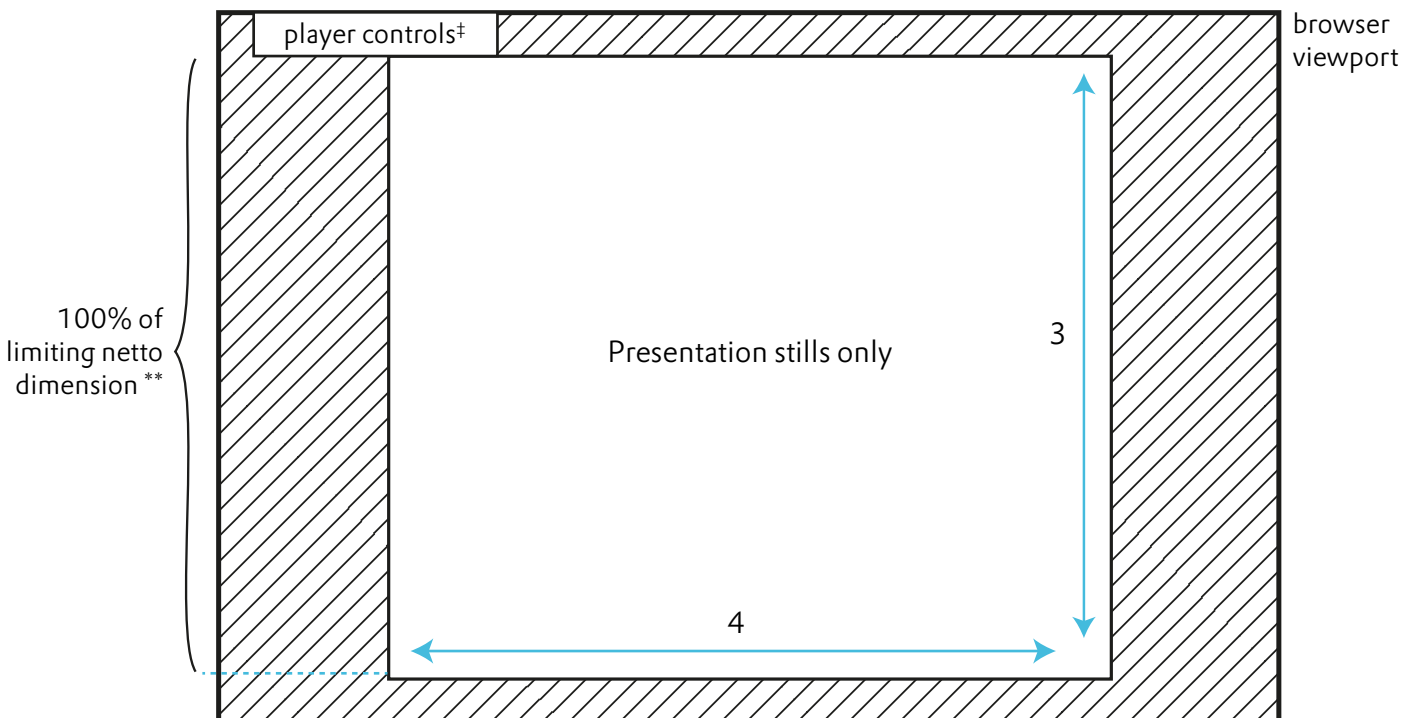


just slides

# APPENDIX B - PLAYER VIEWPORT MODE 1/2



## MODE 3



† The native resolution for each video is 400x300 pixels and is scaled to fill the frame.

\* The netto viewport dimensions are the viewport width/height minus margins, gutter and browser elements like scrollbars.

\*\* The size and ratio of the viewport is beyond our control, therefore the player maximizes the content to the smallest dimension, ensuring all content is visible at all times.

‡ Player controls include only pause and remaining time.

## Appendix C – Questionnaire

1. What is your sex?
  - Female
  - Male
  
2. What is your age?
  
3. At which faculty do you study?
  - Faculty of Beta Sciences
  - Faculty of Veterinarian Medicine
  - Faculty of Humanitarian Studies
  - Faculty of Medicine
  - Faculty of Geological Sciences
  - Faculty of Law, Economy, Business and Organization
  - Faculty of Social Sciences
  - Centre for Education and Learning
  - University College Utrecht / Roosendaal
  - Other
  
4. At which level do you study?
  - Higher Vocational Education
  - Master Higher Vocational Education
  - University Premaster Inflow Trajectory
  - University Bachelor
  - University Premaster
  - University Master
  - Other
  
