Computers & Education 94 (2016) 151–161

Contents lists available at ScienceDirect

Computers & Education

journal homepage: www.elsevier.com/locate/compedu

Look at me and pay attention! A study on the relation between visibility and attention in weblectures

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ARTICLE INFO

Article history:
Received 11 August 2015
Received in revised form 11 November 2015
Accepted 21 November 2015
Available online 2 December 2015

Keywords:
Applications in subject areas
Distance education and telelearning
Media in education
Post-secondary education
Teaching/learning strategies

ABSTRACT

Online educational content is becoming increasingly popular in higher education. In prior studies it has been reported that students prefer weblectures with a visible lecturer over weblectures consisting of audio and slides only. Anticipated was that the amount of attention students pay to a weblecture is relevant for this preference. A study was conducted to see whether lecturer-visibility was related to reported attention for a weblecture. Lecturer's appeal was expected to be a moderator in this relation. Eighty-eight participants viewed two different clips of weblectures in one of three visibility-modes where the lecturer was visible in a large or a small frame, and where the slides were large or small. After watching the lecture their opinion was asked about their attention and, after the second lecture, to compare their attention to the first lecture. The two weblectures were analysed separately. Weblectures of six different lecturers were used, integrated in a web-application so participants could participate from home. Nine other variables, that could influence attention, were used as control variables in analysis. For the first weblecture no differences on reported attention were found between the visibility-modes. For the second weblecture participants reported significantly more attention for the condition in which a large image of the lecturer was shown than for the condition in which a small image of the lecturer was shown. Lecturer's appeal was found not to moderate the relation between the visibility of the lecturer and reported attention. Practical and theoretical implications are discussed.

1. Introduction

The availability and use of educational content on the internet, including weblectures, is becoming more and more common in higher education (Danielson, Preast, Bender, & Hassall, 2014; Griffin, Mitchell, & Thompson, 2009; Köllöffel, 2012). As lectures are the primary means of knowledge transmission in higher education (Bligh, 1998; Risko, Anderson, Sarwal, Engelhardt, & Kingstone, 2012), as well as an effective method for the transfer of information and personalisation of the subject matter (Bligh, 1998), it is not surprising that weblectures are becoming increasingly popular. Paechter and Maier (2010) found that Austrian university students actually preferred online learning over face-to-face methods for distributing information, transmission of knowledge, providing structure of the learning material and in acquiring and supporting self-

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http://dx.doi.org/10.1016/j.compedu.2015.11.011
0360-1315/

regulated learning. The possibilities of online educational content has led to the introduction of MOOCs (massive open online courses) in 2007. An online course for university students, also open for public enrolment (Creed-Dikeogu & Clark, 2013).

Weblectures in an educational setting are commonly used in a blended way. In blended learning, such as the flipped classroom (Abeysekera & Dawson, 2015), the weblecture provides the online framework, while the classroom course supports deeper understanding. It is not perfectly clear though how the use of weblectures in higher education is related to learning. Some studies have found a positive relation (Bacro, Gebregziabher, & Fitzharris, 2010; Day, Foley, Groeneweg, & Van der Mast, 2005; Day & Foley, 2006; Franklin, Gibson, Samuel, Teeter, & Clarkson, 2011), some a mixed or negative relation (Fernandes, Moira, & Cruickshank, 2012; Franklin et al., 2011) and other studies found no relation at all (von Konsky, Ivins, & Gribble, 2009; Shaw & Molnar, 2011). Despite this lack of clarity about the mechanism, students do not seem to bother: for them it is clear that weblectures support their learning processes (Bacro et al., 2010; Franklin et al., 2011; Heilesen, 2010; Holbrook & Dupont, 2011; von Konsky et al., 2009; Scutter, Stupans, Sawyer, & King, 2010).

The preference for lectures with a visible lecturer, instead of audio sound of the lecturer only (Day, Foley, & Catrambone, 2006; Paechter & Maier, 2010), is thought to be explained by attention (Baggett, 1984; Day et al., 2006). Also "focusing conscious attention to relevant pieces of information" is an important first step (*selecting*) in the process of making sense out of information, i.e. learning (Mayer, 1992b; 1996). This study tries to understand this reported preference for lectures with a visible lecturer by looking into the relation between visibility of the lecturer in a weblecture and attention. We consider visibility to be the degree in which a lecturer is visible in a weblecture. Psychological concepts of attention are centred 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 (Baldauf & Desimone, 2014). Focusing attention on an object, or thought, is considered to require attentional resources within the mind (Proctor & Van Zandt, 2008). We regard attention to be: concentration on a specific subject in a certain period of time or focusing attentional resources on a subject during a period of time. In our study we will look at reported attention, i.e. what participants in the study report about their attention.

