#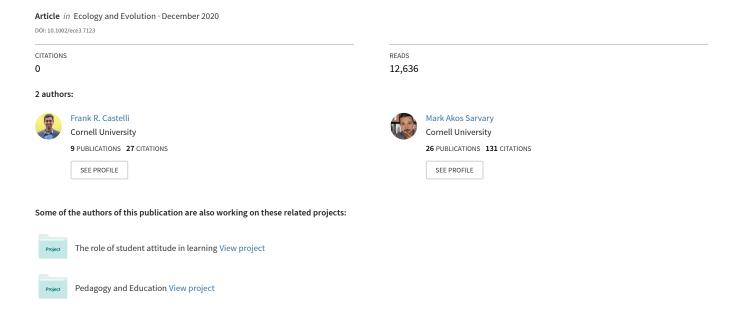 Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so

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7

Why students do not turn on their video cameras during online classes and an equitable and inclusive plan to encourage them to do so

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23   ABSTRACT

24

25   Enrollment in courses taught remotely in higher education has been on the rise, with a recent surge in
26   response to a global pandemic. While adapting this form of teaching, instructors familiar with traditional
27   face-to-face methods are now met with a new set of challenges, including students not turning on their
28   cameras during synchronous class meetings held via videoconferencing. After transitioning to
29   emergency remote instruction in response to the COVID-19 pandemic, our introductory biology course
30   shifted all in-person laboratory sections into synchronous class meetings held via the Zoom
31   videoconferencing program. Out of consideration for students, we established a policy that video
32   camera use during class was optional, but encouraged. However, by the end of the semester, several of
33   our instructors and students reported lower than desired camera use that diminished the educational
34   experience. We surveyed students to better understand why they did not turn on their cameras. We
35   confirmed several predicted reasons including the most frequently reported: being concerned about
36   personal appearance. Other reasons included being concerned about other people and the physical
37   location being seen in the background and having a weak internet connection, all of which our
38   exploratory analyses suggest may disproportionately influence underrepresented minorities.
39   Additionally, some students revealed to us that social norms also play a role in camera use. This
40   information was used to develop strategies to encourage –without requiring– camera use while
41   promoting equity and inclusion. Broadly, these strategies are to not require camera use, explicitly
42   encourage usage while establishing norms, address potential distractions, engage students with active
43   learning, and understand your students' challenges through surveys. While the demographics and needs
44   of students vary by course and institution, our recommendations will likely be directly helpful to many
45   instructors and also serve as a model for gathering data to develop strategies more tailored for other
46   student populations.

47

48   KEYWORDS (4-6)

49

50   synchronous teaching
51   remote instruction
52   distance learning
53   video cameras
54   videoconferencing
55   Zoom

56

57

58

59   1 INTRODUCTION
60
61   Student enrollment in distance education courses in postsecondary institutions has been on the rise
62   (NCES 2020, Palvia et al. 2018). Some forms of distance learning utilize advances in technology that
63   allow for synchronous class meetings over the internet using videoconferencing software (Al-Samarraie
64   2019). Moreover, the ongoing COVID-19 pandemic has led to a widespread need for instruction to move
65   online and for instructors to hold synchronous class meetings using videoconferencing software to
66   maintain social distancing and prevent the spread of infection (The Chronicle of Higher Education 2020;
67   UNESCO 2020; Yuan 2020). Many educators now find themselves teaching remotely for the first time
68   and facing a new set of challenges (e.g., Reich et al. 2020). One such challenge in the world of remote
69   instruction, and the focus of this study, is not being able to see students during synchronous class
70   meetings held via videoconferencing software, because students do not have their video cameras
71   turned on.
72   Midway in the spring semester of 2020, like at many other institutions in the United States,
73   courses at Cornell University made an emergency shift to remote instruction due to the COVID-19
74   pandemic (Cornell University 2020; Milman 2020), and our introductory biology laboratory course,
75   covering topics in ecology and evolution, was among them. We desired to continue the course with
76   synchronous laboratory section meetings due to the many educational benefits for students of
77   synchronous remote learning compared to asynchronous.
78   Benefits of synchronous remote learning include: opportunities for higher interactivity and
79   engagement among students, timely and constructive feedback, and real-time collaborative learning
80   (Racheva 2018). Additionally, synchronous learning helps to build a stronger sense of community that
81   fosters interactions, discussions, and the sharing of ideas (Lin and Gao 2020), something we valued to
82   maintain after transitioning but is also important in future semesters as new cohorts of students begin
83   classes remotely. Another benefit of synchronous learning is that the increased social interaction that
84   comes with it compared to asynchronous learning is strongly related to greater remote learning
85   enjoyment, improved effectiveness of remote learning, and a higher likelihood of enrolling in another
86   online class (Muilenburga and Berge 2005). Student performance in synchronous remote courses also
87   has the potential to be similar to performance in face-to-face versions of the same course (e.g.,
88   Francescucci and Rohani 2019). Lastly, interactions from synchronous instruction may help to counter
89   the effects of social distancing policies that can increase feelings of loneliness and result in negative
90   cognitive (Cacioppo and Hawkley 2009) and other health consequences (Aleman and Sommer 2020).
91   Despite our desires to teach synchronously while remote for the rest of the semester, we, and
92   the rest of the course staff, endeavor to practice inclusive pedagogy, which includes having a mind-set
93   that values course design and policies that do not exclude students due to inequities (Gannon 2018).
94   Hence, we were initially concerned about the "digital divide," in that many of our students might not
95   have access to a reliable internet connection or to a computer with a working webcam and microphone
96   (Cullen 2001). To find out if this was the case, we surveyed our students during a pause in classes before
97   remote instruction began. Fortunately, only a small percentage of students indicated these problems
98   (webcam: 2%; internet: 5%; N=301). Therefore, we felt it was not unreasonable to resume instruction
99   for our laboratory sections in the form of live synchronous class meetings held via Zoom (Zoom Video
100 Communications, San Jose, CA, USA), with video recordings of meetings and asynchronous means for
101 participation for those who could not attend synchronously. Students without reliable access to the
102 necessary technologies were also referred to university resources put in place in response to the
103 pandemic.
104   After deciding that we would hold synchronous class meetings, the next question became
105 whether we should mandate that students turn on their video cameras during class. The supervising
106 staff agreed that the best student-centered policy would be to *not require* students to use cameras

