2023

Attention Contagion in Online Courses: Examining Student Attention During Recorded Lectures

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ATTENTION CONTAGION IN ONLINE COURSES: EXAMINING STUDENT ATTENTION DURING RECORDED LECTURES

by

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A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Psychology
in the College of Sciences
and in the Burnett Honors College
at the University of Central Florida
Orlando, Florida

Spring Term, 2023

Thesis Chair: Dr. Matthew Chin, PhD

ABSTRACT

Recorded lectures have become increasingly common and are now widespread in online courses. Given this rapid rise, it is important to investigate how students interact with this multimedia and best practices for lecturers in using this technology. One area of investigation is how students interact with the recordings of previously live-streamed lectures with visible students. Attention contagion is one such interaction, and previous research has shown that attention and inattention can spread in in-person and live-streamed lectures. The present study builds off the existing limited literature to examine whether attention contagion can occur across time through asynchronous, recorded lectures. One hundred and twenty participants, who were all UCF undergraduate students aged 18 years and older, completed the study in one of two conditions. The first condition had a recorded lecture sample with attentive students, and the second condition had a sample with inattentive students. Participants then completed the same post-lecture quiz, self-report survey, and demographic questionnaire. The results suggest that inattention can spread unconsciously while watching recorded lectures, with cognitive overload as a potential influence. However, social appraisals were not an influence in either condition. Future research is needed on how attention or inattention may spread unconsciously and how potential influences on attention contagion may differ by lecture format, such as synchronous versus asynchronous.

ACKNOWLEDGEMENTS

I would first like to thank my thesis committee, which included my thesis chair Dr. Matthew Chin and two committee members Dr. Valerie Sims and Dr. Mason Cash, for their guidance throughout this project. I would also like to thank the ACAT lab for their assistance, from serving as confederates to helping me set up my study within SONA. Lastly, I would like to thank my family for their support and encouragement throughout all of my educational endeavors, especially during the following thesis.

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INTRODUCTION

The coronavirus pandemic necessitated a sudden and dramatic technological shift in higher education. With an increased reliance on remote learning technologies, students experienced a reduction in social connections (Singhi et al., 2020; Almendingen et al., 2021; Shim & Lee, 2020), concentration (Shim & Lee, 2020), and motivation (Almendingen et al., 2021). Professors became creative in response to such issues. For example, professors used instant messaging platforms for live discussion boards (Ackerman & Gross, 2021) and implemented discussion boards where students posted video recordings of their responses (Xiu & Thompson, 2020). These innovative activities had benefits, including improvements in perceived learning (Ackerman & Gross, 2021) and perceived interaction (Xiu & Thompson, 2020). However, both Xiu and Thompson (2020) and Ackerman and Gross (2021) determined that students' concerns about these activities related to issues with technology use and schedule flexibility.

A practice more likely to endure, though, is producing recorded lectures that students can later access at their convenience. While knowing that a live-streamed lecture will later be available as a recording has no effect on memory during the initial lecture (Patel et al., 2019), learners still seem to favor recorded lectures. Students feel that recorded and live-streamed lectures can be beneficial to online classes, despite the stressful manner in which these lectures were introduced (Almendingen et al., 2021). Additionally, Harris et al. (2021) found that students valued the flexibility of recorded lectures, possibly because another struggle for some students was balancing online learning with family responsibilities (Singhi et al., 2020). Since

students support the use of recorded lectures, ongoing investigation into how students interact with these videos is critical in improving the effectiveness of online courses.

LITERATURE REVIEW

Given that students also struggled with focus during remote learning (Singhi et al., 2020), attention is one area of research with promise. Examining attention in education is an active endeavor, and the literature includes the effects of attention on student memory and performance. Risko et al. (2012) determined that students' minds wander more often as the length of a lecture increases, both when alone and in a group setting. This decrease in attention can lead to students remembering less lecture content (Risko et al., 2012). Wammes et al. (2016) also found that reduced attention can worsen student performance; additionally, there was a greater negative impact on quiz performance when students chose to shift their attention away from the lecture, as opposed to unintentional mind wandering. Still, regardless of whether mind-wandering thoughts are intentional or not, they can improve test performance if they are related to the lecture, whereas unrelated thoughts can hurt performance (Jing et al., 2016). Fellow students can play a role in such mind wandering and distraction.

Specifically, a variety of student behaviors can affect classmates and strain their cognitive resources, such as through speaking to others during the lecture and using technology (Frisby et al., 2018). Sana et al. (2013) focused on examining the impact of technology use; the researchers found that students' quiz results were lower when they saw other students multitasking when browsing the internet during the lecture. Student performance was worse for both simple and complex learning, where simple learning was measured through the ability to remember facts and complex learning through the ability to apply information and solve a problem (Sana et al., 2013). Despite the implications for attention, Sana et al. (2013) stated they

did not directly assess attention. More recent research, though, explores the impact of attention contagion, a newly described phenomenon, on student performance.

The concept of contagion, in that people can transfer and receive states of feeling and thinking from other people, is not new or limited to education. For example, contagion can occur for emotions on social media (Goldenberg & Gross, 2020), vaccine beliefs (Konstantinou et al., 2021), and passion for work (Ho et al., 2021). In the context of education, contagion among students can involve engagement (Mendoza & King, 2020), work avoidance (Mendoza & King, 2022), and a fixed mindset view of intelligence (King, 2020), demonstrating that students can pick up both helpful and harmful behaviors from each other.