We will study differences in reported attention while watching weblectures via *lecture capture* – slides, audio and the choice between a visible lecturer in a video or not – which in the Netherlands is the most common way of presenting weblectures (Gorissen, 2013). Lecture capture is just one of the ways to present a lecture online, others are for example; voice-over-presentation, Khan-style video, picture-in-picture, stop-and-think method, presentation by a synthetic pedagogical agent, knowledge clips and live webinars (Chen & Wu, 2015; Chorianopoulos & Giannakos, 2013; Fitrianie & Rothkrantz, 2007; Miyake & Shirouzu, 2006). When reported attention after weblectures with a visible lecturer is higher, compared to reported attention after weblectures without a visible lecturer, this could help to understand the preference for lectures with visibility of the lecturer.

2. Relation between visibility of the lecturer and attention

2.1. Background

We hypothesize a positive relation between visibility of the lecturer and reported attention for the weblecture for three reasons. The first reason is that information that a person's face and body emits, adds understanding to what is being said, which can aid attention. Watching a person's face will give the one spoken to more information about what is being said and meant than hearing what is being said only (Bruce, 1996). An explanation is to be found in phonetic distinctions such as place of articulation, which are difficult to hear but easy to see (McGurk & MacDonald, 1976). Or in facial expressions that inform about emotions which are difficult to hear. Moreover, the timing of each expression and the final posture of the face during an interaction make the perception of expressions easier to see than to hear. And simple face perception also helps people decipher speech, demonstrated by the fact that speech can be deciphered with much more background noise when a lecturer's face can be seen compared to only an auditory channel (Bruce, 1996; Summerfield, 1992; Vitkovich & Barber, 1994). In a study with video lectures, Day et al. (2006) showed that participants who could study with a video lecture reported that this aided them significantly in their attention for, and their comprehension of, the lecture. Baggett (1984) demonstrated that participants who had watched a video narration wrote a more complete summary one week later, compared to participants who listened to an audio narration only. The researcher suggested that mental models are easier derived from both auditory and visual symbol systems than from auditory or linguistic information only. She considered the improvement to be related to attention. Similarly, Choi and Johnson (2005) showed that participants who watched a video-based instruction reported significantly more attention than participants who read a text-based instruction only. Thus, it seems that visibility aids attention.

A positive relation between visibility and reported attention is also hypothesized because the human face draws attention, both on photographs (Yarbus, 1967) and in face-to-face interaction (Kleinke, 1986). People that are spoken to tend to look continuous and attentive at a speakers 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: maintaining eye contact signals attention, interest and engagement (Kleinke, 1986). Gullberg and Holmqvist (2006) found that participants spent about the same amount of time focused on the speakers' face, irrespective whether the speaker sat across from them or was shown in a video. Both groups of participants looked at things speakers themselves looked at, contributing 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). In sum, these findings suggest that attention is easier allocated to lectures with video of the lecturer.

A third explanation of why visibility of a lecturer will relate positively to reported attention is the theory of cross-modalities for multiple attentional resources. The human information-processing system is thought to have two main input-channels: 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 information. When both input-modalities work together to process information, less energy might be needed for attention on the lecture, which will make it easier to follow what is being said. 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 slide is constant; once the information is read it will not attract visual attention anymore. A lecturer's face changes constantly and will keep attracting visual attention (Kleinke, 1986). The study of Day et al. (2006) confirms this: participants who used a video to study reported more attention on the lecture and more engagement with the material, compared with participants who studied with audio only. Therefore, students who receive a video of the lecturer could have more attentional resources available to focus on the lecture.

2.2. Factors that have an effect on the relation between visibility and attention

The current study is set up to explain the preference for a visible lecturer by suggesting that visibility relates to more attention for a weblecture shown by *lecture capture*. Various ways of presenting weblectures, and their relation to aspects of attention, cognitive load, memory and learning, have been studied earlier (Baggett, 1984; Choi & Johnson, 2005; Day et al., 2006; Gorissen, 2013). However, in those studies (Chen & Wu, 2015; Day et al., 2006; Miyake & Shirouzu, 2006) important factors expected to have an effect on the relation between visibility and attention were not included. For example they used the same lecturer in multiple conditions which makes generalisation difficult. The current study uses multiple lecturers in multiple conditions: lecturers who differ in age, sex, department, lecturing style and the amount of movement that they made during the lecture (walking, gesturing). In addition, in earlier studies the influence of other factors on attention was not sufficiently taken into account. An interest in the lectures' subject, relevance of the subject of the weblecture to the education of the participant or television-watching habits are relevant factors that could have an effect on the relation between visibility of the lecturer and attention (Proctor & Van Zandt, 2008). Therefore, in this study factors that potentially influence the relation between visibility and attention were measured and included in the analysis. The appeal of the lecturer, not measured in other studies (Bagget, 1984; Chen & Wu, 2015; Choi & Johnson, 2005; Day et al., 2006) while it is expected to influence attention, was also considered a moderating factor on the proposed relation between visibility and attention. A lecturer may appeal more to a viewer either because he or she makes use of attracting lecturing styles or because of positive non-verbal communication (e.g. he or she speaks with use of hands and facial expressions). Since earlier literature has shown that such personalization of messages can contribute to the attention for a lecture (Bruce, 1996; Langton et al., 2000; Paechter & Maier, 2010), this study looks at this relation by measuring lecturer-appeal and analysing whether this influences the relation between visibility and reported attention. Finally, thus far, studies have been performed in laboratories with computers (e.g. Chen & Wu, 2015; Day et al., 2006), while the natural place where students watch a weblecture is at home at their convenience. In our study the weblectures were integrated in a web-application and participants could participate at home or another preferred location. This avoids the effect that research-subjects change behaviour when they know and notice they are being studied (Kirschner, 2014; Risko & Kingstone, 2011).

