Does instructor's image size in video lectures affect learning outcomes?

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Abstract

One of the most commonly used forms of video lectures is a combination of an instructor's image and accompanying lecture slides as a picture-in-picture. As the image size of the instructor varies significantly across video lectures, and so do the learning outcomes associated with this technology, the influence of the instructor's image size should be evaluated. This study tested the effect of image size of the instructor on learners' experience of social presence, cognitive load, learning performance and satisfaction. In the study, 87 Chinese undergraduates were randomly assigned to view a video lecture with a small image of the instructor, with a medium image size of the instructor or with a large image of the instructor. The results of analyses of variances and analysis of covariance suggested that learners perceived the same level of social presence and cognitive load across video lectures with different image sizes of the instructor; learners who watched the video lecture with the small image of the instructor learned better than those who watched the video lectures with the medium and the large images of the instructors. Furthermore, learners who watched the video lecture with the small image and medium image of the instructor experienced more learning satisfaction. The findings highlight the importance of image size of the instructor in video lecture learning.

Introduction

Video lectures are powerful learning tools, as they can present knowledge through vivid visual and audio forms at the same time. They have increasingly been applied in both online and blended learning teaching methods (Giannakos, 2013). One of the most commonly used forms is a combination of an instructor's image and accompanying lecture slides as a picture-in-picture in video lectures (Yang, Tao, & Luo 2015). The image size of the instructor varies significantly between video lectures. The image size of an instructor means the space taken by an instructor's image in a video lecture (Yang et al., 2015).

Some multimedia learning theories focus on the role of the instructor's image in video lectures, such as the social presence theory, social agency theory and cognitive theory of multimedia learning. The social presence theory and social agency theory emphasize the importance of nonverbal and relational cues in online learning (e.g. an instructor's image). According to those theories, presenting the instructor's image has the potential to improve learning outcomes (Mayer, 2014; Lowenthal, 2009). The rationale for this assumption is that the instructor's image, gestures, eye contact and facial expressions improve learners' sense of being in and belonging in a course, that is, social presence; and social presence activates learners' social response, such as working harder to select, organize and integrate learning

content (Mayer, 2014; Lowenthal, 2009). However, the cognitive theory of multimedia learning suggests that the instructor's image could also distract and overload learners (Harp & Mayer, 1998). From this point of view, the instructor's image is not essential learning content and is extraneous material. Processing it might exceed the learner's cognitive capacity and offset the social advantages of the instructor's image. The cognitive theory of multimedia learning would recommend that if using the instructor's image in video lectures, the benefit from it should justify drawing on additional cognitive resources (Mayer & Fiorella, 2014; Sweller, 1994). In summary, the aforementioned theories indicated that the instructor's image in video lectures learning should influence learners' social presence and cognitive load, but they did not refer specifically to the image size of the instructor.

Furthermore, although they have not taken into account instructor image size, a number of studies have tested the importance of the presence of an instructor's image in video lectures (Ilioudi, Giannakos, & Chorianopoulos, 2013; Pi & Hong, 2016; Pi, Hong, & Yang, 2016). They suggest that presenting the instructor's image enhances learners' positive learning experience in video lectures. For example, some recent studies found that most learners preferred video lectures with the instructor's image, and they reported more engagement (Kizilcec, Bailenson, & Gomez, 2015; Lyons, Reysen, & Pierce, 2012). However, the results of previous studies on the effect of the instructor on learning performance are inconclusive (Homer, Plass, & Blake, 2008; Pi & Hong, 2016). Some studies found that presenting the instructor's image as a picture-in-picture in the lower right corner did not improve under-graduate students' learning performance when the topic of the video lectures was organization and management (Kizilcec et al., 2015; Kizilcec, Papadopoulos, & Sritanyaratana, 2014); whereas other studies revealed that presenting the instructor's image as a picture-in-picture in the lower right corner facilitated learning performance when the topic of video lectures was educational technology (Hong, Pi, & Yang, 2016). Although the instructor's image presented as a picture-in-picture in the lower right corner in these studies, the image size might be variable. Unfortunately, most previous studies provided little information about the image size of the instructor. The inconsistent results thus might be due to variation in the image size of the instructor in video lectures.

