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Seeing Self and Others On-Screen Does Not Negatively Impact Learning in Virtual Classrooms

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With an increase in remote learning and virtual learning environments, it is important to know how different conditions (e.g., video cameras on/off) influence student learning. We investigated learning outcomes in virtual classrooms under three video camera conditions: (1) students who did not see themselves, nor others; (2) students who saw others, but not themselves; (3) students who saw both themselves and others. Participants consisted of 150 students who watched a recorded video lecture then took a quiz on the lecture material. Analyses indicate that students who saw both themselves and others had higher quiz scores, as compared to students who did not see themselves, nor others. These results suggest that, although there might be other considerations regarding video camera use in remote learning (e.g., privacy), negative learning outcomes do not seem to be one of them.

Keywords: remote learning, virtual classrooms, memory, learning, online instruction

The move to online teaching and learning necessitated by the Coronavirus disease (COVID-19) pandemic prompted many creative adaptations and spirited debates in higher education. Among the most ubiquitous was the debate as to whether students should have their computer cameras on during synchronous class meetings. Like many other practical issues faced by educators during this time, the research literature provided scant direction to guide effective practice; there were no empirical articles available to directly address the impact of camera status on student learning. Thus, the arguments on the topic of whether to leave cameras on or off primarily revolved around conjecture or values. For example, opponents of keeping cameras on tended to couch their arguments around issues of equity, access, and privacy. Finders and Muñoz (2021) responsibly point out that "a cursory search of the literature shows research relating to communication, technology and the use of cameras as data-gathering tools but none on the necessity of cameras for learning or engagement" and proceed with a strong argument that requiring students to have cameras on was "racist, sexist, gendered and classist." Others have argued that requiring students to have their cameras on exacerbated digital divide-related issues such as poor internet speeds, and so forth (Terada, 2021). It has also been argued that students may feel psychologically unsafe sharing their home learning context because of feeling that it is an invasion of privacy (Piemme, 2020), or for socioeconomic or cultural differences (Finders et al., 2021).

Several arguments revolved around the idea that cameras-on could increase student anxiety and self-consciousness, heightening a feeling of being constantly watched which could impede students paying attention to the material (Lännström, 2020; Reed, 2020). In addition, Bailenson (2021) has also argued that the constant gaze during virtual meetings or classes can be exhausting and distracting for students, which would, presumably,

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impair learning. Again, however, these authors are advancing only theoretical arguments but not providing empirical evidence.

Survey research performed during this time supported arguments that some students may be sensitive to exposing their learning context to classmates on camera, in addition to encouraging feelings of self-consciousness (Castelli & Sarvary, 2021; Rajab & Soheib, 2021). At the same time, students in these same studies report that cameras-on increases engagement and learning, encourages feeling more actively connected to their classmates (Castelli & Sarvary, 2021), and yields an increased sense of accountability (Rajab & Soheib, 2021), which again, are argued to increase learning (Terada, 2021). Thus, self-report findings can be leveraged to support either side of the argument.

Previous experimental studies using mirrors rather than video also yield a nuanced set of findings. The use of mirrors increases self-awareness, which can have both positive (e.g., increasing prosocial behavior, reducing cheating, Diener & Wallbom, 1976) and negative (e.g., increase in cheating to protect self-image, Vallacher & Solodky, 1979) outcomes in a variety of situations (for a review, see also Silvia & Duval, 2001). Furthermore, research on the "audience effect" generally shows that when people are being watched (Froming et al., 1982) or feel they are being watched (Cañigueral & Hamilton, 2019), prosocial behaviors increase. For example, Cañigueral and Hamilton (2019) found that prosocial behaviors (i.e., increased support for charitable giving) increased for participants who believed they were having a virtual conversation with another participant who could see them (which was, in fact, a cover story), versus participants who were told they could not be seen. However, there was also a positive correlation between the increase of prosocial behaviors and social anxiety for those who believed they were being watched. It is plausible, then, that cameras, especially those that depict one's own image on the screen, may impact learning in one way or another; however, it is not clear in which direction. For example, viewing one's own image during a class may increase self-consciousness and cause a distraction that may subvert learning or viewing an image of oneself during a lecture may increase the perception of accountability and engagement and positively impact learning.

While we have speculation and student preference data emerging on this question, no attempts were made in these arguments and studies to link student preferences and responses to student performance, leaving educators without firm evidence as to the impact on learning. This is an important issue as student preference and student performance can often be negatively correlated (Wesp & Miele, 2008). Although discussions regarding video camera use in virtual classes have centered around fatigue, increased distraction and anxiety, privacy, and bandwidth issues, with the presumption that these concerns would be detrimental to learning, there is scant research empirically investigating the impact of video cameras on learning authentic classroom materials.

