Student Perceptions of Differences in Visual Communication Mode for an Online Course in Engineering

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***Abstract*—Online courses have the promise of extending the horizons of today's academic landscape with their cost-effective and convenient model compared to traditional learning environments. Despite the promising nature of the learning model, there continue to be several challenges that hinder learning, one of which is lack of instructor presence. This study aims at understanding the effect of instructor presence on student satisfaction in an online setting of a course in engineering.**

We conducted a student-centered pilot experiment to assess engineering students' perceptions of two modes of online mini-lectures: the first, a presentation with the instructor appearing in window, created using an off-the-shelf screen-capture software; the second, a presentation with the instructor overlaid in the slides created using recent visual communication technology that overlays the video of the instructor without any background images or outline boxes. The instructor was the same in both the presentations. Our focus here is on the following factors: 1. Comparing overall student satisfaction after watching the two modes; 2. Comparing the perceived non-verbal immediacy factors of the instructor; and, 3. Comparing the preference of video mode for future online courses.

Preliminary results suggest a preference of the video mode with the instructor overlaid over that with the instructor in a box. The effect sizes of the differences in overall satisfaction between the experimental groups and their perceived levels of non-verbal immediacy factors when viewing the online lecture in the two modes are encouraging enough to pursue more longitudinal studies with the set-up.

I. Introduction

The advent of online learning has extended the horizons of today's academic landscape. The new model is being promoted as being more cost-effective and convenient than traditional learning environments while providing educational opportunities for larger communities of learners regardless of geographic location and independent of time. Despite the promising nature of the learning model, there continue to be several challenges that hinder learning in such environments.

One of the oft-cited disadvantages of the new learning model is its being not as effective as traditional classroom learning owing to the lack of face to face interactions. Several case studies [1], [2] have cited instances where students felt disconnected from others in this type of learning environment, citing lack of facial expressions and other features common to a traditional classroom environment. Unfortunately, until recently there have been very few ways for an instructor to create this sense of instructor presence in the online learning environment aside from a handful of interactions in online discussion environments and in the pre-recorded video lectures. In this study, we explore how different visual modes that incorporate instructor presence in an online lecture are perceived differently by students.

II. Background

Research in psychology, communication and online learning reveal that learners need to have a sense of relatedness to their instructors and that this sense of relatedness is often communicated through information that is superfluous to the learning objectives [3]. A recurring finding of empirical studies on motivational agents in the context of embodied interfaces is that these agents make the user experience more engaging (a phenomenon termed persona effect) - users find that the visual and auditory presence of a virtual person renders these interactions more human-like and more social (e.g. [4], [5]). Moreover, research suggests that pedagogical agents have a supportive role when learners are working with complex tasks [6] and that in multimedia learning environments they increased both learners' retention and transfer scores [7].

Research in nonverbal communication has identified a number of nonverbal cues (nonverbal immediacy), that include bodily behaviors such as proximity, gaze, gestures, posture, facial expressions, and touching as well as vocal behaviors such as vocal tone and expressions, as critical components of human to human communication [8], [9]. That nonverbal immediacy behaviors positively affect student motivation, participation and attendance, affective and cognitive learning in classroom scenarios has been well studied [10], [11]. It has also been found that these positive effects prevail in large classes [12], and under high workload demands [13]. However, only recently is the use of non-verbal modalities being harnessed in virtual communication scenarios (e.g, access to the course instructor teaching in a window at the corner of the presentation screen in a video lecture). It is likely, though, that increased amounts of non-verbal communication in a video lecture can improve an instructor's sense of presence in an *online-only* learning environment and thus improve students' learning and

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their desire to stay engaged in their learning. Unfortunately, research is still inconclusive regarding which elements of a pedagogical agent's non-verbal communication is critical to learning. Moreover, studies on the effects of instructor non-verbal behavior on student satisfaction and performance in online learning scenarios are only in their incipient stages creating an immediate need to address this heretofore unexplored aspect of online learning.

III. Objectives of the Study

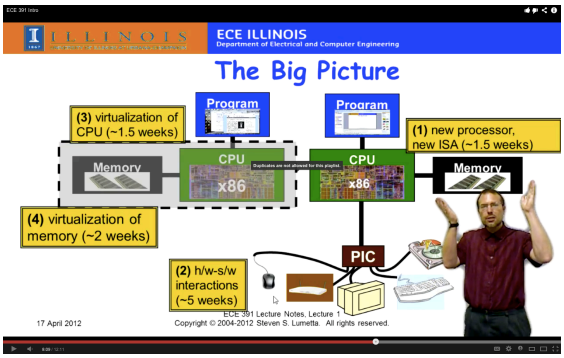
This study aims at understanding the effects of instructor presence on student satisfaction and choice of preferred visual mode in an online course setting. A fundamental question that arises towards this end is - how can we make the essential modalities of human communication accessible to students in an online setting?