Why is image size of the instructor a crucial problem in video lectures? Image size of the instructor may influence learners' visual attention and cognitive load, and thereby influence their learning performance. Some previous studies investigated the effect of screen size on learners' attention when technology was used to display either text or text and pictorial annotation (Reeves, Lang, Kim, & Tatar, 1999; Kim & Kim, 2012; Maniar, Bennett, Hand, & Allan, 2008). For example, Reeves et al. (1999) compared university students' attention when viewing pictures with three different size screens (large, 56 in.; medium, 13 in.; small, 2 in.). In their study, attention was measured by heart rate deceleration. It found that the large screen produced greater heart rate deceleration than the medium and small screens. The study suggested that large screen sizes required more attention to process and higher cognitive load.

The image of the instructor is presented in many of today's video lectures. Because the instructor's image may distract the learner, it is very important that researchers understand the effects of image size of the instructor on learners' cognitive load and learning performance. To our knowledge, no previous study compared different image sizes of the instructor in video lectures. This study extends the existing literature on the multimedia learning theories by examining learners' sense of social presence, cognitive load, learning performance and satisfaction in response to three video lectures with different image sizes of the instructor. In the study, learners were randomly assigned to view one of the video lectures. They completed scales on social presence, cognitive load, learning performance and satisfaction.

According to the studies on the effect of screen size on learners' attention, we assumed that learners require fewer attentional resources to process a small image of an instructor in video lectures than a large image. As long as the gestures, eye contact and facial expressions in the small image of an instructor could be viewed clearly, the small image should reduce the redundant cognitive load while preserving the social and nonverbal benefits of the instructor. Therefore, we postulated the following:

(1) Learners will perceive the same level of social presence in video lectures with different image sizes of the instructor.
(2) Learners will report a lower level of cognitive load in video lectures with a small image of the instructor than with a large image of the instructor.

(3) Learners will obtain more knowledge from video lectures with a small image of the instructor than with a large image of the instructor.

(4) Learners will experience more satisfaction to video lectures with a small image of the instructor than with a large image of the instructor.

Method

Participants and design

The participants were 87 undergraduate students (35 male and 52 female) recruited from a Chinese university via advertisements. They were aged 18 to 25 ($M = 21.36$, $SD = 1.28$). They had all taken courses using online video lectures at their university for over 1 year. They were studying a broad variety of disciplines (e.g. chemistry, bio-science, geography, physical education, history, mathematics and economics), and none of them was majoring in educational technology. Prior to the study, none of the participants was familiar with the topic presented in the video lectures. For their participation, they received a small present. They all signed a written informed consent. The study protocol was approved by the Academic Committee of the School of Psychology at Central China Normal University.

Materials

According to the study of Yang et al. (2015), the image size of the instructor ranged from 1% to 60% as picture-in-picture in massive open online lectures (e.g. Coursera, Udacity, edX), and it was most commonly between 21% to 40%. In reference to the information of Yang et al. on modal screen size, we created three sizes: small, medium and large. 'Small' was defined as mid-way between the minimal value and the modal values; 'medium' was defined as the lower edge of the modal values; and 'large' was defined as the upper edge of the modal values. In the video lecture with a small image of the instructor, the instructor's image took 8.4% of the space of the video lecture (small image video lecture). Informal interviews before the study were used to ensure that the facial expression and gestures of the small image could be viewed clearly. In the video lecture with a medium image of the instructor, the instructor's image took 26.1% of the space of the video lecture (medium image video lecture). In the video lecture with a large image of the instructor, the instructor's image took 41.8% of the space of the video lecture (large image video lecture). The accompanying lecture slides took the same space in the three video lectures (Figure 1). Each video lecture lasted approximately 7 min and introduced the topic of adjustment of curve in Photoshop.

Measures

Demographic scale
Participants were asked to report their gender, age, grade and major. They also reported how many years they had been taking courses with online video lectures (less than 1 year, 1–3 years or more than 3 years).

Prior knowledge test
Eight multiple-choice items were used to test participants' prior knowledge of Photoshop. The test was developed by the instructor who presented the video lecture. No items were about the specific learning topic, in order to avoid any effects of expectation on learning performance. Every item had four choices, and only one choice was correct. For example, one of the items was 'What are the main usages of Photoshop?' Test scores were computed by assigning 1 point for each correct answer. There were no significant differences between the small image video lecture group, the
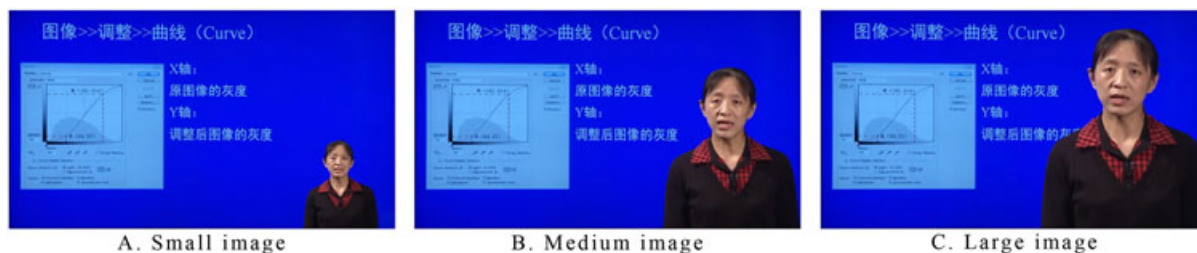