2.3. Aims

In this study the relation between visibility and reported attention in weblectures, and whether the appeal of a lecturer influences this relation, is investigated. A positive relation is expected between visibility and reported attention (hypothesis 1), based on the literature discussed above on personalization, attention drawing by faces and the multiple resource model of attention. Furthermore, we expect that this proposed relation between visibility and reported attention will depend on the appeal of the lecturer because every lecturer is different, from looks to voice and from facial expressions to formality of address. We propose that the positive relation between visibility and reported attention will be stronger when a lecturer appeals more to the viewer than when the lecturer is less appealing (hypothesis 2). The hypotheses and the design of the study are displayed in Fig. 1. Appendix A shows larger images of the three visibility-modes.

3. Material and methods

3.1. 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). Students were invited to participate via an email, which was sent to 300 students from the UU-faculty of social sciences and 60 students of LU-computer science by the researcher, via a website where psychology-students could gather study participation credit (which is a requirement to receive a bachelor's degree), and via

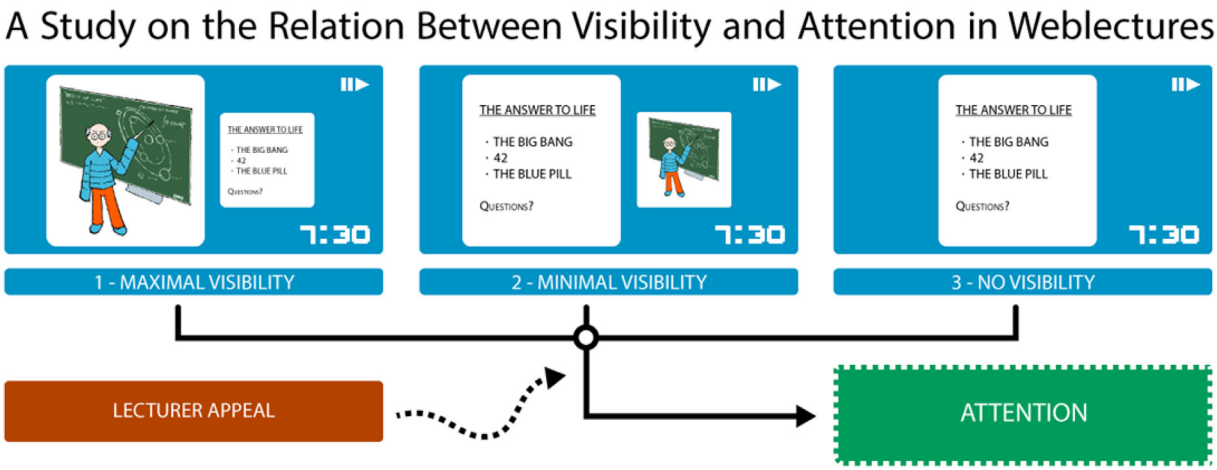

Fig. 1. Graphic display of hypothesis and study design.

posters with information about the study at the university buildings and libraries around the cities of Utrecht and Leiden. For unknown reasons, three of the participants spent more than 3 h to complete the study and these participants were excluded from analyses.

3.2. Procedure

Participants could register themselves, after which they received an e-mail with a link to the study. The link contained a unique participant-ID which determined the visibility-mode participants were randomly assigned to. On the site of the study participants were given a briefing about its goal, content and duration and were asked to consent to participating. The first part of the study consisted of background-questions (sex, age, education). Participants were asked how many elective lectures they visited, how much they listened to the radio, podcasts and books on tape and watched television, YouTube and movies. Every participant watched two different videos of college lectures in two different visibility-modes (Table 1). Each video lasted approximately 7:30 min, which made the total study last no more than 30 min, since attention and arousal factors are less effective after 20 min in a task (Day et al., 2006). After the first video the participant responded to questions pertaining to their attention, enjoyment, lecturer appeal, content, interest in the subject and relevance of the subject to their education. After the second weblecture participants were asked to respond to the same questions, but to compare these to the first weblecture. At the end of the study participants were asked to compare their attention during the weblectures to their attention during a lecture in a lecture-hall. The duration of the study was between 25 and 35 min ($M_{duration}$ = 28 m 51 s, $SD_{duration}$ = 13 m 50 s).