A number of previous research studies suggested that an interactive teaching style and high levels of learner-to-instructor interaction are strongly associated with high levels of user satisfaction and learning outcomes [14], [15]. Until very recently, most instructor to student communication in online courses was textual. However, with the recent use of streaming media, online course materials now make instructor voice and video accessible to students, making instructor non-verbal immediacy behaviors more accessible to learners.

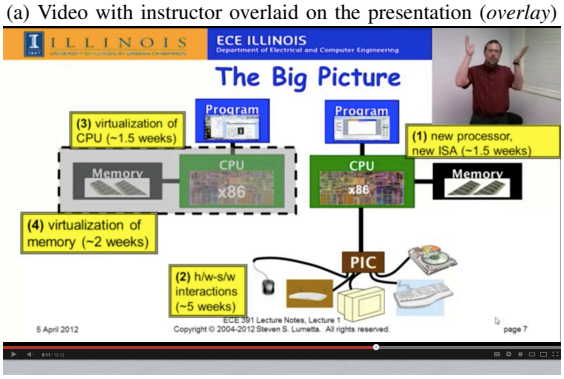
Recent advances in video capture technology allow the creation of video lectures that increase instructor's presence in the online classroom. While previous technologies such as Camtasia can embed a video of an instructor inside a recording of a video lecture, the instructor appears inside a small window that includes extraneous background information from the room that the instructor was in. New screen capture tools from Personify[1], are able to capture only the instructor sans background and overlay video of the instructor into a presentation such as PowerPoint Slides. Thus, a human avatar can be overlaid into any video lecture with a minimal level of effort and without adding the extraneous information present in older technologies such as Camtasia. We thus have two modes of visual communication that make instructor non-verbal behaviors available to the students and the question then, is whether one mode is better than the other for online learning.

As a first step towards answering the research question, we conducted a student-centered pilot study to assess engineering students' perceptions of an online mini-lecture created in the two modes (mentioned above) with increased presence of the instructor. The two modes differ fundamentally in how they make instructor non-verbal immediacy factors accessible to the students 1. One mode (termed henceforth *window*) is a presentation with the instructor appearing in a window of the screen, created using an off-the-shelf screen-capture software Camtasia; the second, a presentation with the instructor overlaid in the slides created using Microsoft's Kinect camera and Personify Live technology that overlays the video of the instructor without any background images or outline boxes (henceforth termed *overlay*). The same instructor appeared in

[1]Personify Inc., a start-up spun off from the University of Illinois is the maker of Personify Live, a tool that uses state-of-the-art machine vision techniques to include an embedded video of the presenter alongside the central material being presented



(a) Video with instructor overlaid on the presentation (*overlay*)



(b) Video with instructor appearing as picture in picture (*window*)

Fig. 1: Screenshots of the two video modes, *overlay* and *window*. The instructor without any distracting background is embedded in the *overlay* mode and dynamically points to material on the slides; the *window* mode has the instructor relegated to a corner in the screen.

both the modes and the recording was done simultaneously. In particular, our focus in this study is to answer the following questions: a) How do the two video modes affect overall student satisfaction? b) Is a video mode better at making non-verbal immediacy factors, such as that of instructor's gestures and eye gaze, available to the student? c) Among the two video modes, do students have a preference for future online courses?

IV. Methods and Data Source

Our experiment involves 60 students from the department of electrical and computer engineering at the University of Illinois, Urbana-Champaign. In the study, the students watched an introductory online lecture summarizing the course objectives and tasks of an optional course (Computer Systems Engineering). The course would be offered by an instructor who was rated high for teaching quality and had not taught the students before. Students were randomly assigned to two groups (A and B) to watch a video mode online and then asked to answer a questionnaire. The questionnaire solicited participants' demographic information and asked them to rate their level of satisfaction and perceptions of non-verbal immediacy behaviors of the instructor. Overall satisfaction was sought on a scale of 1-5 (1=Poor, 5=Excellent). The ratings of the non-verbal immediacy behavior of the instructor were obtained via questions based on the non-verbal immediacy behavior (NIB) scale originally constructed in [16] adapted to an online learning scenario. In the end, the subjects were

asked to watch the video in the other mode and indicate their preferred mode for an online course upon having watched the two visual modes. The variables obtained from this section of the survey are students' overall satisfaction score and students' perceived level of non-verbal immediacy behaviors of the instructor (derived from students' response to the NIB scale).

There were 28 students in Group A (that watched *window* followed by *overlay*) and 32 in Group B that watched the videos in reverse order from that of Group A. The majority of participants in both the groups were sophomores (A: 36%, B: 53%) but there were freshmen, juniors and seniors as well. 82% of Group A and 91% of Group B were male. A majority of the participants (A: 61%, B: 56%) reported that they had no prior online course experience.

V. Results

	Group A ($n = 28$)		Group B ($n = 32$)		
Factor	Mean	SD	Mean	SD	Cohen's d
Satisfaction	3.67	0.98	4.03	0.74	0.40
NIB	19.46	3.45	21.34	4.30	0.49

TABLE I: Descriptive statistics of the two groups with Cohen's effect sizes for mean ratings of satisfaction and perceived non-verbal immediacy.