However, few studies directly examine if and how people can become more attentive or inattentive due to others' actions. Colombatto and Scholl (2022) researched attention contagion through a physiological perspective, where pupil dilation can be indicative of one's cognitive and emotional states, leading observers to unconsciously assess other's attention levels. Specifically, they found that faces are perceived more quickly when pupils are dilated, which is a physical sign of attention. Forrin et al. (2021), who were the first to propose the term attention contagion, attempted to study it while students watched a lecture in a classroom setting. In contrast to when the confederate was inattentive, the researchers found that participants with an attentive confederate self-reported as being more attentive, were behaviorally observed as more attentive, and performed better on the quiz. Additionally, to a lesser extent, students' attention was affected by confederates seated behind them. Forrin et al. (2021) suggested that even though participants could not see the confederate's behavior, they could detect auditory cues, like note-taking. When the confederate was not visible, attention contagion was only noticeable in participants through

behavior coding and not on the self-report measure or quiz. Participants' coded behavior consisted of one general rating for attentiveness and two categories for inattentiveness: sleepiness and fidgeting.

Kalsi et al. (2022) provided more specific examples of attentive and inattentive behavior while examining attention contagion during live-streamed lectures. They described attentiveness as including head nodding, interested facial expressions, and steady gaze on the lecture, while inattentiveness could consist of bored facial expressions, slouching, and restlessness. The researchers also assessed multitasking, which they defined as participants checking their phones and browsing other websites on their computer. Kalsi et al. (2022) found that when the confederates were attentive, participants self-reported as being more attentive, were observed as multitasking less, and had better quiz results. The present study will continue to investigate attention contagion as it occurs in education through examining this phenomenon in recorded lectures. There are a variety of possible factors to consider in what can influence the likelihood of students' attention levels being affected through this medium.

Cognitive Load Theory

Frisby et al. (2018) found that students' distracting behaviors can increase the cognitive load of their classmates, which is in line with cognitive load theory. Cognitive load theory (CLT) is based on the concept that a learner has only so many cognitive resources available at one time due to the limitations of working memory (Sweller, 1988). Overwhelming working memory can lead to difficulty in constructing schemata and transferring information to long-term memory (Sweller et al., 1998). As for what inhibits and promotes this transfer, the original theory has three main components. The first is intrinsic cognitive load, which is the inherent difficulty an

individual may encounter during the learning process or with the inherent difficulty of a topic, meaning that it cannot be controlled through external methods (Sweller et al., 1998). Extraneous cognitive load, in contrast, can be avoided as it is the learner's confusion from the unclear presentation of information; germane cognitive load refers to the beneficial effort a learner dedicates to processing information (Sweller et al., 1998). Additionally, Valcke (2002) argued for differentiating germane load through adding a "meta-cognitive load" to emphasize the learning aspect of the germane load and highlight schema creation through metacognitive regulation, where metacognition concerns an individual's awareness of their cognitive processes.

Given the implications of CLT in learning, there is extensive literature about cognitive load in educational contexts. This literature includes a similar phenomenon known as information overload; it differs from cognitive load in that it occurs earlier in the learning process, during the sensory stage of perception (Chen et al., 2011). However, since some researchers use the terms interchangeably (for example, Ismailov & Ono, 2021), and because information overload has been likened to extraneous load (Chen et al., 2011), the two terms can be seen as synonymous for the purposes of this study.

No matter the terminology, CLT can help educators understand and facilitate effective cognitive processing in students. The benefits of germane load, paired with motivation, include the ability to learn more in a shorter period of time (Woo, 2014). Such benefits are why Sweller et al. (1998) recommended that learning environments be designed to encourage germane load and reduce extraneous load. When inadequate design occurs, the resulting overload can increase feelings of perceived difficulty in online classes (Conrad et al., 2022) and is associated with decreased motivation (Ismailov & Ono, 2021). Cognitive overload may also be common among

first-time online learners and influence their dropout rates (Tyler-Smith, 2006). Even though Tyler-Smith (2006) studied adult learners in entirely online programs, there were still numerous students learning remotely for the first time at the beginning of the pandemic.

While it may seem intuitive to ease students into online learning through incorporating social interaction and collaborative work, doing so indiscriminately has the potential to eventually increase extraneous load, akin to diminishing returns (Strang, 2011). Relatedly, Costley and Fanguy (2021) examined the effect of collaborative note-taking on online learners, finding that this form of collaboration can increase both germane load and extraneous load. This type of note-taking typically involves students independently watching recorded lectures and adding their notes to a shared Google Doc (Almusharraf et al., 2020; Costley & Fanguy, 2021).

Since the behavior of classmates, along with poor instructional design, can negatively impact students' cognitive processing and learning experiences, reducing extraneous load is essential. However, despite the overall positive effects of increasing germane load, it is important to remember that learners each have individual capacities. Chen et al. (2012) found that information overload does not affect students equally, indicating they do not all struggle with overload to the same degree. The researchers suggested that these differences may be attributed to varying metacognitive abilities, including the regulation that Valcke (2002) highlighted, and prior knowledge. For example, Chen et al. (2011) determined that low levels of prior knowledge could lead to increased information overload. Valcke also argued that prior knowledge can impact cognitive processes for learning; additionally, prior knowledge may help students have more lecture-related thoughts during class and ultimately perform better (Jing et al., 2016).