3.3. Materials

3.3.1. Video-materials

The videos that were used in the study originated from the Mediasite server of Utrecht University, most of them recorded by the LectureNet service of the University (Lecturenet.nl). This site consists of a multitude of college-lectures and other video-recorded lectures. Six college-lectures were chosen, based on subject (different from each other), a high frame-rate, the 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 of Utrecht University and the lecturers had different speaking styles, so results could be generalized to more than just one (type of)

Table 1
Visibility-modes of the Study with their According Visibility of the Lecturer and the Visibility of the PowerPoint-slides (PP).

	First Weblecture	Second Weblecture
AB	Lecturer large, PP small	Lecturer small, PP large
BC	Lecturer small, PP large	No lecturer, PP large
CA	No lecturer, PP large	Lecturer large, PP small
AC	Lecturer large, PP small	No lecturer, PP large
BA	Lecturer small, PP large	Lecturer large, PP small
CB	No lecturer, PP large	Lecturer small, PP large

lecturer. The lecture contents all had an introductory nature of six different subjects. The lecturers varied on the following aspects; dynamic – static, formal – informal, gender, age, use of blackboard, use of PowerPoint-slides and content of PowerPoint-slides.

A clip between 7 and 8 min of each lecture-video was screen captured (M_{time} = 7 m 28 s, SD_{time} = 9.5 s), which approximated a beginning and an end of a story. The sound was not adjusted, only a fade-in at the beginning and a fade-out at the end were added. The video player used was a HTML5 player, so weblectures could be watched on iOS devices. The video-controls were removed, except for the pause-button. Participants could see how long the lecture would last, but they could not rewind or fast-forward it. PowerPoint-slides were downloaded separately and saved in big (683 × 512 pixels) and small (341 × 265 pixels) jpegs. 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.

3.3.2. Questionnaire

The questionnaire administered was designed by the researchers, guided by literature. Participants were asked about their attention during the weblecture in 3 questions. After the 1st weblecture, they could answer on a 7-point Likert-scale, which ranged from "*totally not*" (1) via "*neutral*" (4) to "*totally*" (7). After the 2nd weblecture questions were the same as after the 1st weblecture, with the addition of the sentence: *"[…], compared to the first lecture"*. Answers after the 2nd 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). Since participants would probably intuitively compare the second weblecture to the first weblecture, asking them to compare avoided incongruity in answers. An example of questions and answer-possibilities is shown in Fig. 2. In Appendix B the entire translated questionnaire is added.

In addition nine aspects which influence attention were included in the questionnaire. These were enjoyment of weblecture, judgment of the lecturer (lecturer-appeal), judgment of content of weblecture, interest in subject of weblecture, relevance of subject of weblecture to the education of participant, radio-listening, TV-watching, visits to elective lectures during the last course with elective lectures and comparison of attention during the weblectures to the attention during a lecture in a lecture-hall. Means and standard deviations of all covariates are displayed in Table 2.

Answers for Enjoyment, Attention, Lecturer and Content after the 1st and 2nd weblecture were recoded to make comparisons between 1st and 2nd weblectures possible. By subtracting 4 from every answer given after the 1st weblecture, the value 0 became a neutral answer, values below zero were negative judgments and values above zero positive judgments. This was done for reasons of clarity; recoded answers were obvious in one glance: positive, negative or neutral.

Seeing that participants were asked to compare their judgments of the 2nd weblecture with the judgments of the 1st, the meaning of the range from 1 to 7 differed. The formula corrects this by adding the values given for the 1st weblecture and giving extra weight to answers at the ends of the scale. This resulted in a range between −3 and 3 for the answers after both weblectures for Attention, Enjoyment, Lecturer and Content.

The following formula was used to recode the answers after the 2nd weblecture:

$$\frac{Answer'_1 + sign(Answer_2 - 4)*(Answer_2 - 4)^2}{4}$$

3.3.3. Web-application and randomization

The weblectures and questionnaire were implemented in a web-application. This application consisted of a client-side, resources, a server-side and a backend. The backend was password protected, and for safety of the research the data could not be manipulated. To give each participant two of the six possible videos to watch in two of the three possible visibility-modes, in a random order, a computerized random permutation was used. This permutation was based on the Fisher-

How attentive did you follow the story of the weblecture?	*How attentive did you follow the story of this weblecture, compared to the 1st weblecture?*
○*1. Totally not*	○*1. Much less attentive than the first weblecture*
○*2.*	○*2.*
○*3.*	○*3.*
○*4. Neutral*	○*4. About the same as the first weblecture*
○*5.*	○*5.*
○*6.*	○*6.*
○*7. Totally*	○*7. Much more attentive than the first weblecture*

Fig. 2. Example of questions and answer-possibilities after the 1st and 2nd weblecture.