107 because they may not be comfortable doing so, particularly if they do not have access to a private space
108 or are embarrassed of their home environment (Costa 2020). Such concerns have been expressed by
109 other educators (Reich et al. 2020). The COVID-19 pandemic has already increased college student
110 anxiety and depression (Huckins et al. 2020), and a mandate for camera use may add to that trauma
111 (Costa 2020). Furthermore, students of some populations may be disproportionately affected by stress
112 from the pandemic (McGinty et al. 2020). For example, national surveys of adults in the United States
113 show that measures of symptoms of psychological distress increased from about 4% to 14% from 2018
114 to April 2020 with the highest increases in adults aged 18-29 (4% to 24%), adults with household
115 incomes of less than $35,000/year (8% to 19%), and Hispanic adults (4% to 18%) (McGinty et al. 2020).
116 Thus, the negative effects of mandating that cameras be kept on may also be disproportional to some
117 student populations, such as underrepresented minorities in STEM (Science, Technology, Engineering,
118 and Mathematics), and contribute to already high attrition rates (PCAST 2012).
119   There are several reasons that students having cameras on may be beneficial for teaching and
120 learning, justifying our encouragement of their use, and we review some of them here. Perhaps the
121 most obvious benefit is the ability to communicate with non-verbal cues. Instructors benefit from
122 receiving non-verbal cues from their students such as smiles, frowns, head nods, looks of confusion, and
123 looks of boredom, so that they can evaluate their teaching in real-time and adjust accordingly to
124 improve student learning (Miller 1988; Mottet and Richmond 2002). Instructors that perceive a higher
125 amount of non-verbal responsiveness also rate themselves as having been more effective (Mottet
126 2000). Students similarly benefit from being able to see other students when collaboratively learning.
127 Students with video in addition to audio were more able than students with only audio to tell how their
128 other study group members were reacting to things they said while remote learning (Olson et al. 1995).
129 The inclusion of video has also been suggested as a way to address the fact that students in remote
130 classes without video reported that a lack of non-verbal communication "reduced their educational
131 experience" (McBrien et al. 2009).
132   In addition to improving instructor effectiveness, being able to see students while teaching
133 makes for a more positive affective experience. For example, instructors that perceived a higher amount
134 of non-verbal responsiveness reported higher satisfaction and a higher preference for wanting to teach
135 in a remote video class (Mottet 2000). Additionally, instructors of our course expressed displeasure with
136 a general feeling of "talking to yourself" that occurs when students do not have their cameras on. This is
137 consistent with feedback from remote meeting participants who preferred videoconferencing over
138 audio-only conferencing because the former had the advantage of "not talking into a void" (O'Conaill et
139 al. 1993). If instructors have a negative experience, they may do a poorer job teaching, and poor
140 teaching may lead students to switch out of science, math, and engineering majors (Seymour and Hewitt
141 1997).
142   Students having their cameras on also helps to build instructor-student and student-student
143 relationships. Instructors that perceived a higher amount of non-verbal responsiveness while teaching
144 remotely with video reported instructor-student interpersonal relationships that were warmer, closer,
145 and more comfortable (Mottet 2000). The majority of students of a virtual classroom indicated that
146 using videoconferencing helped build trust and rapport with other students and helped them to develop
147 a sense of identification with others in their group, commenting that being able to hear and see each
148 other in real time helped construct a "more complete picture" of their peers (Falloon 2011). Moreover,
149 building stronger relationships via videoconferencing likely helps fend off loneliness that may come with
150 remote learning and social distancing, as videoconferencing has been shown to decrease feelings of
151 loneliness in nursing home residents (Tsai et al. 2010).
152   Nevertheless, by the end of the semester, many students had often chose to leave their cameras
153 off, as reported by our frustrated instructors. This attrition with camera use in online classes has been
154 reported elsewhere (Tonsmann, 2014). Given the potential benefits of students having their cameras on