Figure 1 Example of Video Lectures with Different Image Sizes of the Instructor. [Colour figure can be viewed at wileyonlinelibrary.com]

medium image video lecture group and the large image video lecture group in terms of prior knowledge (F (2, 84) = 1.56, $p > .05$, $\eta^2 = .04$).

Social presence scale

Social presence was measured by a 7-point Likert scale, from *strongly disagree* to *strongly agree* (1 = strongly disagree to 7 = strongly agree). It was adapted from a self-report scale used by Kim and Biocca (1997). They measured the social presence from two dimensions: departure and arrival at a mediated place or space. The scale consisted of eight statements about the participants' perception of social presence (e.g. 'When the video lecture ended, I felt like I came back to the "real world" after a journey.').

Cognitive load scale

The cognitive load questionnaire was based on cognitive load subjective ratings developed by Paas and van Merriënboer (1993). The questionnaire consisted of two 9-point Likert scale questions, which assessed the degree of task difficulty and the mental effort involved in learning ('How difficult do you find learning from the video lecture?' and 'how much mental effort do you make learning from the video lecture?'). This scale is widely used in research, and it can be considered to reflect the actual cognitive load (Brünken Plass, & Leutner 2004; Paas, Tuovinen, Tabbers, & Van Gerven, 2003).

Learning test

To measure the acquisition of knowledge presented in the video lectures, a learning test was conducted. It was developed by the instructor who presented the video lecture. All items were derived from the learning content presented in the video lectures. The test consisted of ten multiple-choice items and two open-ended items. Every multiple-choice item had four choices, and only one choice was correct. For example, one of the multiple-choice items was 'Before adjustment of picture, what is the curve like in Photoshop?' For multiple-choice items, 1 point was given for each correct answer. The open-ended items were as follows: 'According to the adjustment of curve in the following Photoshop interfaces, what are the results of the adjusted picture and please explain the reasons?' and 'Look at the following two pictures. How would you adjust the first picture into the second picture?' For open-ended items, raters scored

the answer to the first item on two dimensions: consequences after adjustment (1 point) and reasons (4 points). The raters scored the answer to the second item on three dimensions: adjusting the degree of light (1 point), adjusting colour channels (3 points) and adjusting a certain area in the picture (1 point). The total possible score for each item was 5 points. Two independent raters who were blind to the study goal showed high inter-rater agreement on each of the two open-ended items (respectively, $r = 0.90$, $p < 0.01$; $r = 0.83$, $p < 0.01$). Thus, the average of the two ratings' was used as the final score on each item. The total score for the learning test was the sum of the average of scores from the multiple-choice items and the open-ended items.

Learning satisfaction scale

One item ('Overall, how satisfied were you with learning with the video lecture') was adapted from previous research to assess participants' learning satisfaction (González-Gómez, Guardiola, & Martín, 2012; Ho & Dzeng, 2010). The item was measured using a 5-point Likert scale from *extremely disappointed* to *extremely satisfied* (1 = extremely disappointed to 5 = extremely satisfied).

Procedure

The study was carried out in three computer laboratories and took approximately 30 min. Before starting the study, participants were assigned to one of three groups according to their order of arriving at laboratories, each group including 29 participants. The three groups were escorted into different computer laboratories. All participants filled out the demographic scale and the prior knowledge test. The first group viewed the small image video lecture, the second viewed the medium image video lecture and the third viewed the large image video lecture. Immediately after viewing the video lectures, the participants filled out the social presence scale, cognitive load scale, learning test and learning satisfaction scale.

Results

Descriptive statistics and intercorrelations for all variables are shown in Tables 1, 2 and 3. The following statistical tests and effect sizes for social presence, cognitive load and learning satisfaction were derived

from analyses of variance (ANOVA). Statistical test and effect size for learning performance was derived from analysis of covariance (Table 4).

