Perception of Eye Contact in Video Conferencing & Attention

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Figure 1: Setup of eye tracking technology with subject.

ABSTRACT

In this eye-tracking experiment, the perception of eye contact on information retention via an online video conferencing platform is studied. Eye-contact has always remained an issue when using the relatively new platform of communication that is online video conferencing, as the richness of the conversation is believed to be inferior to face-to-face conversation due to the fact that more non-verbal means of communication is often shielded by the view of the web camera's lens. Some researchers in this field have attempted to manually adjust the caller's gaze using specialized software, while others have focused more on other non-verbal cues, such as synchrony. This experiment aimed to study the effects of eye contact on attention and retention via a simulated Zoom call – a popular online video conferencing application. After each participant was showed one of two videos (differing in whether eye contact was maintained), it was discovered that the participants who watched the video without consistent eye contact answered slightly fewer answers correctly on the quiz. Additionally, those same participants were found to have more eye movements during the video, with their fixation duration shorter on average when compared to the participants who watched the other video. However, there existed a few roadblocks, such as a small sample size and availability of the participants to perform in the study.

CCS CONCEPTS

• **Computer systems organization → Embedded systems**.

KEYWORDS

eye tracking, visual attention, cognitive load

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1 INTRODUCTION

Eye contact has long been believed to be responsible for a majority of nonverbal communication cues that humans use to communicate, but when face-to-face interaction is taken away, such as on an online platform, it can be difficult to remain focused in the conversation and pick up on those nonverbal cues. In this experiment, we are going to track participants' gaze through a simulated video conference (pre-recorded video) in order to discern what parts of the face are looked at the most. Using this method, we can also record how long eye contact was maintained and whether the amount of eye contact made correlates with the attentiveness of the participant. Attentiveness is measured by a self-reported survey or quiz.

2 BACKGROUND

In the research paper written by Leanne S. Bohannon, Jeff Pelz, Esa Rantanen, and Andrew Herbert, the authors discuss the importance of eye contact in conveying verbal and non-verbal information in human interaction while measuring where video conferencing falls on the scale of communication richness [1]. Similarly, in the research paper written by Roel Vertegaal, Chris Cheung, Changuk Sohn, and Ivo Weevers, the authors focus on the importance of perceived eye contact via video conferencing using a video conferencing software called GAZE-2 that automatically adjusts the camera angle to addresses the parallax issue that plagues video calls, which simulates eye contact with the camera, regardless of whether the camera is aligned perfectly with the caller's eyes [3]. Lastly, Sophie Wohltjen and Thalia Wheatley discuss in their research article the concept of "synchrony" and its significance in maintaining attention throughout conversation, using videos recorded by the participants to study the correlation between eye contact and mutual understanding of the conversation [2]. The aforementioned study can be applied to video conferencing by studying the effects

Figure 2: Pre-recorded video stimulus (practice)

of synchrony on attention with and without a parallax-free video stream.

2.1 Relevance

Within the domain of academic research, the selected papers investigate the influence of eye contact on our interpersonal connections and communication. One noteworthy study, conducted by Bohannon and their research team, delves into a multitude of research findings that emphasize the pivotal role of eye contact. It's not just about making conversations smoother; it is about establishing trust and shaping critical first impressions [1].

Similarly, Wohltjen and Wheatley focus on crucial moments in conversations where eye contact holds particular importance. These moments impact how we can coordinate our dialogues with others [2].

The prevalence of video conferencing in our lives is undeniable, but it's worth noting that something feels missing when genuine eye contact cannot be established through a screen. This is precisely what these studies address. They reveal that when video calls fall short of replicating genuine eye contact, it can disrupt our communication and alter our perceptions of others. Investigating eye gaze behavior in virtual chats holds immense relevance as it helps us understand the implications of not being able to establish eye contact.

In terms of methodology, Bohannon and their team have employed advanced eye-tracking technology to carefully observe where our eyes wander during real or simulated video chats, providing insights into virtual eye contact [1].

Finally, Vertegaal and their colleagues have introduced an innovative video conferencing system that leverages eye tracking to make video chats feel as natural as face-to-face conversations. It is a bit like infusing technology with a human touch [3].

These studies are not merely academic exercises; they aim to make our virtual interactions as authentic as in-person meetings, a vital objective in today's interconnected world.

3 EMPIRICAL VALIDATION

This section will focus on the design, participants, apparatus, stimulus, and procedure.