Our analysis seeks whether overall student satisfaction, perceived level of instructor non-verbal immediacy, and preferred mode for an online course differed between the two groups. The results are summarized in Table I. Two-sample t-tests for difference between mean satisfaction scores, ratings of the instructor's nonverbal immediacy between the two groups, suggest that based on this sample of subjects there is no difference between the means between of the two groups at the 0.05 level (p-values 0.13 and 0.06 respectively). However, given that measures of statistical significance are critically dependent of sample sizes, we consider Cohen's effect sizes of the mean scores to see whether the differences are meaningful. We find medium effect sizes in the differences in mean scores between the two groups (0.40 and 0.49 respectively), suggesting that the means of Group B are bigger than that of Group A. Further, in choosing their preferred video mode for future online courses, 82% of subjects in Group A and 88% of subjects in Group B preferred the overlay mode to the window mode. This indicates that the overlay mode was preferred by a majority of the subjects in both the groups.

VI. Significance of Results

Results suggest a student preference of the overlay video mode over the window mode. The medium effects in differences in overall satisfaction between the experimental groups and their perceived levels of non-verbal immediacy factors when viewing the online lecture in the two modes are encouraging enough to pursue more longitudinal studies with a larger set of subjects and in other online learning scenarios. Assuming that the overlay mode permits better access to gestures and eye-gaze of the presenter, the preliminary results obtained are in-line with the background literature on the positive effects of access to instructor non-verbal immediacy.

Our planned extensions to the study include conducting experiments over the duration of an entire course (including a massively open online course) and augmenting the factors studied to include aspects of performance by including pre- and post-tests to assess the influence of the visual mode on learning and transfer.

The emerging virtual environment for engineering education presents a great opportunity for learners and educators. New research in pedagogy informed by psychology and cognitive science combined with the technological enhancements in the area of visual communication can make online classes more engaging and an active learning environment.

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References

[1] M. Bullen, "Participation and critical thinking in online university education," *Journal of Distance Education*, vol. 13, no. 2, pp. 1–32, 1998.

[2] M. Ward and D. Newlands, "Use of the web in undergraduate teaching," *Computers and Education*, vol. 31, no. 2, pp. 171–184, 1998.

[3] M. C. Carlisle, "Using youtube to enhance student class preparation in an introductory java course," in *Proc. ACM technical symposium on Computer science education*, Milwaukee,WI, 2010, pp. 470–474.

[4] M. Moundridou and M. Virvou, "Evaluating the persona effect of an interface agent in an intelligent tutoring system," *Journal of Computer Assisted Learning*, vol. 18, no. 3, pp. 253–261, 2002.

[5] S. van Mulken *et al.*, "The persona effect: How substantial is it?" in *BCS HCI*, 1998, pp. 53–66.

[6] S. Heidig and G. Clarebout, "Do pedagogical agents make a difference to student motivation and learning?" *Educational Research Review*, vol. 6, pp. 27–54, 2011.

[7] M. Kim and J. Ryu, "Meta-analysis of the effectiveness of pedagogical agent," in *Proc. World Conference on Educational Multimedia, Hypermedia and Telecommunications*, Chesapeake, VA, 2003, pp. 479–486.

[8] M. Argyle, *Bodily Communication*. Madison: International Universities Press, 1988.

[9] R. Vertegaal *et al.*, "Effects of gaze on multiparty mediated communication," in *Proc. Graphics Interface*, Chesapeake, VA, 2000, pp. 95–102.

[10] B. S. Titsworth, "The effects of teacher immediacy, use of organizational lecture cues, and students' note-taking on cognitive learning," *Communication Education*, vol. 50, pp. 283–297, 2001.

[11] L. Pogue and K. AhYun, "The effect of teacher nonverbal immediacy and credibility on student motivation and affective learning," *Communication Education*, vol. 55, pp. 331–344, 2006.

[12] S. Messman and J. Jones-Corley, "E?ects of communication environment, immediacy, and communication apprehension on cognitive and a?ective learning," *Communication Monographs*, vol. 68, no. 2, p. 184200, 2001.

[13] T. Mottet *et al.*, "Testing the neutralizing effect of instructor immediacy on student course workload expectancy violations and tolerance for instructor unavailability," *Communication Education*, vol. 55, no. 2, pp. 147–166, 2006.

[14] J. Arbaugh, "Virtual classroom characteristics and student satisfaction with internet-based mba courses," *Journal of management education*, vol. 24, no. 1, pp. 32–54, 2002.

[15] K. Swan, "Virtual interaction: Design factors affecting student satisfaction and perceived learning in asynchronous online courses," *Distance Education*, vol. 22, no. 2, pp. 306–331, 2001.

[16] V. Richmond *et al.*, "Development of the nonverbal immediacy scale (nis): Measures of self-and other-perceived nonverbal immediacy," *Communication Quarterly*, vol. 5, pp. 504–517, 2003.