Table 1. Descriptive Statistics and Bivariate Correlations for Each Outcome Measure in Video Lectures with Small Image of the Instructor

Measure	M	SD	1	2	3
1. Social presence	4.24	0.65	—		
2. Cognitive load	6.09	0.85	0.27	—	
3. Learning performance	2.01	0.86	0.01	0.30	—
4. Learning satisfaction	4.07	0.75	0.29	0.22	0.03

Note. Data were based on 29 participants.

Table 2. Descriptive Statistics and Bivariate Correlations for Each Outcome Measure in Video Lectures with Medium Image of the Instructor

Measure	M	SD	1	2	3
1. Social presence	4.06	0.82	—		
2. Cognitive load	5.81	1.18	0.21	—	
3. Learning performance	1.08	0.79	0.02	−.12	—
4. Learning satisfaction	3.86	0.79	0.14	0.53**	0.09

Note. Data were based on 29 participants.
**$p < 0.01$.

Table 3. Descriptive Statistics and Bivariate Correlations for Each Outcome Measure in Video Lectures with Large Image of the Instructor

Measure	M	SD	1	2	3
1. Social presence	3.81	0.66	—		
2. Cognitive load	6.18	1.00	0.10	—	
3. Learning performance	1.13	0.84	−0.01	0.31	—
4. Learning satisfaction	3.17	0.89	0.33	0.15	0.01

Note. Data were based on 29 participants.

Table 4. Analysis of Covariance for Learning Performance

Source of variation	Type III sum of squares	df	F
Experimental condition	17.841	3	8.883***
Prior knowledge	0.379	1	0.566
Experiment condition * prior knowledge	3.373	2	2.519

***$p < 0.001$.

Social presence

The first hypothesis was that learners would experience the same level of social presence in the video lectures with different image sizes of the instructor. The results of ANOVA found that there was no significant difference between experimental conditions, which supported our first hypothesis (F (2, 84) = 2.77, $p > 0.05$, $\eta^2 = 0.06$, power = 0.131). The results suggested that although the instructor's image was small, it might provide social cues such as eye contact and facial expression as clearly as a large image of the instructor. The small image of the instructor might also be enough to activate learners' social response.

Cognitive load

The second hypothesis was that learners would experience less cognitive load in the small image video lecture than in the large image video lecture. The results of ANOVA showed no significant difference across experimental conditions (F (2, 84) = 1.13, $p > 0.05$, $\eta^2 = 0.03$). The results were in contrast to our second hypothesis. The data suggested that participants experienced the same level of cognitive load regardless of the image size of the instructor in video lectures.

Learning performance

We addressed the third hypothesis that learners would acquire more knowledge from the small image video lecture than the large image video lecture. Analysis of covariance was conducted with the scores of the prior knowledge test as the covariate, the experimental condition as the independent variable and the learning test score as the dependent variable. This statistical method controls for the effect of prior knowledge on learning performance. It was found that there was not an interaction between prior knowledge and the experimental condition (Table 4). It meant that prior knowledge did

not have an effect on learning performance. Furthermore, it was found that there was a significant difference between the groups ($F (3, 81) = 8.88$, $p < .0001$, $\eta^2 = 0.22$; Table 4). The results of a *post hoc* test (Bonferroni) showed that learners performed better in the small image video lecture than the medium image video lecture and the large image video lecture (respectively, $MD = 0.97$, $SE = 0.22$, $p < 0.001$; $MD = 0.88$, $SE = 0.22$, $p < 0.001$). Learners performed the same in the medium image video lecture and the large image video lecture ($MD = -0.09$, $SE = 0.22$, $p > 0.05$). The results for learning performance were consistent with the third hypothesis.

Learning satisfaction

We addressed the fourth hypothesis that learners would perceive more satisfaction in the video lecture with the small image than with the large image. The ANOVA analysis found that there was a significant difference in learning satisfaction between experimental conditions ($F (2, 84) = 9.68$, $p < 0.001$, $\eta^2 = 0.19$). The results of a *post hoc* test (Bonferroni) showed that learners experienced lower learning satisfaction in the large image video lecture than in the small image video lecture and the medium image video lecture (respectively, $MD = -0.69$, $SE = 0.21$, $p < 0.001$; $MD = -0.48$, $SE = 0.21$, $p < 0.01$). Learners experienced the same level of learning satisfaction in the small image video lecture and the medium image video lecture ($MD = 0.21$, $SE = 0.21$, $p > 0.05$).