The present study seeks to balance the literature by providing an initial attempt to gauge the impact of camera status on student quiz scores after viewing a video lecture on Zoom. The purpose of this study was to investigate learning outcomes under the three possible camera conditions in most video conferencing platforms for students watching a recorded lecture: (1) students who did not see themselves, nor other students; (2) students who saw other students, but not themselves; (3) students who saw both themselves and other students. If the speculation that having cameras on increases distraction, fatigue, and anxiety, students learning in Conditions 2 and 3 should be negatively impacted; this would be especially true for Condition 3 in which students see others (a possible distraction) and themselves (a possible source of anxiety and self-consciousness). On the other hand, if having cameras on increases engagement and attention, Condition 1 should show impairment to student learning.

Method

Participants

Institutional Review Board (IRB) approval was obtained for this study. Data were collected from 155 undergraduate students at a large public university in the southeastern United States. A postexperiment manipulation check asked participants to report whether they followed directions regarding their camera status and whether they had technical issues preventing them from watching the recorded lecture. This led to four

participants being excluded from Condition 2 (see other students, but not self) because they reported that they did not hide their self-view. One other participant was excluded from Condition 3 (see self and other students) because they reported technological issues and their quiz score mean fell more than three standard deviations below their group quiz score mean. Two other students from Condition 3 (see self and other students) also had quiz score means that fell more than three standard deviations below their group quiz score mean, but they did not report technological issues; therefore, they were included in the overall analysis. The remaining 150 participants (74% female, 26% male) were all enrolled in an introductory psychology course and were given extra credit for participation. Participant ages ranged from 18 to 22 years ($M = 18.79$, $SD = 0.84$), and most participants were freshmen or sophomores (freshmen = 54.7%, sophomores = 36.0%, juniors = 8.7%, seniors = 0.7%).

Materials

Three primary components were utilized in this study: a virtual video conferencing platform (Zoom), a recorded lecture on a textbook chapter, and an online quiz consisting of test bank items relevant to that lecture. The quiz was accessed via *Canvas*, an online course management system commonly used at the university. The quiz was followed by demographic questions.

Zoom

An online classroom was established via Zoom. Using this platform, participants could join into a meeting and simultaneously view the recorded lecture shared by the researcher, as well as a live video feed of themselves and other participants. The researcher, a graduate student, served as host of the meeting, admitting participants, and locking the meeting at the specified start time. This prevented students from joining late or rejoining if they left at any point. Each participant was instructed to stay in a side-by-side gallery view in which they could see the video feed from other participants along the side of the shared presentation screen (if participant cameras were on). The researcher was also able to verify that students who were told to have their cameras on, did so.

The meeting was created with specified settings to reduce possible distractions in the virtual learning environment. First, participants could not type in chat with other participants. Next, participants had their microphones muted on entry and were not able to unmute themselves. Finally, participant screen sharing was disabled.

Lecture and Quiz

The recorded lecture was approximately 27 min long and covered a chapter in the students' introductory psychology textbook, but one that was not assigned for the course. Additionally, it was a PowerPoint lecture in which students could hear but not see the speaker, who was not one of the students' professors. After viewing this lecture in the Zoom meeting, participants accessed the quiz through their class page on Canvas. The quiz was comprised of 15 multiple-choice questions from the textbook test bank corresponding to the lecture content. All participants saw the same questions, but in randomized order, appearing one at a time on the screen. Participants could proceed through the questions at their own pace. Each correct answer was worth 1 point, and a participant's total score was a sum of these points, ranging from 0 to 15.

At the end of the quiz, participants were asked basic demographic questions about gender, age, and year in school. Participants were also asked whether they experienced any technical issues, and if they were able to successfully hide their self-view (if instructed to), which served as a manipulation check for the "see other students, not self" condition.

Design and Procedure

The study was advertised in two sections of an introductory psychology course. Participants could sign up either via email or Canvas and provided informed consent. Participants were randomly assigned to one of three video conditions: no video, see only others, and see self and others. In the no video group (Condition 1), participant cameras were turned off, so participants could not see images of themselves or other participants while they watched the recorded lecture. In the see only others condition (Condition 2), participant video cameras were turned on, but each participant was instructed to hide their

self-view. Each participant in this condition could see other participants while watching the lecture but could not see themselves. In the see self and others condition (Condition 3), participants enabled their video cameras but did not hide their self-view. These participants were able to see themselves and other participants while watching the recorded lecture. Participants were told that they would all watch a recorded lecture and then be tested on that material. After participants watched the lecture in their respective conditions, they were directed to Canvas and given instructions to access the content quiz.

Results

Descriptive statistics for quiz scores, separated by video condition, can be found in Table 1. Quiz scores were similar across all three conditions. Contrary to speculation regarding student learning outcomes with cameras on, students who saw the video feed of themselves and other students (Condition 3) during the lecture had the highest quiz scores, $M = 13.29$, $SD = 2.13$, 95% CI [12.70, 13.88], followed by students in Condition 2 who could see only others, $M = 13.04$, $SD = 2.10$, 95% CI [12.45, 13.63]. Students who could not see the video feed of themselves or others had the lowest quiz scores, $M = 12.54$, $SD = 2.01$, 95% CI [11.98, 13.09]. A one-way between-subjects analysis of variance was performed on student quiz scores as a function of video condition (video off, see only others, see self and others). There was not a statistically significant difference in quiz scores among video conditions, $F(2, 147) = 1.76$, $p = .175$, $\eta^2 = .023$.