155 and the costs of having their cameras off, we were wondering what strategies we could use to
156 encourage students to voluntarily turn on their cameras during laboratory sections. To develop
157 strategies informed by data, we asked our students in an end-of-semester survey about why they might
158 have chosen to not turn on their video cameras during class. In this paper we present the results of that
159 survey and the strategies we developed based on those results in combination with successful
160 experiences of some of our instructors, conversations with colleagues, suggestions from articles and
161 social media, and a review of the literature. We plan to try these strategies going forward as the need
162 for remote instruction continues for us as well as many instructors across the globe during the COVID-19
163 pandemic (UNESCO 2020). While the demographics and needs of students vary by course and
164 institution, we believe that these strategies are likely to be helpful to many instructors directly, or at
165 least, serve as a model for gathering data to develop strategies more tailored for their students.
166
167
168 2 METHODS AND MATERIALS
169
170 2.1 Course description
171
172 The students surveyed were undergraduates enrolled in the Investigative Biology Laboratory course at
173 Cornell University (Ithaca, NY, USA), a PhD-granting institution, in the spring semester of 2020. This
174 course is required for majors in the biological sciences and uses an inquiry-based approach to teaching
175 the scientific method within two main topics: the evolution of antibiotic resistance in bacteria and the
176 ecological impact of limiting nutrients on algal growth. Before the COVID-19 pandemic, this course was
177 taught with one 50-minute lecture and one 3-hour lab section per week. After the switch to emergency
178 remote instruction (Cornell University 2020; Milman 2020), lectures were pre-recorded for
179 asynchronous viewing and sections were held synchronous via Zoom (Zoom Video Communications, San
180 Jose, CA, USA) with recordings available for asynchronous viewing. We decided on this format after
181 surveying our students before remote instruction began in order to assess the challenges they would be
182 facing once they left campus, including differences in time zones, distractions from family obligations,
183 and access to technology. Each of 12 graduate student laboratory instructors led two sections and most
184 were assisted by one undergraduate teaching assistant. Section enrollment was capped at 18 students.
185 During synchronous lab sections, instructors gave short presentations while screen-sharing a slideshow
186 and incorporating active learning techniques such as polling (Sarvary and Gifford 2017) and think-pair-
187 share (Tanner 2013). For several weeks, a portion of each class meeting was devoted to students
188 meeting with their long-term groups to work on data analysis and a poster presentation using the
189 breakout room feature of Zoom. Instructors could move between breakout rooms to help students.
190 Students also presented their group posters to the rest of the class and responded to questions during
191 the last synchronous class meeting.
192
193
194 2.2 Student sample
195
196 Total enrollment for spring 2020 was 312 students. Ninety-one percent of enrolled students took the
197 end-of-semester survey (N=283) and seven respondents were excluded from analysis because they
198 either did not attend any live synchronous remote class meetings or skipped all the relevant questions,
199 resulting in a final sample of 88% (N=276) of enrolled students.
200   Students were assigned demographic categories based on self-reporting and had the option to
201 skip demographic survey questions or indicate that they choose not to disclose. Results were broken
202 down by gender based on male and female, as only one respondent identified as non-binary (N=1).

203 Students were asked about their race and ethnicity ("How would you describe yourself? Check all that
204 apply."), and their responses were used to assign them an underrepresented minority (URM) in science
205 and engineering or a non-URM. URMs were defined as three racial or ethnic minority groups: blacks or
206 African Americans; Hispanics, Latinx, or Spanish origin; and American Indians or Alaska Natives, or a mix
207 including one of these groups (NSF 2019). Non-URMs included: whites; Asians; Native Hawaiians or
208 other Pacific Islanders. URM status was unknown for 23 students. Freshman or non-Freshman
209 (Sophomore, Junior, or Senior) status was unknown for ten students. Non-Freshman were combined
210 due to relatively small sample sizes (Freshmen, N=215; Sophomores, N=32; Juniors, N=14; Seniors, N=5).
211
212
213 2.3 End-of-semester survey
214
215 Students were administered an end-of-semester survey designed to collect feedback on teaching,
216 course design, and student experiences within the course. The survey was administered with the
217 Qualtrics online survey tool (Qualtrics, Provo, UT, USA) during their last synchronous section meeting of
218 the semester. Lab instructors were directed to email any absent student after class with a link to the
219 survey and a deadline of a few days. The survey was anonymous, most questions were able to be
220 skipped, and taking it was completely voluntary. No credit was awarded for taking the survey.
221   The main survey question analyzed for the current study asked, "If you ever left your video off
222 during the live Zoom lab meetings, why did you leave it off? (check all that apply)." Students could select
223 up to 12 reasons we hypothesized *a priori* or select "Not Applicable – I always had my camera on."
224 When selecting "Other," students also had the option of typing a reason not listed. In order to be
225 included in analysis, students had to indicate that they attend at least some of the synchronous class
226 meetings ("Have you attended any of the Zoom lab meetings as they occurred in real time?").
227 Additionally, students indirectly offered insight into the phenomenon of leaving cameras off during class
228 when responding to other survey questions that solicited feedback about the course, the emergency
229 switch to remote instruction, and the performance of laboratory instructors.
230
231
232 2.4 Statistical analyses
233
234 For each of the 13 possible answer choices to the question: "If you ever left your video off during the
235 live Zoom lab meetings, why did you leave it off? (check all that apply)," pairwise differences between
236 demographic categories (URM versus non-URM, male versus female, and Freshman versus non-
237 Freshman) were analyzed with two-tailed Fisher's exact tests using the GraphPad QuickCalcs website
238 (GraphPad 2020). The α level for this study was set at 0.05. We chose not to correct for multiple
239 comparisons by adjusting the significance threshold because we consider these analyses to be
240 exploratory, with significant results requiring subsequent study for confirmation (Bender and Lange
241 2001).
242
243
244 3 RESULTS
245
246 The vast majority of students (N=249, 90%) had their video cameras off at least some of the time during
247 remote synchronous class meetings held via Zoom. Students indicated several reasons for doing so.
248 **Table 1** summarizes the percentages of students selecting each reason from a provided list, along with
249 break downs by demographic categories. The most frequently selected reason overall and across all
250 demographic categories was being concerned about appearance (N=113, 41% of students). The next