Prior knowledge, then, can potentially assist with cognitive overload (Chen et al., 2012). Still, other factors, such as time, can mitigate the benefits of prior knowledge, leading students to adopt strategies to cope with overload in online environments (Chen et al., 2011). Specifically, Chen et al. (2011) reported that some students tried to assess the importance of information through external cues, such as "assignments, learning objectives, and overviews of the module content" (p. 112). Another potential cue is the behavior of other students.

Social Influence and Appraisals

People affect each other's learning, especially since learners pay more attention to information presented in a social context than in a non-social context (Puskaric et al., 2018). In all social situations, conformity is one factor that can shape beliefs and behavior. Two types of conformity are normative social influence and informational social influence. Normative influence occurs with the goal of fitting in within a group, while information influence occurs when an individual accepts what is true based on the actions of others (Deutsch & Gerard, 1955). Conformity in either form is powerful as unanimous agreement can affect one's judgement, even if the influence is from strangers (Asch 1956, as cited in Levitan & Verhulst, 2016).

Levitan and Verhulst (2016) researched how normative and informational influence affect opinion sharing when individuals do not debate their views. They examined both in-person and online opinion sharing, finding that normative influence was stronger in in-person environments. A possible implication for informational influence is that it may be more prominent in online environments. Wu et al. (2019) can support this notion as, when information is perceived as valuable, online learners are more likely to seek others' opinions about their learning progress. Learners are even more likely to ask for this feedback when the social risk is

low (Wu et al., 2019). Since normative influence can be more influential when interacting with others face-to-face (Levitan & Verhulst, 2016), social risk is presumably lower in online courses. Reduced social risk may give rise to informational influence as students can focus on using their peers as a cue for their beliefs, including about their academic development, rather than for behavior.

These social influences may initially result in conformity, but over time this conformity can lead to legitimate changes to an individual's attitudes (Levitan & Verhulst, 2016). As such, conformity may transition into the realm of social appraisals. Social appraisals differ from informational influence in that when an individual socially appraises information, they change their view rather than superficially adopting another's view (Manstead & Fischer, 2001; Parkinson, 2011). More specifically, an individual evaluates a person's reaction to an event, which can then affect their personal interpretation of that same stimulus (Manstead & Fischer, 2001; Parkinson, 2011). Social appraisals could have a role in attention contagion as Kalsi et al. (2022) found that students' beliefs about the relevance of online lecture content may have been influenced by the attentiveness of their peers. So, while attention contagion can reflect a form of conformity, it may also contribute to a more substantial belief change if students can appraise their peers, given that time allows it.

Time

In contrast with both in-person and live-streamed lectures, students can take as much time as needed to interact with content from recorded lectures. Online discussion posts also allow students more time to process elements like social cues, including implicit meanings not directly communicated in written posts, such as from the use of emoticons and ellipses (Dalelio, 2013).

Additionally, students evaluate and assign value to others' discussion comments, with higher value for commenters that were a friend or seemed trustworthy (Sloan, 2015). Trust levels, however, are not associated with seeking cues for online social navigation, which include checking how many people are currently reading the same article (Farzan & Brusilovsky, 2019). Social cues are thus influential in navigating online spaces, and while a person's trust in others does not influence their likelihood to use them, the salience of these cues may depend on time.

For example, Farzan and Brusilovsky (2019) found, with the utilization of eye tracking technology, that people are more likely to use social navigation cues when there is limited time. Students with and without information overload may also use social cues as a means of dealing with pressure caused by limited time (Chen et al., 2012); moreover, students with higher levels of prior knowledge may still struggle with information overload when there is a time limit (Chen et al., 2011). In viewing recorded lectures, though, there are no such constraints as students can pause and rewind as needed (Costley & Fanguy, 2021), a feature that students appreciate (Shim & Lee, 2020). Such viewing behavior increases with rising extraneous load, and in turn, more frequent viewing behaviors lead to a higher germane load (Costley et al., 2021).

The Present Study

Even though viewing strategies, such as pausing and rewinding, can increase germane load, students still may not be as cognitively overwhelmed as during synchronous lectures, whether in-person or live-streamed. Students can control the flow of information while asynchronously watching recorded lectures; so, students may be less inclined to rely on social cues, such as social appraisals. Such social cues could contribute to attention contagion through providing students a means to deal with cognitive overload; for example, a student may use

others' behavior to determine whether they should be paying attention. The present study aimed to examine if and how attention contagion occurs among students watching recorded lectures through considering cognitive load, social influences, and time. Our hypotheses were as follows: (1) quiz performance will not be associated with the attentiveness or inattentiveness of confederates, (2) attention contagion will be more likely among participants who report experiencing cognitive load, and (3) attention contagion will be more likely among participants who report more frequently assessing the behaviors and beliefs of confederates.