As there were two participants in Condition 3 (see self and others) with quiz scores more than three standard deviations below the group quiz score mean, analyses were also conducted excluding these participants. There were no outliers in either of the other conditions. Descriptive statistics for quiz scores, separated by video condition, can be found in Table 2. Similar to the initial analyses reported above, students who saw the video feed of themselves and other students (Condition 3) during the lecture had the highest quiz scores, $M = 13.59$, $SD = 1.61$, 95% CI [13.03, 14.15], followed by students in Condition 2 who could see only others, $M = 13.04$, $SD = 2.09$, 95% CI [12.49, 13.59]. Students who could not see the video feed of themselves or others had the lowest quiz scores, $M = 12.54$, $SD = 2.01$, 95% CI [12.02, 13.05].

Table 1
Descriptive Statistics for Student Quiz Scores by Video Condition

Condition	*N*	*M*	*SD*	Min	Max
Video off	54	12.54	2.01	7	15
See only others	48	13.04	2.09	7	15
See self and others	48	13.29	2.13	6	15

Note. Min = minimum; Max = maximum.

A one-way between-subjects analysis of variance was performed on student quiz scores as a function of video condition (video off, see only others, see self and others). There was a statistically significant difference in quiz scores among video conditions, $F(2, 145) = 3.70$, $p = .027$, $\eta^2 = .049$. The effect size, denoted by η^2, indicates that 4.9% of the variance in quiz scores can be explained by video condition. To see where the significant effect was, post hoc pairwise comparisons were performed using Tukey's Honestly Significant Difference (HSD) test and showed that those in Condition 3, the see self and other students condition, ($M = 13.59$, $SD = 1.61$) scored significantly higher than those in Condition 1, the video off condition, ($M = 12.54$, $SD = 2.01$), $p = .020$.

Discussion

These findings indicate that there may not be any substantial negative impacts on quiz performance when students are asked to keep their cameras on during an online class. Second, although the difference in quiz scores was small, the increased performance of having cameras on, including one's own, may indicate that cameras on helps to increase self-awareness in a positive fashion and, combined with the presence of other students, perhaps impacts accountability

Table 2
Descriptive Statistics for Student Quiz Scores by Video Condition, Excluding Outliers

Condition	*N*	*M*	*SD*	Min	Max
Video off	54	12.54	2.01	7	15
See only others	48	13.04	2.09	7	15
See self and others	46	13.59	1.61	9	15

Note. Min = minimum; Max = maximum.

or engagement. We cannot be sure that self-awareness, nor engagement was increased in the "see other students and self" condition, but this would be consistent with the "audience effect" literature. Froming et al. (1982) found that different self-awareness manipulations (i.e., a mirror vs. an audience) yield different behavioral outcomes. Specifically, they argued that seeing oneself (e.g., in a mirror) activates the private self, which may impact personal beliefs and attitudes; however, increasing self-awareness via an audience would activate pressures to align oneself with societal expectations and behaviors. It is possible that both facets of self are activated by seeing oneself and others. This is also consistent with Cañigueral and Hamilton (2019), in which prosocial behaviors increased for participants who thought they were being watched.

Interestingly, students who could see others, but had their self-view hidden, expressed discomfort with not being able to see themselves and did not benefit compared to having all cameras on. This seems to be counter to the arguments made by educators that students who see themselves would experience increased self-consciousness and anxiety (Lännström, 2020; Reed, 2020). This is also counter to some student opinions regarding having cameras on. For example, in an editorial piece for The Student Life (the oldest college newspaper in Southern California), student Sam Hernandez speculated that having cameras on was detrimental to student learning due to increased self-awareness and a feeling of constantly being watched (Hernandez, 2020).

We add the caveat that these findings may not be the case for certain individuals or groups of students. Given that many arguments for keeping cameras off may be an equity issue, further research is needed to specifically address the impact of camera status with students from a variety of backgrounds and resources. In addition, due to the fact that participation was optional, the stakes were not as high as they would have been for material required for a course and a quiz that counted toward the course grade. The quiz was similar to prelecture quizzes given in these courses, which are shorter and, perhaps, easier than a typical exam; therefore, these results may not generalize to more difficult material. Lastly, this was an exploratory study in which we took a broad swipe at a potentially complex issue. Future research is needed to investigate factors such as individual and cultural differences, contextual variables (such as class size, content, interactive structure of pedagogy, etc.), and the exploration of the mechanisms contributing to the present study's findings (e.g., differences in engagement, increased perceptions of self-awareness or accountability, etc.).

For educators wondering how the use of video cameras may be affecting student attention and learning in virtual classrooms, these results indicate no significant detriment to learning associated with asking students to turn their cameras on during a video lecture. In fact, contrary to the arguments of many, we found an increase in performance when all cameras were on. As we believe that the topic is interesting and, more importantly, the use of video conferencing platforms may be part of the common educational landscape going forward, we encourage future researchers to build on these findings and develop a more nuanced and theoretically rich account of the impacts of cameras status in educational settings.

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