5. How many elective lectures do you attend? *If at the moment there are no elective lectures to be followed, think about the last time you took a course with elective lectures.*
  - 1      None of the elective lectures
  - 2
  - 3
  - 4      About half of the elective lectures
  - 5
  - 6
  - 7      All of the elective lectures
  
6. How many hours a week do you listen to aural media, like the radio, podcasts, books on tape, etcetera?

7. How many hours a week do you watch television, including YouTube, Internet-movies, etcetera?

**You are going to watch the first weblecture. This will take between 7 and 8 minutes. Please make sure the sound of your computer is turned on. If the recording does not start on its own, then you can click the start-button in the top left corner.**

8. How much did you enjoy following the weblecture?

- 1      Totally not
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally

9. How boring was the weblecture?

- 1      Totally not boring
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally boring

10. How nice was the weblecture?

- 1      Totally not nice
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally nice

11. What do you think about the length of the weblecture?

- 1      Too short
- 2
- 3
- 4      Just right
- 5
- 6
- 7      Too long



12. Where you able to keep your **concentration** on the weblecture?

- 1 Totally not
- 2
- 3
- 4 About half of the time
- 5
- 6
- 7 Totally

13. How **attentive** did you follow the story of the weblecture?

- 1 I followed none of the story
- 2
- 3
- 4 I followed about half of the story
- 5
- 6
- 7 I followed the whole story

14. How much did you have to try to keep your **focus** on the weblecture?

- 1 Totally not
- 2
- 3
- 4 Average
- 5
- 6
- 7 Totally

15. How interesting was the **subject** of the weblecture?

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

16. How relevant is the **subject** of the weblecture for your education?

- 1      Totally not
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally

17. How much did you enjoy listening to this **lecturer**?

- 1      Totally not
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally

18. How interesting was the **lecturer** of the weblecture?

- 1      Totally not interesting
- 2
- 3
- 4      Neutral
- 5
- 6
- 7      Totally interesting

19. Do you think the **lecturer** positively influenced the story of the weblecture?

- 1      Totally not
- 2
- 3
- 4      Sometimes
- 5
- 6
- 7      Totally

20. Would you like to follow a complete lecture from this **lecturer**?

- 1 I would not like that at all
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 I would really like that

21. How well do you think the **story** of the weblecture fits together? *Think about the composition of the story, whether it was a coherent whole, whether examples fitted the subject of the weblecture, etcetera.*

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

22. How much did you enjoy the **story** of the weblecture?

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

23. How well could you follow the **story** of the weblecture?

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

24. Which of the following changes would make the weblecture more **interesting** for you? *You can choose more than one answer.*

- Another subject
- Another lecturer
- A larger view of the lecturer
- A smaller view of the lecturer
- More information in the PowerPoint presentation
- A larger view of the PowerPoint presentation
- A smaller view of the PowerPoint presentation
- A change is not necessary
- Other:

25. Which of the following changes would make it easier for you to keep your **attention** on the weblecture? *You can choose more than one answer.*

- Another subject
- Another lecturer
- A larger view of the lecturer
- A smaller view of the lecturer
- More information in the PowerPoint presentation
- A larger view of the PowerPoint presentation
- A smaller view of the PowerPoint presentation
- A change is not necessary
- Other:

**You are going to watch another recording of another weblecture. This will take between 7 and 8 minutes. Please make sure the sound of your computer is turned on. If the recording does not start on its own, then you can click the start-button in the top left corner.**

26. How much did you enjoy following this weblecture, compared to the first weblecture?

- 1      Much less than the first weblecture
- 2
- 3
- 4      About the same as the first weblecture
- 5
- 6
- 7      Much more than the first weblecture

27. How boring was this weblecture, compared to the first weblecture?

- 1 Much less boring than the first weblecture
- 2
- 3
- 4 About the same as the first weblecture
- 5
- 6
- 7 Much more boring than the first weblecture

28. How nice was this weblecture, compared to the first weblecture?

- 1 Much less nice than the first weblecture
- 2
- 3
- 4 About the same as the first weblecture
- 5
- 6
- 7 Much nicer than the first weblecture

29. What do you think about the length of this weblecture, compared to the first weblecture?

- 1 Much shorter than the first weblecture
- 2
- 3
- 4 About the same as the first weblecture
- 5
- 6
- 7 Much longer than the first weblecture