METHOD

Participants

Participants were undergraduate UCF students aged 18 years old or older. All participants were recruited through SONA and received 0.5 credit for completing the 30-minute online study. One hundred and forty-two participants started the study, and 127 completed it. Seven participants in the attentive condition and 8 participants in the inattentive condition did not complete the study. Additionally, three participants who did complete the study were removed for incorrectly answering the attention check question in the post-lecture quiz, with two in the attentive condition and one in the inattentive condition. After these adjustments, the results of this study are based on 120 participants, with 60 participants in each condition.

Materials

Manipulated Recorded Lectures

Two Zoom lectures 4.5 minutes in length were created. The original lecture was recorded once, and the two confederates recorded themselves twice, once while displaying attentive behavior and again while displaying inattentive behaviors. The behaviors they displayed for each condition were the same as those that Kalsi et al. (2022) used for their confederates. For the attentive condition, these behaviors included sitting up straight, looking at the screen, and nodding in reaction to the lecture. For the inattentive condition, behaviors included slouching, looking away from the screen, and restlessness. The confederates' recordings were then spliced on top of the original lecture video, along with two recordings of two fake students with their cameras off.

By manipulating the lectures, the delivery of the content was the same for both lectures so that the only difference was the confederates' behavior. To attempt to account for prior knowledge, the topic of the lecture sample was the vocal folds. The lecture was inspired by SPA 3101, which is an upper-level course only required for students majoring or minoring in communication sciences and disorders, reducing the chance of previous exposure to the content. Additionally, the recorded lecture was designed to mimic a realistic live-streamed lecture where cognitive overload would be possible, such as through not adjusting the design of the slides to accommodate the confederates' boxes and not taking breaks when delivering the lecture. See Appendix A and Appendix B for screenshots of the attentive and inattentive lecture samples.

Post-Lecture Quiz

The post-lecture quiz consisted of seven questions, with one being an attention check. The quiz served as a general attention measure to compare with previous studies; more specifically, the quiz assessed students' retention of information from the lecture. The quiz questions can be found in Appendix C.

Self-Report Survey

The self-report survey assessed a variety of factors from the participant's experience watching the lecture, including their attention, how much they valued the lecture content, whether they experienced cognitive overload, the attention of the confederates, and how much the confederates cared about the lecture. Some of the questions were original to assess potential contributors to attention contagion, and some were inspired by Kalsi et al. (2022). The survey questions can be found in Appendix D.

Demographic Questionnaire

The demographic questionnaire consisted of questions asking for characteristics like age, gender, student classification (freshman, sophomore, etc.), credit hour status (part-time student versus full-time student), employment status, and ADHD diagnosis. The demographic questions can be found in Appendix E.

Procedure

The participants completed the entire study online. Through the Qualtrics randomizer feature, participants completed one of two conditions. Participants either watched the video with attentive confederates or the video with inattentive confederates. Then, all participants completed the same post-lecture quiz, self-report survey, and demographic questionnaire.

Data Analysis

Participant data was analyzed through SPSS with a confidence level of 95%. T-tests and ANOVAS compared the quiz and survey results based on condition and demographic factors. Pearson's correlations were conducted to determine the existence and direction of any relationships between survey responses. As for qualitative data, responses to the final open-ended survey question were coded and then interpreted based on the frequency of each type of response.

RESULTS

The first hypothesis, quiz performance will not be associated with the attentiveness or inattentiveness of confederates, relied on results from the post-lecture quiz and t-tests to compare mean quiz performance. Figure 1 shows the average quiz results for each condition, with the average score in the attentive condition being 65% and the average score in the inattentive condition 62%. T-test results did not reveal a significant difference in participants' performance on the quiz. Relatedly, t-test results did not reveal a difference in how participants in each condition answered survey Question 9, which was "How often did you pay attention to the lecture?"

The second hypothesis, attention contagion will be more likely among participants who report experiencing cognitive load, was assessed through bivariate correlations of the survey responses. Table 7 contains the relevant findings for the inattentive condition. Specifically, there are three relevant findings, with the first being a positive correlation between Question 2 ("If yes, how overwhelmed were you?") and Question 3 ("How frequently did you look at the students with their cameras on?"), $r(58) = .427$, $p < .001$. The second relevant finding is a positive correlation between Question 3 ("How frequently did you look at the students with their cameras on?") and Question 8 ("How frequently did you think about things not related to the lecture?"), $r(58) = .494$, $p < .001$. The final relevant finding is a negative correlation between Question 8 ("How frequently did you think about things not related to the lecture?") and Question 9 ("How often did you pay attention to the lecture?"), $r(58) = -.521$, $p < .001$. For the attentive condition, the only relevant finding is a positive correlation between Question 2 ("If yes, how overwhelmed were you?") and Question 4 ("How frequently did you look at the

students with their cameras off?"), $r(58) = .538$, $p < .001$. The rest of the attentive correlations can be found in Table 6.

The third hypothesis, attention contagion will be more likely among participants who report more frequently assessing the behaviors and beliefs of confederates, was also assessed through bivariate correlations of the self-report survey responses. No bivariate correlations in either condition supported this hypothesis. However, the results of Table 1 from t tests comparing both conditions reveal that participants in each condition significantly differed in how they answered Question 6 ("How important was the information to the students with their cameras on?") and Question 10 ("How often did the students with their cameras on pay attention to the lecture?"), which were the only two survey questions that asked participants to evaluate the confederates.