3.1 Experimental Design

This eye-tracking experiment is designed as a one-factorial between-subjects experiment, in which the authors of this study pose as two lecturers who are communicating information to the participant via a prerecorded Zoom call. In one version of the video, we are maintaining eye contact, whereas the other version we are rarely initiating eye contact. Each participant views only one version of the video, which is rotated for every other participant for even distribution of data. The contents of the video are the same, except for the aforementioned eye contact. The participant's gaze analysis is then compared after watching one of the two videos to determine any correlations between perceived eye contact and retention of the information presented. At the end of the video, a short quiz is presented through PsychoPy to measure the attentiveness of the participant.

3.2 Participants

The subjects of this study included six Clemson University students, of whom volunteered via word-of-mouth and after reviewing the details of the experiment on a flyer. The method for recruiting participants was via word-of-mouth. There were no discriminating factors in determining the participants allowed to take part of the study. The videos emulating a video conference were staged and performed by the authors of the study.

3.3 Apparatus

The apparatus used for this eye-tracking experiment comprises of several key components, each essential to the collection and analysis of gaze behavior data. Our data collection relies on the utilization of a Gazepoint Eye Tracker, an advanced eye-tracking technology that captures and records participants' eye movements during the simulated video conference using infrared light.

To manage the eye tracking data obtained from participants, as well as analysing the data and interpreting it, we are using the program PsychoPy, an open-source software tool widely employed for conducting experiments in psychology and neuroscience. The PsychoPy script is custom-designed to orchestrate the presentation of the pre-recorded videos and the seamless delivery of the questionnaire to participants. As well, the quiz, an integral component of the experiment, is administered through the same PsychoPy software to evaluate participants' attentiveness and their grasp of the content presented in the video.

Our study features two versions of the pre-recorded videos, each a unique stimulus. One version is characterized by a consistent maintenance of eye contact by the lecturers, while the other exhibits less frequent initiation of eye contact. These videos are systematically rotated for each participant, ensuring an even distribution of data and maintaining consistency in content across all trials.

3.4 Stimulus

In this study, the stimulus encompasses several critical elements. The first element of interest is the level of Participant Eye Contact,

which serves as the dependent variable in our research. This variable quantifies the degree of eye contact maintained by participants during the simulated video conference. We then focus on the Lecturer Eye Contact, which acts as the independent variable. This element gauges the extent to which the lecturers initiate eye contact during the pre-recorded Zoom call. Additionally, after participants view the pre-recorded video, a questionnaire is administered to evaluate their attentiveness and their ability to comprehend the information presented.

3.5 Procedure

In this experiment, both authors assume the roles of two lecturers who are communicating information to the participant via a pre-recorded Zoom call. Before the participants view the video, the Gazepoint Eye Tracker is calibrated using PsychoPy to ensure precise tracking of gaze behavior. In one version of the video, eye contact is maintained consistently, while in the other version, eye contact is rarely initiated. Each participant views only one version of the video, which is systematically rotated for every other participant to ensure an even distribution of data.

The content of the video is identical between the two versions, except for the aforementioned variation in eye contact. After participants view the video, their gaze behavior is analyzed to determine any correlations between perceived eye contact and retention of the information presented. At the conclusion of the video, a short quiz is presented through PsychoPy to measure the attentiveness of the participant.

4 RESULTS

Upon analyzing the data collected, it was observed that the group of participants who were shown the video devoid of consistent eye contact demonstrated a slightly lower performance in the quiz following the video. This data has been inputted into a bar chart in figure 3. They answered fewer questions correctly compared to their counterparts who watched the video where eye contact was maintained. This observation suggests a potential correlation between the presence of eye contact in video conferencing and the effectiveness of information retention.

To further expand upon the results, which questions in particular the subjects missed were analyzed. The two most obvious questions were #5 and #8 as questions struggled upon by participants that watched the no eye contact video. The two question were as follows: #5: What type of visualization shows the most and least viewed areas in a visual stimulus? and #8: In the case study presented, what did the company optimize using eye tracking? Both questions directly related to information not very widely known. In our script from the video, author Rodriguez specifically stated "One common way of visualizing this eye-tracking data is by creating heat maps which show the most and least viewed areas in a visual stimulus." at minute 1:45/3:45. Every participant that watched the video with eye contact got it right, while only one participant of the other group got it right in the post-video quiz. This trend could also be seen in question #8, where in the script of the video, two separate times in the video it had been discussed how companies use eye tracking to optimize websites.

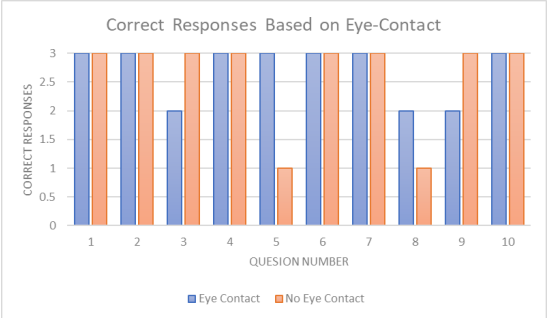

Figure 3: Graph of correct responses.