most frequently selected reason, a concern about other people being seen in the background, was selected by substantially fewer students overall, but was still quite common (N=73, 26%). This reason was selected more frequently than the related reason of not wanting their physical location to be seen in the background. Of relatively moderate frequency were concerns about distracting their classmates or instructor. Not wanting to be seen walking away from the computer, not paying attention, or doing other things while at the computer were relatively infrequently selected overall and across demographic break downs. As for reasons related to technology, a very small number of students (N=6, 2% of students) reported that their webcam was not working, but a much larger number (N=61, 22%) reported having a weak internet connection.

URMs more than non-URMs selected "I was concerned about other people being seen behind me" (URM: N=25/66; non-URM: N=45/187; p = 0.0376) and "I was concerned about my physical location being seen behind me" (URM: N=17/66; non-URM: N=24/187; p = 0.0194). For the same two reasons, females more than males selected "I was concerned about other people being seen behind me" (Male: N=20/99; Female: N=52/164; p = 0.0465) and "I was concerned about my physical location being seen behind me" (Male: N=9/99; Female: N=35/164; p = 0.0104). However, URMs were not more likely to be females (Female URM: N=45/161 [28%], Male URM: N=21/91 [23%]; p = 0.4569). For "My internet connection was weak," females were significantly more likely than males to select this reason (Male: N=15/99; Female: N=44/164; p = 0.0326) and URMS only tended to select this reason more than non-URMs (URM: N=21/66; non-URM: N=37/187; p = 0.0603).

A sizeable number of students selected "Other" from the list of provided reasons (N=53, 19%) and could then type in a reason. One student did not state a reason, three gave two reasons each and the rest each gave only one. The open-ended responses were emergently coded and placed into 15 categories summarized in **Table 2**. By far, the most common category was "It was the norm," with just over half of the typed reasons falling in this category (N=28, 53%). Representative statements from this category include: "Everyone else had their camera off," and, "[it] felt awkward having it on if no one else did." Although concern about appearance was an option to select in the provided list of reasons, four students used the "Other" option to elaborate, mentioning messy hair, wearing pajamas, not having showered, and even crying (unrelated to the course). Examples from "Not feeling a need to have the camera on" include: "I did not see a need to turn on the video…" and, "…I felt like it wasn't necessary for my learning." An example of "Not wanting the camera to be on to be seen, in general" is: "I just didn't want my video on."

Students also provided additional feedback regarding video cameras being on or off during synchronous class meetings when providing open-ended answers to other survey questions. Select quotes are drawn into the discussion that follows.

4 DISCUSSION

4.1 OVERVIEW

By surveying our students to ask why they did not always turn on their video cameras during synchronous class meetings, we gained valuable information to help us to develop strategies for encouraging students to turn on their video during class. With this information, in combination with feedback from our course instructors as well as conversations with colleagues, published research, and suggestions from articles and social media, we developed the following strategies for instructors to implement in remote instruction moving forward, summarized in Table 3. In developing these strategies, we took a student-centered approach, being mindful of equity, inclusion, and the diversity of our