DISCUSSION

The purpose of this study was to examine attention contagion in recorded lectures found in online courses. This study also aimed to assess potential contributors to the spread of attention contagion, such as cognitive overload and social appraisals. Literature on attention contagion is limited; this was the first known study to examine this phenomenon in recordings of previously live-streamed lectures. The results suggest that while attention does not spread, inattention may spread unconsciously while watching recorded lectures, as demonstrated by correlations found between survey question responses for the inattentive condition. Additionally, cognitive overload may play a role while the potential role of social appraisals remains unclear.

As predicted, quiz performance was not significantly different between participants in the attentive and inattentive conditions. Additionally, while there was an overall higher average score in the attentive condition, the 3% difference is not as stark as the 12% difference found by Forrin et al. (2021) and Kalsi et al. (2022). Participants' self-reported attention also did not significantly differ between each condition, which contrasts with both Kalsi et al. (2022) and Forrin et al. (2021), where participants reported higher levels of attention in the attentive condition. This could relate to the small difference in quiz performance, as overall participants' conscious, perceived attention did not significantly differ across the conditions. As such, this study's first hypothesis regarding quiz performance has been supported.

Still, the participants in the inattentive condition performed slightly worse on the quiz, which may have been influenced by the inattentive confederates in the recorded lecture video.

Given the association between participants more often looking at the inattentive confederates and more often thinking about things not related to the lecture, inattention potentially spread to participants since not thinking about the lecture indicated they were not paying attention.

Additionally, inattention may spread unconsciously, as this relationship does not appear with participants' conscious assessment of their attention, but rather is associated with an inattentive behavior. Specifically, the positive correlation between Question 3 ("How frequently did you look at the students with their cameras on?") and Question 8 ("How frequently did you think about things not related to the lecture?") and the negative correlation between Question 8 ("How frequently did you think about things not related to the lecture?") and Question 9 ("How often did you pay attention to the lecture?") demonstrates an indirect relationship between self-reported attention and looking at other students that may indicate inattention spreading unconsciously. Relatedly, Colombatto and Scholl (2022), although in relation to physiological measures and not a classroom setting, did find evidence for unconscious attention contagion. So, there is the possibility of inattention spreading unconsciously as well.

As for potential influences on attention or inattention contagion, cognitive load was an observable factor. In the inattentive condition, there was a positive relationship between participants feeling overwhelmed by the amount of information and looking at the inattentive confederates; as already established, looking at inattentive confederates was associated with not thinking about the lecture. So, unconsciously or not, cognitive overload may help facilitate the spread of inattention. As for the attentive condition, the more often participants felt overwhelmed, the more often looked at the confederates with their cameras off. A potential reasoning for this relationship is that if participants are overwhelmed, they would not want to

focus on students paying attention as this will still leave them feeling overwhelmed. So, they may instead focus on the least information-rich aspect of the lecture: students with their cameras off. So, cognitive overload may influence the spread of inattention, but not attention, meaning that the second hypothesis was supported in the inattentive condition, but not the attentive condition.

The other hypothesized factor, social appraisals, was not as evident. The first finding is that, in both conditions, the two questions that were significantly answered differently were "How important was the information to the students with their cameras on?" and "How often did the students with their cameras on pay attention to the lecture?" Both of these questions were the only two that asked participants to evaluate the student confederates. In the attentive condition, participants more often reported that the confederates were paying attention, and that the lecture information was important to the confederates. The opposite is true in the inattentive condition. So, participants fairly accurately assessed confederates' attention and assigned meaning to that behavior.

Overall, these results demonstrate that in both conditions, participants were paying attention to the confederates' behavior and were evaluating it. However, there is no evidence that suggests consciously assessing confederates' attentive or inattentive behavior affected the participants' own attention levels and beliefs about the importance of the lecture. So, the third and final hypothesis relating to social appraisals was not supported by this study. This result could be because recorded lectures are asynchronous events that do not facilitate live social interaction. Additionally, such interactions may depend on factors like student classification, as there was a meaningful difference in how participants answered the question "How important

was the information to the students with their cameras on?" in the attentive condition based on whether they were a freshman, sophomore, junior, or senior. This finding is relevant as it may indicate that one's length of college experience may influence the interpretation of fellow students' behavior.

While social appraisals were not evident, open-ended feedback from the survey suggests that the confederates' behavior still may influence what aspects of a lecture students pay attention to and how they perceive the quality of the lecture as a whole. In the attentive condition, the most common comments related to the lecturer and the lecture design; for example, three participants all commented on the amount of "uhs" spoken by the lecturer, whereas no participants in the inattentive condition noted this. In the inattentive condition, the most common comment related to the quality of the lecture; for example, three participants noted the lecture should be more "engaging," whereas only one participant noted this in the attentive condition. So, students who are already engaged with a lecture may not look at other students, as they could instead be focused on evaluating the details of the lecture, such as the performance of the lecturer and the design of the lecture. In contrast, if students are not engaged with a lecturer, they may focus on evaluating the lecture as a whole, such as its overall effectiveness.

These results provide guidance for future research, including directly researching how other students' behavior may affect students' perception of the quality of the lecture. Additionally, attention contagion should be further investigated based on if and when it is an unconscious process and in what types of environments, particularly synchronous versus asynchronous. Cognitive load can also be further examined in the spread of inattention, as well as whether social appraisals are a factor for synchronous lectures, in-person or live-streamed.

