# Lights, Camera, Attention? A Quantitative Study on the Influence of Video Cameras on Sustained Attention in Videoconferences

*Keywords: Videoconferences, Zoom fatigue, sustained attention, distraction, concentration*

## Extended Abstract

With the onset of the Covid-19 pandemic in early 2020, a large percentage of workers saw themselves working from home overnight. But students, in particular, also had to adapt quickly to the new circumstances. Meetings and lectures had to go digital and took place online via videoconferencing tools such as Zoom or Microsoft Teams. Statistics from Zoom prove this digital transformation: In 2013 Zoom started with only 400,000 registered users in the first month, in 2020 the software was downloaded more than 485 million times in total and counts about 300 million individual daily users (Dean, 2022). Compared to the same quarter the year before, annual Zoom meeting minutes increased by 3,300% in October 2020 (Dean, 2022).

Especially students did not find the transition to remote learning and education easy. In addition to all the problems that came with the pandemic, such as being separated from family members and friends due to various lockdowns or fear of economic problems, the switch to videoconferencing led to many unforeseen problems. These were both of a technical nature (e.g., data protection, Internet bandwidth) (Karl et al., 2021) and of a learning organization nature: How do you learn alone and without a teaching person around who can help at any given time? How do you manage to concentrate on the subject matter during online class sessions besides all private problems and not get distracted by things apart from the online lecture? A well-known phenomenon that has arisen as a result of this change is the so-called Zoom fatigue. This describes exhaustion after numerous or long-lasting videoconferences (Bailenson, 2021). Bailenson (2021) explains that one of the reasons for Zoom fatigue is self-focused attention resulting from the constant confrontation with one's camera image. Hoping that a quick end to the pandemic would bring workers and students back into the offices and classrooms of the world, many institutions speculated that they would not have to deal with the problems and challenges caused by videoconferencing, including but not limited to Zoom fatigue and attention deficits. But the reality painted a different picture: Even after the pandemic has subsided, many employees and students remain at least partially working and studying from home. Therefore, there is still much to learn about the problems of videoconferencing and online lectures.

Initial research investigating these problems explored the question of where participants in videoconferences actually look and what they do during meetings (George et al., 2022). George et al. (2022) found that participants often engage with and observe their own or other video images besides the actual contents of the virtual meetings, which in turn affects participants' attention. This paper sets out to explanatorily test the hypothesis of whether sustained attention is affected by one's and other conference participants' video images in videoconferences. However, we explicitly do not want to measure the effects on attention during the videoconference, but instead the subsequent effects on concentration and attention after the videoconference.

To achieve this goal, a quantitative study was conducted with two groups consisting of 35 subjects each. Both groups performed a Sustained Attention to Response Task (SART) at the

beginning of the study to measure their sustained attention. Then they participated in a fictional online lecture via a fictional videoconferencing tool. While one group saw only the content of the lecture, subjects in the other group saw the content of the lecture and additionally their video image and the video images of other, fictional lecture participants. This setup can be seen in figure 1.

Following the videoconference, participants again performed the SART. In the analysis, using t-tests both the before and after results of the same groups were compared with one another and the results of the two groups were compared with each other. The results confirm the hypothesis that the attention of videoconference participants is influenced by video cameras. They suggest that subjects who only saw the lecture performed better in the second attention test.

By confirming the hypothesis, this study provides a solid foundation on which future work can build. At the same time, the results show that established theoretical constructs, such as Attention Restoration Theory (Kaplan, 1995), cannot be transferred 1:1 to virtual environments and thus need to be rethought in the context of future research.

We designed the experimental environment to not only resemble but exactly match typical videoconferencing and remote lecture scenarios as they were frequently used during the COVID-19 pandemic and are likely to be used in the future. The spontaneous switch to distance learning and conferencing left little time to figure out how this transition should be done as efficiently as possible.

This paper provides possible clues to facilitate smoother conferencing in the future: The improvement of attention caused by the lack of video cameras suggests that in the future, especially during mentally challenging phases in videoconferences, the cameras and microphones of all participants should be switched off. This knowledge can be particularly useful for the education sector, as sustained attention is a key component of successful knowledge transfer. For example, during future remote lectures, all cameras could be turned off during theory phases and turned on only for discussions and question sessions following the theory part. This could enable a higher level of attention during discussion phases.

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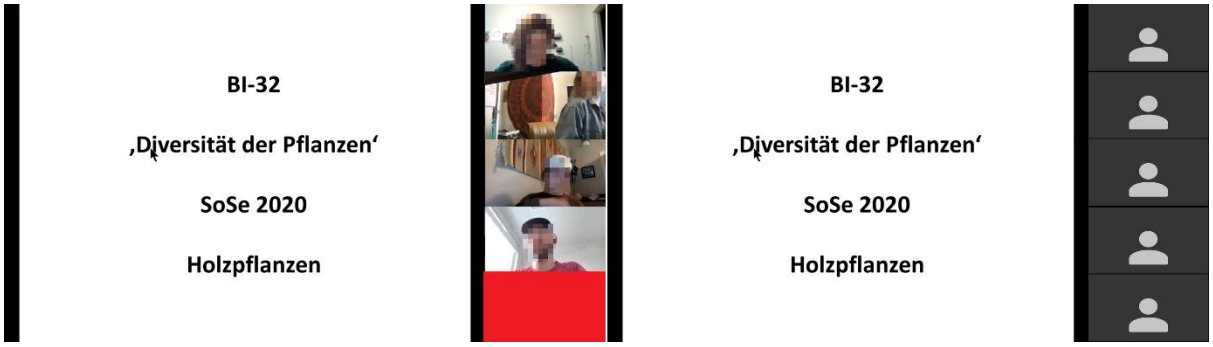


Figure 1. Screenshots of both fictional videoconference in which the subjects participated. Subjects from group 1 participated in the conference on the left side where four other fictional conference participants can be seen on the right side of the screen. For purposes of this paper they were retroactively pixelated, however, they were visible to the subjects unpixellated during the study. The red area indicates where the subjects could see themselves in their own video images during the study. Subjects from group 2 participated in the conference on the right side where all camera images were switched off and all other participants were represented only by an empty tile on the right side of the screenshot.