Overall, the results for learning satisfaction supported our fourth hypothesis. With the increase in the instructor's image, learners experienced less satisfaction in the video lectures.

Discussion

This study investigated the effect of image size of the instructor on learning outcomes of video lectures. Results confirmed the beneficial effect of the small image of the instructor in video lectures by showing that learners performed better in the learning test when watching the video lecture with the small image of the instructor compared with the video lecture with the medium image and large image. Furthermore, the results suggested that learners who watched the video lecture with a small image experienced a higher level of learning satisfaction and perceived the same level of social presence as those who watched the video lecture with a large image. Overall, the results of this study suggested that the video lectures with a small image facilitated learning outcomes. This study makes unique contributions that can be interpreted in light of the social presence theory, social agency theory and the cognitive theory of multimedia learning, and the findings have applied value for technology-based pedagogical design principles. In the remaining part of this discussion, we discuss the reasons for differences between our findings and previous work, and the limitations in the study.

The results related to social presence supported our first hypothesis. That is, learners who watched the video lecture with the small image of the instructor experienced the same level of social presence as those who watched the video lecture with the large image of the instructor. Based on our informal interview before the study, although the instructor's image was small, it could clearly convey gestures, eye contact and facial expressions. Therefore, the small image of the instructor was assumed to activate learners' social response to the same degree as the large image of the instructor.

However, the results related to cognitive load found that there was no difference between the small image video lecture, the medium image video lecture and the large image video lecture; the results were inconsistent with our second hypothesis and the cognitive theory of multimedia learning predicting that the large image video lecture might produce higher cognitive load (Mayer & Fiorella, 2014; Sweller, 1994). This inconsistency may be a result of self-report bias or the degree of difficulty of the learning materials. Cognitive load was measured by learners' self-report of the degree of difficulty and the effort involved in their experience with the video lecture learning. Because of the social desirability bias effect, learners may tend to report that they worked hard even when they had not (Zheng et al., 2012). And in fact, all learners gained high scores on the cognitive load scale. What is more, for learners, the degree of difficulty was relatively constant across the three conditions as the learning content was the same. Thus, the effect of the instructor's image size on cognitive load might not show on the scores of the cognitive load scale. Future research should use more sensitive tools to measure cognitive load, such as heart rate, pupillary dilation and task-evoked brain potentials (Paas et al., 2003).

The key insight gained from this study is that learners gained more knowledge from the video lecture with the small image of the instructor, and they experienced more satisfaction with it. The results were consistent with our third and fourth hypotheses. The cognitive theory of multimedia learning suggested that the video lectures with the small image of the instructor included fewer distracting cues. Furthermore, the small image of the instructor could clearly present the instructor's image, gestures, eye contact and facial expressions, and therefore according to the social presence theory and social agency theory, the small image could preserve the social and nonverbal benefits of the instructor (Reeves et al., 1999; Kim & Kim, 2012; Maniar et al., 2008). The small image was assumed to require fewer attentional resources to process and meanwhile maintain learners' relatively higher social presence (Reeves et al., 1999). Although there was no difference in cognitive load between the groups, the large image of the instructor was so salient that it might easily distract learners and increase extraneous cognitive processing, and thereby hinder knowledge acquisition (Sweller, 1994). No differences were observed on learning performance for video lectures with the medium and the large image of the instructor. This suggests that increases in image size may exhibit a floor effect for learning performance. It appeared that when image size increased to a certain level, the learners were less susceptible to the increase.

There were some limitations in the study. Firstly, although we collected participants' learning experience with video lectures, we did not control for it. This kind of experience might be important for learners to learn effectively in video lectures. Secondly, the prior knowledge test included eight multiple-choice items, and the learning test included ten multiple-choice items. In such tests, when the participants were not sure of the answers, they might be correct simply by guessing. This answer strategy might influence our results to some certainty. Lastly, there were some limitations about the hypothesis of social presence. We hypothesized that learners perceived the same level of social presence in the small image video lecture as in the large image video lecture. Therefore, there was about a 95% chance of finding null results, but only a 5% chance of finding a difference between groups.

The results of the study are especially important because of their contribution to the literature on video lectures. To our knowledge, there is no previous work that has investigated the effect of image size of the instructor in video lectures. This topic is of importance both for theories of learning in technology-rich environments (social presence theory, social agency theory and cognitive theory of multimedia learning) and for the design of video lectures. In conclusion, these findings indicated educators should insert small instructor's image taking approximately 8.4% of the space of the video lecture in order to gain best learning outcomes.

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