299 students and the situations they find themselves in while learning remotely. We encourage any
300 instructor to gather information about their own students to better tailor these strategies.
301
302
303 4.2 DO NOT REQUIRE VIDEO CAMERAS TO BE TURNED ON AND DO OFFER ALTERNATIVES
304
305 By taking a student-centered approach, we make pedagogical decisions based on what is best for the
306 student's learning, not the instructor's teaching *per se*. While some instructors may feel a strong need to
307 mandate that students turn on their video cameras during class, we strongly advise against this. While
308 we surveyed students to find broad reasons why they chose not to turn on their cameras, there are
309 many more specific, and very sensitive, reasons for their not doing so. One of our surveyed students
310 strongly captured this point when asked about any challenges they have faced with the transition to
311 online learning: "I would like to mention that no one should assume the living conditions of students
312 when not on campus. Some students live in some of the worst conditions possible." This concern is
313 consistent with those of educators reported elsewhere (Reich et al. 2020). For example, one teacher
314 told researchers that their students of working class families do not want to turn on their cameras
315 because they do not want their wealthy peers to see inside their homes and another said they have
316 students that lack private spaces and end up connecting to Zoom from inside a closet (Reich et al. 2020).
317   College student anxiety and depression have already been increased by the COVID-19 pandemic
318 (Huckins et al. 2020), and a mandate for camera use may add to that trauma (Costa 2020). Furthermore,
319 psychological distress due to the pandemic has disproportionately affected adults 18-29 years old,
320 adults from low income homes, and Hispanic adults (McGinty et al. 2020). Thus, the negative effects of
321 mandating that cameras be kept on may also be disproportional to some student populations, such as
322 underrepresented minorities in STEM, and contribute to already high attrition rates (PCAST 2012).
323   We will offer alternative means for students to participate and communicate with the instructor
324 and the rest of the class, such as polling (Sarvary and Gifford 2017), discussion boards (Suler 2004), shared
325 documents (e.g., Google Docs; Perron and Sellers 2011) and cooperative annotations (Zhu et al. 2020).
326 Additionally, our instructors have had great success using the chat feature within Zoom. Some of them
327 reported that individuals that did not often speak when class was in-person were suddenly more
328 communicative when using the chat feature online. We also found that our undergraduate teaching
329 assistants were helpful facilitating student participation in several ways including monitoring the chat
330 window during class, creating polls, and managing discussion boards (Asgari and Sarvary 2020). Having
331 multiple avenues for participation should improve equity and likely benefit all students, not just those
332 that do not turn on their camera. Our students appreciated this strategy. When asked, "What are some
333 of the positive aspects about how your lab instructor taught specifically during the online Zoom
334 meetings?" one surveyed student wrote, "Using different ways to engage us because many people were
335 not comfortable with sharing their cameras." Another student wrote, "I thought [my instructor] did a good
336 job allowing us to be a part of the class without forcing any of us to speak or turn on our videos when we
337 were not comfortable."
338   By not requiring camera use, it is inevitable that at some point one or more students will turn
339 off their video cameras, making it more challenging to identify who is speaking or even present. In this
340 case, we have found it to be helpful to ask students to properly format their name as it appears to
341 others in the videoconferencing program. The name displayed in Zoom, for example, is sometimes a
342 student's obscure university ID, merely their initials, or their legal name instead of their preferred name.
343 We also recommend that students be encouraged to add a static image of their face that will appear
344 when their video is turned off. Furthermore, instructors could set a good example by following these
345 suggestions themselves.
346

347
348 4.3 EXPLICITLY ENCOURAGE CAMERA USE, EXPLAIN WHY YOU ARE DOING SO, AND ESTABLISH THE
349 NORM
350
351 Instead of requiring video cameras to be turned on, we recommend encouraging it while fostering an
352 inclusive classroom environment. We suspect that some students will not need much encouragement,
353 especially in an age of social distancing to fight the pandemic. For example, one student wrote, "[My
354 instructor] had her camera on [and it] was nice to see another face during times like this [sic]." However,
355 others may need more encouragement.
356   An early step in encouraging students to use their cameras is to explicitly request it. One of our
357 students wrote, "…if asked to turn my camera on I would have," and another student indicated that they
358 left their camera off because that was the default setting when connecting with Zoom. We plan to
359 include our camera use policies in the syllabus and have instructors communicate explicit
360 encouragement of camera use on the first day of class, repeating later in the semester if necessary. In
361 addition to communicating when cameras are encouraged to be on, it is also important to explicitly
362 communicate when it would be appropriate to turn them off (and separately, the microphone), like
363 when being interrupted by a family member or trying to improve a weak internet connection.
364   We also plan to explain to our students why we encourage camera usage, as such transparency
365 should build student buy-in (Seidel and Tanner 2013). For example, our instructors could mention some
366 of the many benefits for camera use in remote classes, as reviewed in the introduction section, such as
367 the value of non-verbal cues in communication (Miller 1988), improved instructor effectiveness (Mottet
368 2000), and building instructor-student and student-student relationships (Mottet 2000; Falloon 2011).
369 We also think our students would like to know that when we asked past students for suggestions for
370 improving the online Zoom lab meetings, several suggested that cameras be turned on more often
371 because it made class feel "more interactive" and "more like a normal class," for example. Similar
372 sentiments were reported by students in chemistry classes (Kalman et al. 2020).
373   By explicitly encouraging camera usage and explaining why we are doing so from the first day of
374 class, we plan to establish video sharing as the classroom norm. Our survey revealed how powerful
375 setting the norm can be. The most frequent "Other" reason students provided for not having their video
376 on was some form of if not being the norm set in the online classroom. For example, "no one else had it
377 on so I shut mine off as well," "[our class] kept ours off," and "everyone else had theirs off and I felt
378 awkward having mine on." This suggests that unspoken social norms are at play and that some portion
379 of students experience the social pressure to follow what their classmates are doing. Classroom
380 interaction norms implicitly set by student peers have been found to significantly shape participation
381 and it has been suggested that instructors have the power to shape such norms (Fassinger 1995; 1996).
382   We believe that the focus theory of normative conduct (Cialdini et al. 1990; 1991) may help to
383 explain our observations and form potential solutions. Applying the theory, students not turning on their
384 cameras because of the perception that that is how most others *are* behaving would be a "descriptive
385 norm." The more students that the instructor can encourage to turn on their cameras, the greater the
386 student perception that having cameras on is the (descriptive) norm and the more likely students will
387 comply. Another type of norm described by the theory is an "injunctive norm," which guides a student's
388 behavior based on the perception of how most others *ought* to behave, that is, how most others would
389 approve or disapprove of the behavior. Injunctive norms work even when most are not behaving as
390 desired. Instructors can help set the injunctive norm by explicitly stating that turning cameras on is
391 valued by the instructor and student peers. Theory also posits that a student's actions are more likely to
392 conform to the type of norm that is salient, or in focus, at the time of behavior, so it is ideal if these
393 norms are aligned. To avoid misalignment, we suggest that on the first day of class instructors do not
394 describe the issue of cameras being turned off as unfortunately frequent while they encourage cameras