Table 2
Means and standard deviations for all covariates used in the analyses.

Covariates	Scale	Questions	N	Mean	St. Dev	Range
Radio	Hours per week	1	88	7.67	8.72	0–50
Television	Hours per week	1	88	11.59	7.12	0–30
Lecture_Visits	1–7	1	88	5.88	1.52	1–7
Interest1	1–7	1	88	3.99	1.91	1–7
Interest2	1–7	1	88	4.28	1.91	1–7
Relevance1	1–7	1	88	2.91	1.96	1–7
Relevance2	1–7	1	88	3.07	1.93	1–7
Enjoyment1	1–7	4	88	0.10	1.41	−3 to 3
Enjoyment2	1–7	4	88	0.19	1.09	−3 to 3
Lecturer1	1–7	4	88	0.25	1.33	−3 to 3
Lecturer2	1–7	4	88	0.21	0.89	−3 to 3
Content1	1–7	3	88	0.39	1.18	−3 to 3
Content2	1–7	3	88	0.26	0.76	−3 to 3
Attention_Lecture-hall	1–7	1	88	3.97	1.61	1–7

Note: A '1' after a variable represents the 1st weblecture, a '2' represents the 2nd weblecture.

Yates algorithm, which resulted in a random sequence of 'n!/(n − k)!' permutations, where n stands for the amount of videos (6), or the amount of visibility-modes (3) and k is the number of times you choose an n (Fisher & Yates, 1953).

3.4. Analysis

The program SPSS 20.0 was used to analyse the data gathered in this study. To assess the reliability of the questionnaire reliability analyses were calculated on all scales of the questionnaire. To check for co-dependency between the answers after the 1st and 2nd weblecture t-tests for dependent groups and correlation analyses were administered for all question pairs and subscale-pairs. To see if there were differences in judgment between the lecturers t-tests for independent groups were administered between male and female lecturers on all subscales and ANOVA's were performed between all six lecturers on all subscales. If significant differences were found on the subscale attention between the male and female lecturers or the six lecturers, different subsets were made to analyse in order to answer the research questions.

To answer the research-questions separate ANCOVA's were calculated with visibility-mode as independent variable, reported attention as dependent variable and significant covariates for attention. These covariates were Enjoyment, Radio, Television, Lecture-visits, Lecturer, Content, Interest, Relevance and Attention compared to a lecture in a lecture-hall. Contrast analyses were used to ascertain between which of the three visibility-modes differences in reported attention were significant. To see whether lecturer appeal would moderate the relation between visibility and reported attention, an ANCOVA was administered with only these variables, which tested the interaction between lecturer appeal and visibility.

3.4.1. Results of preliminary analyses

To ascertain the quality of used methods, several preliminary analyses were done. A factor analysis revealed that Attention, Enjoyment, Lecturer and Content could be considered different subject-scales in the questionnaire. For both weblectures all subject-scales had medium to high reliabilities (COTAN, 2000). Cronbach's alpha's and Eigenvalues of the four subscales are displayed in Table 3.

T-tests for independent groups revealed no differences between the answers of every question after the 1st and 2nd weblecture and the four subject-scales (Attention, Enjoyment, Lecturer and Content) also revealed no significant differences. Correlation-analyses between the questions after the 1st and the 2nd weblecture were non-significant. The four subject-scales of the questionnaire after the 1st and the 2nd weblecture also did not correlate.

The t-tests for independent groups revealed no difference between the male and the female lecturers on Attention, Enjoyment, Lecturer, Content and relevance in both the 1st and the 2nd weblecture. For the 2nd, but not the 1st weblecture, participants reported significantly more interest in the subjects of female lecturers, than in those of male lecturers: $t(86) = 2.340$, $p = 0.022$, Cohen's $d = 0.560$. As interest is used as a covariate, separation of male and female lecturers is not deemed necessary in the final analyses.

Table 3
Cronbach's Alpha's and Eigenvalues for the four subject-scales in the study.

	Attention		Enjoyment[a]		Lecturer		Content	
	Alpha	Eigen	Alpha	Eigen	Alpha	Eigen	Alpha	Eigen
1st weblecture	0.861	2.94	0.832	1.37	0.904	7.65	0.791	4.31
2nd weblecture	0.919	3.11	0.935	1.52	0.941	7.06	0.763	4.17

[a] After removal of 1 question, which resulted in a scale of 3 questions.

The ANOVAs for differences between lecturers after the 1st 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 of the six lecturers. The ANOVAs for differences between lecturers after the 2nd weblecture revealed significant between-group differences on Attention, Lecturer and Content, also shown in Table 4. Post-hoc Tukey tests revealed that the difference in attention was reported between the same two lecturers as for the 1st weblecture. Seeing that the current study was set up to find a difference in Attention between view-modes, regardless of the lecturer, the significant difference on reported attention found between two lecturers suggest that final analyses should be made on two subsets. One subset without the lecturer for who significantly more attention was reported (Subset_less) and one subset without the lecturer for who significantly less attention was reported (Subset_more).