Future research should also consider examining the effects of recorded lectures where all students have their cameras on as well as the effect of confederates switching from being attentive to inattentive mid-way through the lecture, and vice versa.

For limitations of this research, there was a lack of a true objective measure of students' attentive or inattentive behavior, with the majority of the results relying on self-report measures. Kalsi et al. (2022) and Forrin et al. (2021) both conducted behavior coding, and the present study originally planned on comparing self-report measures with eye tracking results. However, traditional eye tracking technology does not lend as well to assessing videos as it does still images. In addition to the data being more difficult to interpret, the eye tracker would have prevented participants from looking away from the screen, otherwise the eye tracker would reset. This requirement would inherently bias attention, and so the eye tracker was removed from this study. However, recommendations for future research include the use of VR eye tracking, where participants have more freedom in movement. Additionally, motivation could also be considered in future studies as while Forrin et al (2021) also only offered course credit, Kalsi et al. (2022) offered both course credit and a lottery for $100 Amazon gift certificates based on participants' quiz performance.

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Table 1: Significant Independent T-Tests

	Attentive		Inattentive		t	p
	M	SD	M	SD		
Q6 Responses	2.65	1.071	3.17	1.167	-2.527*	.013
Q10 Responses	2.77	.945	3.67	.877	-5.407**	<.001

* = p < .05, ** = p < .01

Note. Both results are from comparing responses to survey questions in the attentive and inattentive conditions. There were no significant t-test results for the applicable demographic factors.

Table 2: Significant ANOVA Tests

	Freshman		Sophomore		Junior		Senior		F	Sig.
	M	SD	M	SD	M	SD	M	SD		
Q5 Responses	2.78	1.023	2.69	1.138	1.97	.897	2.22	.972	5.010**	.003
Q6 Responses	2.70	1.057	3.44	1.153	2.88	1.238	3.56	1.014	2.951*	.036

* = $p < .05$, ** = $p < .01$

Note. The responses to survey Question 5 and Question 6 differed by student classification, which were freshman, sophomore, junior, and senior.

Table 3: Significant ANOVA Tests in Attentive Condition

	Freshman		Sophomore		Junior		Senior		F	Sig.
	M	SD	M	SD	M	SD	M	SD		
Q6 Responses	2.48	.906	4.00	.707	2.47	1.281	3.00	.707	3.693*	.017

* = $p < .05$, ** = $p < .01$

Note. The responses to survey Question 6 differed by student classification, which were freshman, sophomore, junior, and senior.

Table 4: Significant ANOVA Tests in Inattentive Condition

	Freshman		Sophomore		Junior		Senior		F	Sig.
	M	SD	M	SD	M	SD	M	SD		
Q5 Responses	2.93	1.081	2.64	1.286	1.93	.884	2.50	1.291	2.829*	.047

* = $p < .05$, ** = $p < .01$

Note. The responses to survey Question 5 differed by student classification, which were freshman, sophomore, junior, and senior.

Table 5: Significant Bivariate Correlations for All Data

Survey Question	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Q2		.315**	.400**				.240**		
Q3			.220*				.315**		
Q4									
Q5						.288**		.304**	
Q6									.336**
Q7							-.438**	.432**	
Q8								-.486**	
Q9									
Q10									

* = p < .05, ** = p < .01

Table 6: Significant Bivariate Correlations in the Attentive Condition

Survey Question	Q2	Q4	Q5	Q6	Q7	Q8	Q9
Q2		.538**					
Q4							
Q5							.261*
Q6							
Q7						-.410**	.428**
Q8							-.450**
Q9							

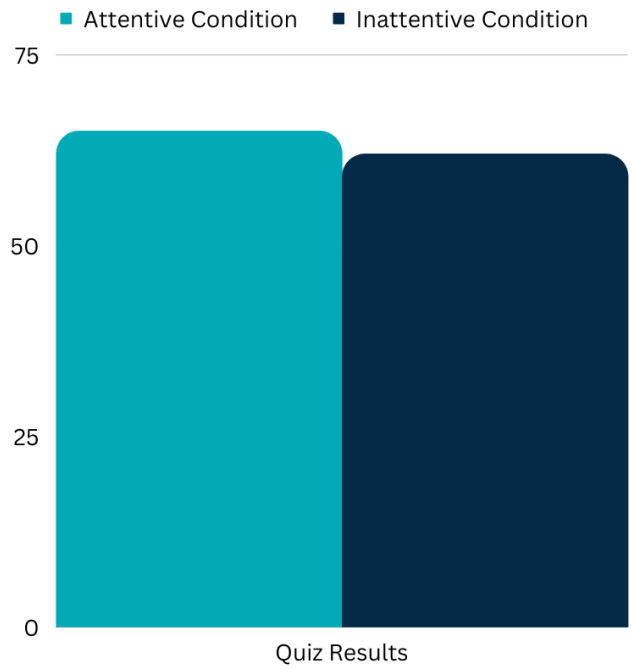
* = $p < .05$, ** = $p < .01$

Table 7: Significant Bivariate Correlations in the Inattentive Condition

Survey Question	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Q2		.427**					.303*		
Q3							.494**		
Q4									
Q5						.399**		.328*	
Q6									.354**
Q7							-.462**	.438**	
Q8								-.521**	
Q9									
Q10									