395   to be on as this would set up contradictory descriptive and injunctive norms. Moreover, aligning norm
396   types makes persuasive messages more likely to be effective (Cialdini 2003).
397   We would also like to note that when influencing the injunctive norm, an instructor must be
398   careful to not create the perception that having a camera off is disapproved so much as having a camera
399   on is approved. Part of the classroom norms should be that it is okay to choose not to have your camera
400   on (Stanford University 2020). An analogy to this would be the injunctive norm that stopping to make a
401   donation (e.g., at a Salvation Army charity kettle) is a behavior that most would approve of, but
402   continuing to walk past is a behavior that most would not likely disapprove of.
403   Instructors can seek to set the norm of having cameras turned on early on so that students who
404   are willing and able to turn their video on are more comfortable doing so. For example, on the first day
405   of class instructors can devote time for students to introduce themselves to the rest of the class with
406   icebreaker activities like show-and-tell. Subsequent classes could begin by checking-in with each
407   student, asking them to at least briefly turn on their cameras if they are comfortable doing so, and
408   asking fun short questions like "what was your favorite cartoon growing up?" In larger classes where this
409   is not practical, students could dress according to rotating themes like "funny hat day" or "show your
410   school pride day." While setting the norms for the class, we will be mindful that no student should be
411   made to feel uncomfortable for choosing to leave their video off. Offering alternative methods for
412   participation and building an inclusive classroom should help with not causing any student to feel
413   excluded.
414   Setting the norm that camera usage is encouraged should also help to address the most
415   frequently cited reason our students gave for not turning on their camera: concern about their personal
416   appearance. If students anticipate that they will likely want to have their camera on during class, they
417   are probably more likely to prepare their appearance by, for example, brushing their hair and not
418   wearing pajamas. It may be also helpful to tell them that a common tip from people whose careers
419   involve working from home is to maintain a routine that often includes getting dressed and good
420   personal hygiene (Rivkind 2012; Knowlton 2020; Limon 2020). We should also note that the Zoom
421   program currently offers a feature to "Touch up my appearance," which airbrushes a user's face in real
422   time, although we do not promote its use as we suspect it contributes to the negative effects of
423   unrealistic beauty ideals despite being an obvious manipulation (MacCallum and Widdows 2018).
424   A state of public self-awareness, when individuals focus their attention on aspects of the self
425   that are able to be perceived by others, has been shown to be induced by the presence of an audience
426   or even only a video camera (Froming et al. 1982; Govern and Marsch 2001; Davies 2005; Myllyena and
427   Hietanen 2016). More similar to videoconferencing, the presence of a camera and seeing one's own
428   video image was shown to heighten public self-awareness in pairs of strangers that were engaged in
429   video chatting (Miller et al. 2017). It stands to reason that a videoconference like those of a Zoom
430   meeting would also increase public self-awareness.
431   Increasing public self-awareness may increase concern about one's personal appearance as that
432   is one aspect of the self that is visible to the public. The level of concern that a student has for their
433   appearance may be due to a number of different psychological and social factors that are beyond the
434   control of the instructor, including aspects of personality (Johnson et al. 2007), culture, gender, and
435   relationship status (Aune and Aune 1994). As all these factors cannot possibly be addressed by an
436   instructor, we speculate that if students are expecting to turn on their cameras, they will more likely
437   prepare their appearance in a manner that assuages their individual concerns about being seen. While
438   enhanced public self-awareness is an antecedent to social anxiety, it does not necessarily lead to it
439   (Fenigstein et al. 1975). Nevertheless, instructors should be aware that cameras may trigger such
440   anxiety in students and so this is another reason not to mandate camera use.
441   To help maintain the norm of camera use throughout the semester and combat a potential
442   decline in usage (e.g., Tonsmann, 2014), we plan to individually reach out to those students that