30. How much were you able to keep your **concentration** on this weblecture, compared to the first weblecture?

- 1 Much less than the first weblecture
- 2
- 3
- 4 About the same as the first weblecture
- 5
- 6
- 7 Much more than the first weblecture

31. How **attentive** did you follow the story of this weblecture, compared to the first weblecture?

- 1 I followed much less of this weblecture, than the first weblecture
- 2
- 3
- 4 I followed about the same of this weblecture
- 5
- 6
- 7 I followed much more of this weblecture, than the first weblecture

32. How much did you have to try to keep your **focus** on this weblecture, compared to the first weblecture?

- 1 Much less than the first weblecture
- 2
- 3
- 4 About the same as the first weblecture
- 5
- 6
- 7 Much more than the first weblecture

33. How interesting did you find the **subject** of this weblecture?

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

34. How relevant is the **subject** of this weblecture for your education?

- 1 Totally not
- 2
- 3
- 4 Neutral
- 5
- 6
- 7 Totally

35. How much did you enjoy listening to this **lecturer**, compared to the lecturer of the first weblecture? 9/11

- 1 Much less than the first lecturer
- 2
- 3
- 4 About the same as the first lecturer
- 5
- 6
- 7 Much more than the first lecturer

36. How interesting did you think the **lecturer** of this weblecture was, compared to the lecturer of the first weblecture?

- 1 Much less interesting than the lecturer of the first weblecture
- 2
- 3
- 4 About the same as the lecturer of the first weblecture
- 5
- 6
- 7 Much more interesting than the lecturer of the first weblecture

37. How much did you think the **lecturer** positively influenced the story of this weblecture, compared to the lecturer of the first weblecture?

- 1 Much less than the lecturer of the first weblecture
- 2
- 3
- 4 About the same as the lecturer of the first weblecture
- 5
- 6
- 7 Much more than the lecturer of the first weblecture

38. How much would you like to follow a complete lecture from this **lecturer**, compared to the lecturer of the first weblecture?

- 1 Much less than the lecturer of the first weblecture
- 2
- 3
- 4 About the same as the lecturer of the first weblecture
- 5
- 6
- 7 Much more than the lecturer of the first weblecture

39. How well do you think the **story** of the weblecture fits together, compared to the story of the first weblecture? *Think about the composition of the story, whether it was a coherent whole, whether examples fitted the subject of the weblecture, etcetera.*

- 1 Much less than the story of the first weblecture
- 2
- 3
- 4 About the same as the story of the first weblecture
- 5
- 6
- 7 Much more than the story of the first weblecture

40. How much did you enjoy the **story** of this weblecture, compared to the story of the first weblecture?

- 1 Much less than the story of the first weblecture
- 2
- 3
- 4 About the same as the story of the first weblecture
- 5
- 6
- 7 Much more than the story of the first weblecture

41. How well could you follow the **story** of this weblecture, compared to the story of the first weblecture?

- 1 Much worse than the story of the first weblecture
- 2
- 3
- 4 About the same as the story of the first weblecture
- 5
- 6
- 7 Much better than the story of the first weblecture

42. Which of the following changes would make the weblecture more **interesting** for you? *You can choose more than one answer.*

- Another subject
- Another lecturer
- A larger view of the lecturer
- A smaller view of the lecturer
- More information in the PowerPoint presentation
- A larger view of the PowerPoint presentation
- A smaller view of the PowerPoint presentation
- A change is not necessary
- Other:



43. Which of the following changes would make it easier for you to keep your **attention** on the weblecture? *You can choose more than one answer.*

- Another subject
- Another lecturer
- A larger view of the lecturer
- A smaller view of the lecturer
- More information in the PowerPoint presentation
- A larger view of the PowerPoint presentation
- A smaller view of the PowerPoint presentation
- A change is not necessary
- Other:

**Final questions:**

44. How attentive were you able to follow these weblectures compared to a lecture in a lecture-hall? *Compare these weblectures to a lecture, where you are not asked to participate actively as a student.*

- 1 I was much less attentive than in a lecture-hall
- 2
- 3
- 4 I had about the same attention as in a lecture-hall /  
I never followed lectures in a lecture-hall
- 5
- 6
- 7 I was much more attentive than in a lecture-hall

45. How would you like it if your educational program would provide recordings of lectures online for you as a student?

- I would like that very much
- It would not make a difference for me
- I would not like that at all
- My program already does this
- Other:

46. What did you think of the quality of the video/audio material used in this study?

- Very bad quality
- Bad quality
- Average quality
- Good quality
- Very good quality

47. Do you have any suggestions to improve this study?