4. Results

Weblectures were shown in three visibility-modes; mode1 showed a large video of the lecturer and a small image of the slides, mode2 showed a small video of the lecturer and a large image of the slides, and mode3 showed only a large image of the slides (Fig. 1 & Appendix A). Participants watched two weblectures in two different visibility-modes and answered questions after the first and after the second lecture, among others about the appeal of the lecturer they just watched.

4.1. Hypothesis 1

The first hypothesis of this study proposes a positive relation between the visibility of a lecturer and reported attention for a weblecture. Using univariate analyses of covariance the difference between the visibility-modes were tested, with Enjoyment, Radio, Relevance, Lecturer, Content and Attention_Lecture-hall as significant covariates. For the first weblecture the ANOVA showed no significant effect of visibility-mode on reported attention to the lecture, $F(2,76) = 2.299$, $p = 0.107$. Adjusted means and standard errors for the visibility-modes on reported attention are displayed in Table 5. Because the adjusted means for the three visibility-modes were quite different, a simple contrast analysis was done. This revealed no significant difference between all three modes.

For the second weblecture, the ANOVA analysis showed a significant effect of visibility-mode on reported attention for the lecture, $F(2,75) = 3.320$, $p = 0.042$, $\eta_p^2 = .081$. Adjusted means and standard errors for the three visibility-modes on reported attention for the first and second weblecture are displayed in Table 5.

A contrast analysis revealed a significant difference between mode1 and mode2 (Contrast Estimate $= -0.472$, $p = 0.016$) and no significant difference between mode1 and mode3 or between mode2 and mode3. The significant difference between mode1 and mode2 consists of *more reported attention* in mode1 compared to mode2. As shown in Fig. 3, participants report significantly *more attention* when the image of the lecturer is large and the PowerPoint small, than when the image of the lecturer is small and the PowerPoint large.

4.1.1. Subsets for visibility effects on attention for the 2nd Weblecture

Because participants reported significant differences in attention between two of the lecturers during the second weblecture, two subsets were made to ascertain whether and how the effect of visibility on reported attention differs in these two groups. The subsets consisted of one group *without* the lecturer who elicited significantly more attention (Subset_less) and another group *without* the lecturer who elicited significantly less attention (Subset_more). For both subsets the same ANCOVA's were administered, with visibility as independent variable, reported attention for 2nd weblecture as outcome-variable and the significant covariates (Lecture visits, Enjoyment, Relevance, Radio, Lecturer, Content and Attention compared to a lecture-hall).

The ANCOVA for Subset_less revealed no significance difference between visibility-modes on reported attention for the second weblecture. For Subset_more the ANCOVA revealed results consistent with results for all six lecturers. There was a significant effect of visibility-mode on reported attention during the second weblecture $F(2,62) = 3.661$, $p = 0.031$, $\eta_p^2 = 0.106$, and a contrast analysis revealed a significant difference between mode1 and mode2 (Contrast Estimate $= -0.530$, $p = 0.012$),

Table 4
Significant results of ANOVAs for differences between lecturers.

	First Weblecture			Second Weblecture		
	F-statistic	*p-value*	η_p^2	*F*-statistic	*p-value*	η_p^2
Attention	3.675	0.046	0.130	2.973	0.023	0.150
Enjoyment	0.989	*ns*		1.603	ns	
Lecturer	1.779	*ns*		2.684	0.003	0.190
Content	0.883	*ns*		1.895	0.004	0.190
Interest	1.758	*ns*		1.903	*ns*	
Relevance	2.958*	0.024	0.170	1.400	*ns*	

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

Table 5
Adjusted means and standard errors for the three visibility-modes on attention for the 1st and 2nd weblecture.

	1st Weblecture			2nd Weblecture		
	Mode1	Mode2	Mode3	Mode1	Mode2	Mode3
Adj. Mean	−0.127	0.272	0.340	0.324	−0.148	−0.006
St. Error	0.160	0.169	0.176	0.128	0.140	0.126

Note. Mode1 = Lecturer large/PowerPoint small, Mode2 = Lecturer Small/PowerPoint Large, Mode3 = No Lecturer/PowerPoint Large.