443 regularly do not turn on their cameras. We will let them know that we have noticed their camera has
444 been off and to ask if there is anything we can do to help them feel more comfortable with turning it on.
445 When doing so, we will be mindful of student-teacher power dynamics and seek to avoid pressuring a
446 student into doing something they are not comfortable doing. We will also reiterate that camera use will
447 not affect their grade and remind them of the alternative ways to participate in class and to
448 communicate with instructors. Reaching out to students creates the opportunity to make them feel
449 more welcomed and to gain a better understanding of the challenges they face while learning remotely.
450 Knowledge of these challenges may allow us to provide solutions or direct students to helpful resources.
451
452
453 4.4 ADDRESS POTENTIAL DISTRACTIONS AND GIVE BREAKS TO HELP MAINTAIN ATTENTION
454
455 While a sizeable number of our students selected concerns about distracting their classmates and their
456 instructor as reasons for not leaving on their video during class, we suggest ways to minimize these
457 distractions while encouraging general camera use.
458   Students may be assuming that sharing their video feed while the instructor is presenting
459 distracts from the instructor and is thus disrespectful. For example, one student wrote, "I left my video
460 off when [my instructor] would present his slides out of respect so that all the attention would be on
461 him." Instructors who actually prefer students' cameras to be on may not realize that some students
462 assume their preference to be the opposite. Obviously, explicitly communicating camera polices that
463 include when it is inappropriate to have cameras on would help.
464   If students find themselves distracted by the video feeds of their classmates while the instructor
465 is presenting, they can likely alter their personal viewing settings in the videoconferencing program
466 being used. For example, Zoom has a "speaker view" which automatically focuses on the person
467 speaking and an option to pin the instructor's video so that it remains in focus (for an instructional video
468 see Finio 2020). If, as the results of our survey suggest, some students may be preoccupied by the
469 thought that their classmates are "looking at them the whole time," it may be comforting to briefly
470 inform students about the "spotlight effect," which is the tendency of people to overestimate how much
471 they are watched and evaluated by others (Gilovich and Savitsky 1999). If students are distracted by
472 their own video feed, which is consistent with the findings that mirrors have been shown to increase
473 self-awareness (Froming et al. 1982; Govern and Marsch 2001), they should look to see if the
474 videoconferencing software being used has an option to hide it, as Zoom does (Zoom 2020).
475 Alternatively, students can place a sticky note on the portion of their screen that shows their own video.
476   The second most frequent reason given for not turning on their camera was concern about
477 other people being seen in the background. There are several reasons why this may be concerning to
478 students such as protecting the privacy of their family or roommates. Regardless of why, students may
479 be distracted by the possibility of someone else coming into view. Similarly, students were concerned
480 about their physical location being seen behind them. Students can be provided suggestions to deal with
481 these concerns, including communicating with roommates and family members about when they have
482 class and ask not to be disturbed, finding a private area of their home where they can connect with
483 minimal distractions (Basile and Beauregard 2016), staging their background to look more presentable,
484 using a virtual background in the videoconferencing software if their computer allows it, or simply sitting
485 with their back against a wall.
486   However, we must be mindful that not everyone will have access to a private space, as one of
487 our students pointed out, "It has been difficult to stay focused for long periods of time because there is
488 a lot of commotion in my house, and I have nowhere quiet to go work." Furthermore, our results
489 suggest that URM students may be disproportionately more concerned about their physical location and

490 other people being seen behind them than non-URM students. Again, we recommend against requiring
491 cameras be turned on and instead to look for other ways to promote inclusion.
492   To help maintain attention, we also encourage giving students breaks, especially with longer
493 classes. Students can use that time to go to the bathroom, get something to eat, and relax while fighting
494 off "Zoom fatigue" (Jiang 2020; Morris 2020). They will then also be less likely to turn off their video and
495 take a break during class anyway. When students return from break, it is potentially a good time to
496 encourage cameras to be turned on again by facilitating an activity that makes use of them.
497
498
499 4.5 USE ACTIVE LEARNING TECHNIQUES TO KEEP STUDENTS ENGAGED AND PROMOTE EQUITY
500
501 Several of our colleagues at Cornell and other institutions have expressed concern that students
502 sometimes leave their video turned off in order to not be seen being inattentive or doing other things.
503 Indeed, this does seem possible based on our students having selected as reasons for leaving their video
504 off: not wanting to be seen not paying attention, walking away from the computer, and doing other
505 things on their computer. Students may be bored or falling victim to the perils of multitasking (Klemm
506 2016, Mokhtari et al. 2015). To capture student attention, while also improving student learning, we
507 suggest regularly employing active learning techniques which have been shown to increase persistence
508 in STEM, improve academic performance, and lower failure rates (Braxton et al. 2008; Freeman et al.
509 2014). Furthermore, active learning was found to narrow achievement gaps between students from
510 overrepresented and underrepresented groups by improving exam scores and passing rates for all
511 student groups, but disproportionately so for those from underrepresented minorities (Theobald et al.
512 2020). However, it should be noted that active learning does not guaranty equity and instructors should
513 be vigilant of inequity due to a number of factors including small group dynamics (e.g., Reinholz and
514 Shah 2018) or potential hidden biases (e.g., Ernest et al. 2019).
515   By establishing engaging activities such as polling or typing into the chat window as a regular
516 part of class, students should be less tempted to do other things during class and thus less likely to turn
517 off their video in order to conceal themselves. Using the think-pair-share/listen-think-pair-share
518 technique (Lyman 1981; Tanner 2013) along with Zoom's breakout room feature may be a particularly
519 helpful in this regard. Based on feedback from our instructors and students, some students seem to be
520 more willing to turn on their video when the class is split up into smaller breakout rooms within Zoom.
521 This pattern has also been reported by our colleagues at Cornell and other universities. We also
522 recommend incentivizing students with a participation grade while promoting equity by providing
523 multiple ways to participate in active learning that does not require sharing video, mentioned above.
524 Keeping students actively engaged may also have the added bonus of decreasing the likelihood that they
525 feel like everyone is looking at them the whole time.
526
527
528 4.7 SURVEY YOUR STUDENTS TO UNDERSTAND THEIR CHALLENGES
529
530 Our end-of-semester survey has given us information we have used to plan for the fall semester as the
531 COVID-19 pandemic continues. We have shared our data-driven recommendations for encouraging
532 camera use here but caution other instructors to consider that the challenges facing their student
533 population may differ and require different solutions.
534   In addition to an end-of-semester survey, we surveyed our students multiple times to better
535 understand the challenges they were facing in the switch to emergency remote instruction, and what
536 we learned influenced our teaching practices. For example, we were initially concerned about the
537 "digital divide" (Cullen 2001) in that many of our students would not have access to a reliable internet