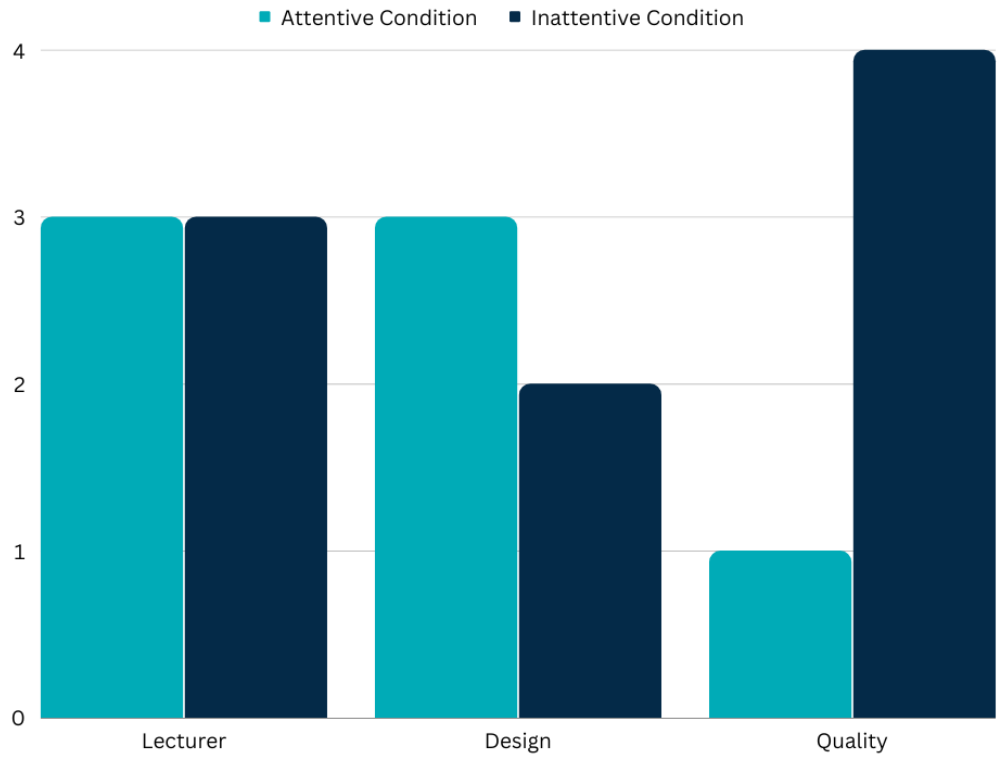
* = p < .05, ** = p < .01

Figure 1: Average Quiz Results in Attentive and Inattentive Conditions



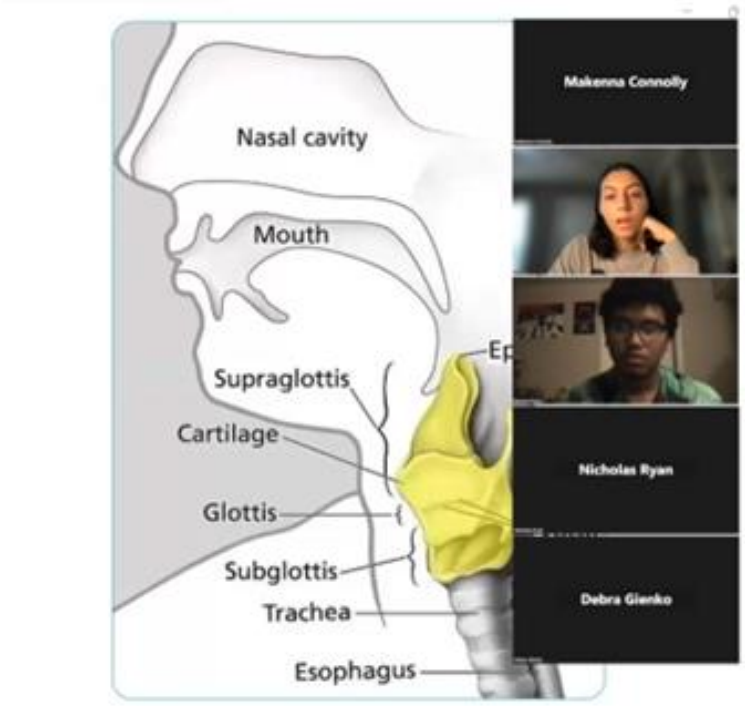
Note. The average quiz score for the attentive condition was 65%, and the average score in the inattentive condition was 62%.