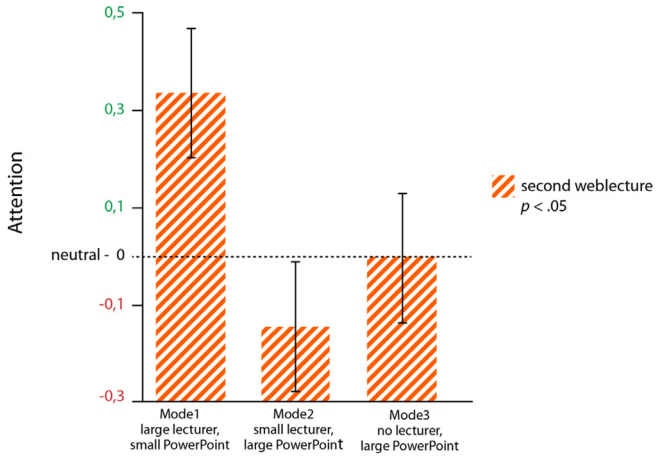

Fig. 3. Estimated marginal means for reported attention during the 2nd weblecture.

and no difference between mode1 and mode3 or between mode2 and mode3. Participants report *more attention* when the image of the lecturer is large and the image of the PowerPoint-slides is small, than when the image of the lecturer is small and the image of the PowerPoint-slides is large. Adjusted means and standard errors for the three visibility-modes on reported attention for Subset_more and Subset_less are displayed in Table 6.

4.2. Hypothesis 2

The second hypothesis in this study states that lecturer appeal will moderate the relation between visibility of the lecturer and reported attention to the weblecture. It is thought that the relation between visibility and reported attention will be stronger for lecturers who are judged as having a higher appeal than for lecturers with a lower appeal. An ANOVA performed to check for differences on reported attention between the watched lecturers revealed that reported attention differed significantly between two lecturers and two subsets could be made. This suggests lecturer appeal could function as a moderator for the relation between visibility and reported attention during weblectures. A moderator analysis revealed no interaction between visibility-mode and lecturer, $F(2,82) = 0.129$, $p = 0.880$. Therefore the judgment of the lecturer cannot be considered to moderate the relation between the visibility of the lecturer and the reported attention for the weblecture.

5. Discussion

This research study was initiated to explore whether the visibility of a lecturer in a weblecture is positively related to reported attention for that weblecture so to understand preference for lectures with video of the lecturer. Participants were shown two separate weblecture-clips. First, participants saw a clip of a weblecture in one of three visibility-modes, after which their opinion was asked about the amount of attention they had for the weblecture. This was considered an unbiased

Table 6
Adjusted means and standard errors for both subsets for the three visibility-modes on attention for the 2nd weblecture.

	Subset_less			Subset_more		
	Mode1	Mode2	Mode3	Mode1	Mode2	Mode3
Adj. Mean	0.137	−0.210	−0.144	0.479	−0.051	0.109
St. Error	0.158	0.178	0.159	0.135	0.152	0.142

Note. Mode1 = Lecturer large/PowerPoint small, Mode2 = Lecturer Small/PowerPoint Large, Mode3 = No Lecturer/PowerPoint Large.

judgment of the visibility-mode of the weblecture. Second, participants saw another clip of another weblecture in another visibility-mode, which they were asked to compare to the first weblecture. This was seen as a comparison of visibility-modes.

The results for the relation between visibility of the lecturer and reported attention seem to contradict each other. Where participants report effects of visibility on attention during the second weblecture, which confirms the hypothesis that visibility positively relates to attention, no significant effects of visibility on reported attention during the first weblecture were found. Participants do not report more attention after watching the first weblecture with a large video of a lecturer compared to watching a weblecture without a visible lecturer. On average, participants actually report less attention when watching a weblecture with a large video of a lecturer, than during a weblecture watched with either a small video of the lecturer or no video of the lecturer. This result contradicts our hypothesis for the relation between visibility and reported attention.

Earlier research did find a positive relation between ways of presenting a weblecture and attention for that lecture (Baggett, 1984; Day et al., 2006). And, as we described in the introduction, several theories indicate that visibility of a lecturer is important for attention (Bruce, 1996; Kendon, 1990; Kleinke, 1986; Wickens, 2002). An explanation for the difference of the effect of visibility on reported attention between weblectures might lie in the attention span of the participants. During the first weblecture the study has not yet claimed much from the participants' attentional resources. During this weblecture participants might use a strategy to gather as much information as possible from the weblecture. Reading the slides, easier when bigger, gives extra information on top of what the lecturer is telling. To see a large image of the lecturer does not necessarily improve their information gathering. This might explain why participants report more attention when they can make use of both, a large image of the PowerPoint-slides and audio only or a large image of the PowerPoint-slides and a small video of the lecturer. During the second weblecture the participants have already spent approximately 15 min on the study and by this time their concentration might be reduced. At this time seeing a large video of the lecturer might make it easier to keep their attention on the lecture, for the reasons why we hypothesized a positive relation between visibility of the lecturer and attention: lecturers' face calls for their attention and being able to see the face makes it easier to understand the lecture. Seeing and reading text on the large image of the slides may claim too much of their (reduced) attentional resources at this time. This suggests that for all weblectures that last more than 15 min, visibility of the lecturer is more important for attention. For weblectures shorter than 15 min paying attention seems to be easier when the image of the slides is large and easy to read.