538 connection or to a computer with a working webcam and microphone. However, only a small
539 percentage of students indicated these problems (webcam: 2%; internet: 5%; N=301) in a survey we
540 gave during a break in classes before remote instruction began. This partly informed our conclusion that
541 it was not unreasonable to hold live synchronous class meetings that encouraged the use of webcams
542 while also offering asynchronous learning opportunities to those that could not attend. Those students
543 without reliable access to the necessary technologies were also referred to university resources set up in
544 response to the pandemic.
545
546
547 5 CONCLUSIONS
548
549 Our end-of-semester survey of students revealed insights into why students might have chosen not to
550 turn on their video cameras during online synchronous class meetings held via Zoom. This information
551 has helped us to develop a plan for encouraging –but not requiring– camera use as we continue remote
552 instruction during the COVID-19 pandemic. While the demographics and needs of students vary by
553 course and institution, we believe that these strategies are likely to be helpful to many instructors. Our
554 data-driven plan also provides a model for other instructors to gather information about their own
555 student population to develop more tailored strategies that also promote equity and inclusion.
556
557
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559

566
567
568 CONFLICT OF INTEREST
569
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571
572
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574

575 **Frank R. Castelli:** Conceptualization (lead); Data Curation (lead); Formal Analysis (lead); Investigation
576 (equal); Methodology (lead); Visualization (lead); Writing-original draft preparation (lead); Writing-
577 review & editing (equal). **Mark A Sarvary:** Funding acquisition (lead); Investigation (equal); Methodology
578 (supporting); Writing-review & editing (equal).
579
580
581 DATA AVAILABILITY STATEMENT
582
583 In order to best protect student privacy, we decline to share data beyond what is reported in the
584 manuscript.
585

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866   TABLES
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868   [Tables begin on the next page]
869

870 **Table 1.** Reasons undergraduate students gave for not turning on their video cameras during synchronous online class meetings in a survey given in an introductory biology
871 laboratory course at a four-year PhD-granting institution at the end of the spring 2020 semester. Each student that indicated they did not always have their camera on
872 could select more than one reason. Reasons are broken down by underrepresented minorities (URM) in science and engineering status, gender, and freshman or non-
873 freshman (sophomores, juniors, and seniors) and are sorted in descending order according to all student respondents combined.

Reasons for not turning on camera	All students	URM	Non-URM	Male	Female	Freshman	Non-Freshman
I was concerned about my appearance.	41%	45%	38%	36%	43%	38%	49%
I was concerned about other people being seen behind me.	26%	38%	24%	20%	32%	28%	22%
My internet connection was weak.	22%	32%	20%	15%	27%	23%	18%
Other [with space to enter text]	19%	15%	20%	18%	20%	18%	25%
I felt like everyone was looking at me the whole time.	17%	20%	17%	16%	18%	18%	14%
I was concerned about my physical location being seen behind me.	17%	26%	13%	9%	21%	16%	20%
I was concerned about distracting my classmates.	17%	12%	21%	16%	19%	17%	20%
I was concerned about distracting my lab instructor.	12%	14%	13%	14%	12%	13%	12%
Not Applicable - I always had my camera on.	10%	8%	11%	12%	9%	10%	10%
I didn't want to be seen not paying attention.	8%	8%	7%	9%	7%	7%	10%
I didn't want to be seen walking away from my computer.	7%	11%	6%	8%	7%	7%	10%
I didn't want to be seen doing other things on my computer.	7%	8%	7%	10%	5%	7%	10%
My webcam was not working.	2%	3%	2%	3%	2%	3%	0%
Number of students	**276**	**66**	**187**	**99**	**164**	**215**	**51**

874

875 **Table 2.** Additional reasons undergraduate students of a biology class gave for not turning on their video
876 cameras during synchronous online class meetings. Reasons were categorized from typed responses
877 after choosing "Other" from a provided list of reasons. Percentages are of those respondents choosing
878 "Other."
879

"Other" reasons given sorted into categories	Percent	Count
It was the norm	52.8%	28
Being concerned about appearance (elaborations for this concern)	7.5%	4
Wanting to improve the internet connection/streaming smoothness	7.5%	4
Not feeling a need to have the camera on	7.5%	4
Not wanting to divert attention from the instructor	5.7%	3
Not wanting the camera to be on or to be seen, in general	5.7%	3
Not wanting to be seen eating	3.8%	2
Not wanting to be seen in bed	1.9%	1
Being distracted by seeing one's own video feed	1.9%	1
Being more comfortable with the camera off	1.9%	1
Having to talk to family members	1.9%	1
Leaving the computer to use the bathroom	1.9%	1
Not having a webcam	1.9%	1
The default setting of the Zoom program was to join without video	1.9%	1
No "other" reason given	1.9%	1

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882   **Table 3.** Our proposed videoconferencing strategies for instructors to encourage, but not require,
883   students to turn on their cameras during synchronous class meetings.
884

Videoconferencing camera use strategies for instructors
▪Do NOT require video cameras to be turned on and do offer alternatives.
▪Explicitly encourage camera use, explain why you are doing so, and establish the norm.
▪Address potential distractions and give breaks to help maintain attention.
▪Use active learning techniques to keep students engaged and promote equity.
▪Survey your students to understand their challenges.

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