Figure 2: Coded Open-Ended Reponses in the Attentive and Inattentive Conditions



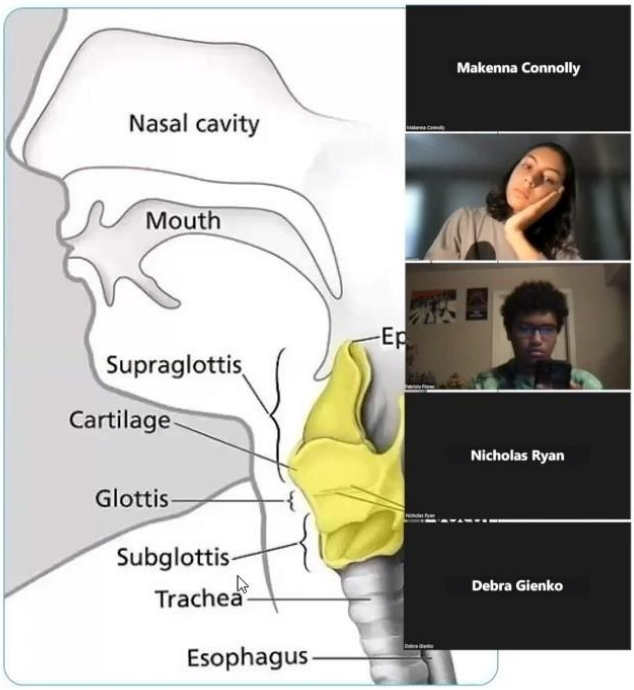
APPENDIX A: ATTENTIVE MANIPULATED RECORDED LECTURE SAMPLE

The Larynx (aka the Voice Box)



APPENDIX B: INATTENTIVE MANIPULATED RECORDED LECTURE SAMPLE

The Larynx (aka the Voice Box)



APPENDIX C: POST-LECTURE QUIZ

1. What is phonation?

    a. the vibration of the vocal folds
    b. the closing of the epiglottis
    c. the closing of the vocal folds
    d. the opening of the vocal folds
2. The trachea is located _____ the vocal folds. (Fill in the blank)

    a. above
    b. below
    c. behind
    d. in front of
3. What are the vocal folds made of?

    a. muscle and cartilage
    b. muscle covered by a layer of mucous membrane
    c. tissue and cartilage
    d. mucosa covered by a layer of mucous membrane
4. Please select “larynx” from the list below.

    a. vocal folds
    b. epiglottis
    c. larynx
    d. trachea
5. What is the difference between adduction and abduction of the vocal folds?

    a. adduction stretches the vocal folds, and abduction condenses them
    b. abduction stretches the vocal folds, and adduction condenses them
    c. adduction opens the vocal folds, and abduction closes them
    d. abduction opens the vocal folds, and adduction closes them
6. What is the purpose of the epiglottis?

    a. to allow air to flow through the vocal folds
    b. to help move the vocal folds
    c. to prevent food and drink from entering the trachea
    d. to warm air before it reaches the lungs
7. What is the difference between paired and unpaired cartilages?

    a. a paired cartilage means there is one cartilage, while an unpaired cartilage means there are two cartilages
    b. an unpaired cartilage means there is one cartilage, while a paired cartilage means there are two cartilages
    c. an unpaired cartilage does not attach to the intrinsic muscles, while a paired cartilage does attach to the intrinsic muscles

d. a paired cartilage does not attach to the intrinsic muscles, while an unpaired cartilage does attach to the intrinsic muscles

APPENDIX D: SELF-REPORT SURVEY QUESTIONS

(Question 1) Were you overwhelmed by the amount of information?

- Yes
- No

(Question 2) If yes, how overwhelmed were you?

- Significantly
- Moderately
- Slightly
- I was not overwhelmed by the amount of information

(Question 3) How frequently did you look at the students with their cameras on?

- Very Frequently
- Frequently
- Occasionally
- Rarely
- Never

(Question 4) How frequently did you look at the students with their cameras off?

- Very Frequently
- Frequently
- Occasionally
- Rarely
- Never

(Question 5) How important was the information from the lecture?

- Very Important
- Important
- Slightly Important
- Neutral
- Not At All Important

(Question 6) How important was the information to the students with their cameras on?

- Very Important
- Important
- Slightly Important
- Neutral
- Not At All Important

(Question 7) How frequently did you think about things related to the lecture?

- Very Frequently
- Frequently
- Occasionally
- Rarely
- Never

(Question 8) How frequently did you think about things not related to the lecture?

- Very Frequently
- Frequently
- Occasionally
- Rarely
- Never

(Question 9) How often did you pay attention to the lecture?

- Always
- Very Often
- Often
- Sometimes
- Rarely
- Never

(Question 10) How often did the students with their cameras on pay attention to the lecture?

- Very Frequently
- Frequently
- Occasionally

- Rarely
- Never

(Question 11) Were you familiar with the information in the lecture?

- Yes
- No

(Question 12, Open-Ended) Do you have any additional feedback about the lecture?

APPENDIX E: DEMOGRAPHIC QUESTIONNAIRE QUESTIONS

(Question 1, Open-Ended) What is your age?

(Question 2, Open-Ended) What is your gender?

(Question 3) What is your student classification?

- Freshman
- Sophomore
- Junior
- Senior

(Question 4, Open-Ended) How many credit hours are you taking this semester?

(Question 5) What is your employment status?

- Unemployed (currently looking for work)
- Unemployed (not currently looking for work)
- Employed part-time (less than 40 hours per week)
- Employed full-time (40 or more hours per week)
- Self-employed
- Retired

(Question 6, Open-Ended) If you selected "Employed part-time," how many hours do you work per week? If you do not work part-time, type N/A.

(Question 7) Have you ever been diagnosed with ADHD?

- Yes
- No

(Question 8) If yes, are you currently taking medication for ADHD?

- Yes
- No
- I have never been diagnosed with ADHD