Our second hypothesis was moderation of lecturer-appeal of the relation between visibility and reported attention. Different lecturers have diverse styles of presenting a lecture and do not appeal to their audience in the same way. Even though this study did find differences in reported attention between the lecturers, the moderator analyses did not reveal significant moderation of the relation between visibility and reported attention. This result suggests that even though lecturers differ in appeal, the effect of their visibility on the reported attention of the participants did not vary. Possibly these six lecturers were still too similar in their lecturing-styles to elicit the proposed differences between visibility on reported attention. A study making use of lecturers who differ more from one another is necessary to test this explanation.

Our results, with the use of six different lecturers in three different conditions, contribute to the current literature because we can generalize to more than one lecturer. The six lecturers differed and we took care that the contents of the weblectures differed, while the difficulty of their content remained similar. Therefore the results of this study can be generalized to lecturers in other universities as long as they teach introductory classes.

This study has included nine covariates, such as radio listening and interest in the subject, that were expected to influence attention, based on literature about attention-aspects (Proctor & Van Zandt, 2008). By keeping these aspects constant while analysing the relation between visibility and reported attention, it was assured that the difference in reported attention could only be caused by the difference in visibility-modes.

While other studies about the relation between visibility and attention were set in a laboratory, we were using an integrated web-application thanks to which participants could participate in our research at home or another location at any time during the day or night. This could neutralize possible influences of participating in a study, for example the wish to be a good study subject, and made the study setting more realistic because it was comparable to the normal setting in which students watch weblectures. Therefore results may be generalized to weblecture-viewing by students in general.

5.1. Limitations

One of the limitations of this study is that videos of lower quality were used. Currently it is possible to make high quality video-materials available online, but high quality leads to very large files that take long to download. In making video-materials available online a trade-off is needed between speed and quality. In this study we have chosen therefore for videos of lower quality than technically possible. While the quality of video materials was good enough to be used on screens of commonly used computer and other devices, the lower quality of videos might have influenced the results. This study was carried out in the natural setting students watch weblectures, at home and at their convenience. However, this meant that participants could not be monitored or helped while participating. Finally, a limitation of this study may be the length of the weblecture-clips. While the usual lecture takes one hour, the clips used in this study were 7.5 min long. This was done to keep the total time for finishing the study under 30 min, for the ease of the participants as well as the reliability of attentional aspects. It can be difficult to compare opinions about a short weblecture to opinions about a full-length (web)lecture, therefore results of this study might not be similar to reported attention in full-length (web)lectures. Nevertheless, our result

indicating that the longer the lecture, the greater the effect of visibility on reported attention seems to be relevant for full-length (web)lectures.

5.2. Practical implications

Our study has shown that students report more attention after watching a large video of a lecturer and a small image of slides when listening to a lecture for more than 15 min. For weblectures shorter than 15 min students report more attention when the image of the PowerPoint-slides is large and easy to read. This helps educational institutions to determine their choice of ways to present weblectures. The video of the lecturer was shown to be more important for attention than the content of the story or the interest students had in the subject. This result implicates that visibility of a lecturer in a weblecture eases the cognitive process of focusing conscious attention, which is a first step in the learning process (Mayer, 1992; 1996). The results of visibility on reported attention were valid for different lecturers and the absence of a moderation-effect show that visibility of a lecturer relates to attention regardless of the lecturer. In addition, differences between students were not found to have an effect on the relation between visibility and reported attention. Therefore, educational institutes do not need to personalise their weblectures based on those differences in background, nor vary their presentation mode with different lecturers. However, because of the differences found between the first and the second lecture, the best strategy for educational institutions will probably be to make it possible for students to watch a weblecture with an option to choose between more than one visibility-mode, and to switch freely between these modes during the weblecture.

6. Conclusion

In this study we found a positive effect of visibility of a lecturer on reported attention, at least when participants had been watching a weblecture for more than 15 min, which probably contributes to students' reported preference for lectures with video of the lecturer. After a short time of watching a weblecture, no differences on reported attention were found between the different visibility-modes. An explanation, to be studied in further research, is that a reduced attention span will lead to different strategies to remain attentive during the weblecture where visibility of the lecturer contributes to these strategies. At present, educational institutes should offer their students a choice on their preferred way of watching a weblecture: with or without a visible lecturer, at which size, and with large or small images of the slides.

Acknowledgements

The authors would like to thank the department of IT services at the Utrecht University for their work in creating available web space on the uu.nl-domain, and dr. Serge O. Dumoulin and dr. Stella F. Donker of the department of Applied Cognitive Psychology of Utrecht University, for grading the first draft of this paper which was submitted as a student thesis. The authors owe a special thanks to miss Micky E. Faas of the Leiden Institute of Advanced Computer Science, for writing and implementing the web-application for administering the weblecture-clips and questionnaire.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.compedu.2015.11.011.

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