It is also important to note that although questions 3, 8, and 9 were not answered correctly by all three participants that watched the video with eye contact, there were no questions where only 1/3 participants answered correctly. This differs from what is seen in the participants that watched the video with no eye contact.

Another aspect of the data collected was a heat map of the participants' fixations while watching the video. The recorded data was mapped to a screenshot from the video. Viewing the generated maps, it was found that the participants that were given the no eye contact video had much more sporadic movements and their fixations were generally smaller(less time focused in one area). The bottom map in Figure 4 shows a participant's fixation map who watched the video with no eye contact. There are far fewer large fixation bubbles and far more scan paths visible than in the map above it, which shows a participant that watched the video with eye contact.

5 DISCUSSION

The results suggest that eye contact plays a significant role in information retention during online video conferencing. This aligns with previous research indicating the importance of non-verbal cues in communication. However, the exact mechanisms through which eye contact influences information retention remain to be explored.

Furthermore, these findings have important implications for online communication, particularly in the context of video conferencing. If eye contact indeed enhances information retention, strategies to improve eye contact in online settings could be beneficial.

The results of this study highlight the need for further research to conclusively establish the impact of eye contact on information retention in online video conferencing. Future studies should aim to involve a larger sample size and ensure more controlled conditions. Additionally, exploring other non-verbal cues and their impact on information retention could be an interesting avenue for future research.

6 LIMITATIONS & FUTURE WORK

Despite aiming for at least ten participants for this study, only six volunteers were able to participate in the experiment. This might have been, in part, due to the method of recruitment changing from a university-wide email (what was initially planned) to word-of-mouth. As such, one could argue that there possibly exists a selection bias in our sample. Furthermore, it may be difficult to

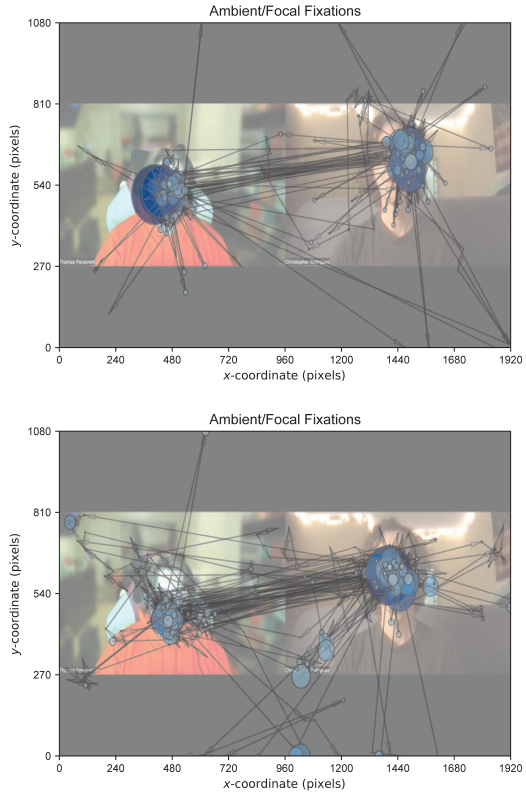

Figure 4: Comparison of heat map of a participant that watched the video with eye contact(top), and without eye contact(bottom).

identify any significant relationships between the dependent variables (the amount of eye contact maintained with the camera by the lecturers in the videos) and how many questions on the quiz each participant answered correctly without a larger sample size. This would certainly make it difficult to discern whether eye contact had any implication on memory attention. Additionally, availability of participants could be considered a limitation in this study, although this might have been avoided with a different means of selection. An additional study, particularly one with a much larger sample size and a more randomized selection process, would be needed to validate the results obtained from this study.

7 CONCLUSION

The results of this experiment provide intriguing insights into the role of eye contact in online video conferencing, particularly its potential impact on information retention. The data suggests that maintaining eye contact during a video conference could enhance the viewer's ability to retain information.

However, it is important to interpret these findings with caution. The difference in quiz performance between the two groups, while noticeable, was not substantial. The study was also conducted with a relatively small sample size and faced certain constraints in terms of availability for conducting the study.

These limitations require further research to form a concrete conclusion as to the impact of eye contact on information retention in the context of online video conferencing. Future studies should aim to involve a larger sample size and ensure more controlled conditions to validate and expand upon these findings.

The implications of this research are significant, particularly in the current digital age where online video conferencing has become a prevalent mode of communication. Understanding the nuances of non-verbal cues like eye contact could pave the way for developing more effective communication strategies and enhancing the user experience on online video conferencing platforms.

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