Toward Understanding Camera Configurations in Online Meetings From YouTube Video Recordings

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The use of video in online meetings has been an integral part of video-conferencing tools. While prior research has studied the psychological effects of various camera configurations, it did so mainly using surveys or in controlled experimental setups. However, it is not fully understood how these configurations are associated with meeting characteristics and dynamics. We discuss preliminary analysis of recorded meetings, which were uploaded on YouTube between 2020 and 2022. Our preliminary results, to a great extent, corroborate previous findings and highlight the need for future research efforts into studying real-world meeting scenarios.

CCS Concepts: • **Human-centered computing → Empirical studies in HCI**; *Collaborative and social computing systems and tools.*

Additional Key Words and Phrases: online meetings, camera configurations, user engagement

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1 INTRODUCTION

While remote work and meeting co-workers online have been common for many years, the COVID-19 pandemic and ensuing stay-at-home orders resulted in a surge of online meetings. We expect that these meetings will remain a significant part of work [3, 25, 26, 29], learning [10], and socializing [40] in the foreseeable future and this motivates our work to understand the effects of different elements of the virtual meeting context on meeting outcomes. The outcomes of interest to us include those related to accomplishing tasks (e.g. disseminating information, or generating new ideas [4]), as well as subjective evaluations by meeting participants.

In this paper, we focus on one aspect of the context of online meetings, that is, the camera configurations. The role of using, as well as not using, cameras in online meetings has been explored before. Previous works have often focused on the psychological effects of various camera configurations, and they did so mainly using surveys or experimental setups [7, 33, 38]. However, we still do not fully understand all of the effects of camera use in online meetings, especially as we consider the broad variety of possible meetings. This is the motivation for our work. To further our understanding of camera configurations in online meetings, we formulated two (2) research questions (RQs):

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RQ_1: What are the most prominent(featured) camera configurations in a corpus of online meetings?
RQ_2: How do the number of participants and the meeting type associate with camera configurations?

2 RELATED WORK

2.1 Online Meetings

The COVID-19 pandemic forced the world into a prolonged natural experiment that tested what researchers and visionaries have been pondering for many decades—the possibilities of remote work. That is why, in the aftermath of lock-downs due to the pandemic, employees continued to engage with work matters remotely [24]—meetings were no exception. In turn, this has led to an upsurge of meetings research [4, 14, 31, 34, 41], and resulted in a number of tools being developed to facilitate and augment online (and hybrid) meetings' experience [5, 15, 22, 36] . At the same time, as more employees engage with online meetings, it is of prime importance to identify what makes them successful [16] and what their best practices are [35].

2.2 Camera Configurations

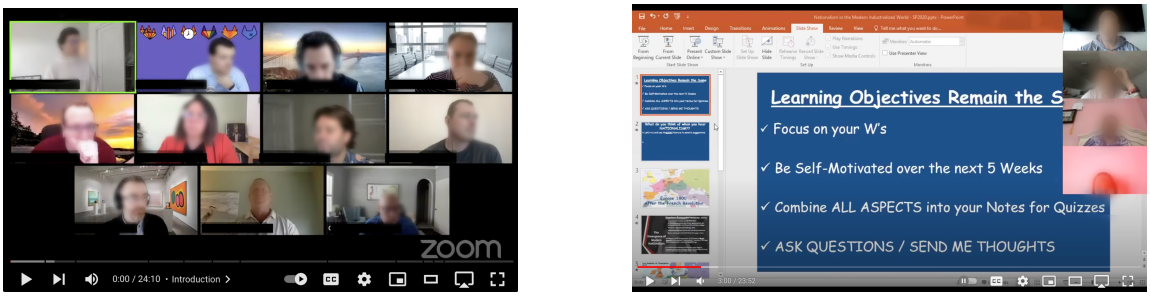
The use of cameras is an integral part of video-conferencing platforms [37]. Different camera configurations in an online meeting have been previously linked to increased trust [17], and have been found to negatively impact participants' well-being [38]. Additionally, it has been found that participants who have their cameras on throughout an online meetings do so as a way to connect with others, while those with their cameras turned off were engaged in multitasking activities [7]. In some cases, avatars are also being used [27], for example, to alleviate facial dissatisfaction [33] or help online participants cope with fatigue [38]. Previous studies that explored camera configurations in online meetings were mainly focused on surveys [7, 18, 23] or in experimental setups [11, 21, 38]. In our work, we built on this prior strand of research by investigating camera configurations preferences in two categories of online meetings: *work-related* and *classroom-related*, and did so by exploring online meeting participants' experience in non-experimental and controlled settings.

2.3 YouTube as a Data Source

Social media platforms such as Twitter, LinkedIn, and YouTube are increasingly used as a source of data in research [12, 13, 19, 30]. Data from social media platforms are often largely available, providing real world insights to human interactions with increased ecological validity (i.e., not being constrained to controlled experimental setups) [6, 19]. A number of previous studies has explored YouTube videos [1], ranging from examining human-wildlife interactions on YouTube [28] to health related research. For instance, one study reviewed YouTube videos for information pertaining to medication used in pregnancy [20]. Social media platforms also present a way to reach a larger audience. YouTube, for example, allows videos to be viewed several times providing continued engagement with the content. That is why, in the wake of the pandemic, many work meetings, class lectures, and social media posts were uploaded on YouTube for later access and wider outreach. In this work, we leverage the availability of meeting recordings to examine the camera configurations of online meetings.

3 METHOD

We resorted to publicly available data from YouTube. We queried YouTube for "`online meetings`" `OR` "`virtual meetings`". This resulted into a total of 36 videos. From the initial set, we kept a total of 21 videos that meeting participants were mostly visible throughout the course of a meeting, that is, parts of the recording showed the meeting



(a) (b)

Fig. 1. (a) Grid view captured at timestamp 0-min. (b) Screen-share captured at timestamp 3-min.

layout in 'grid view'. We first reviewed the video content and its metadata. Based on the content of the video and the title, we classified the videos as classroom, work or social video. For the purpose of this study we focused on classroom and work related videos. To find the number of participants in the meeting, we manually counted the number of participants visible on screen at different times during the meeting. At each set timestamp, the videos were paused and the number of participants visible were counted.

The first author who primarily worked with the data has completed the University of New Hampshire Responsible Conduct of Research course which offers training in the ethical and responsible conduct of research.

3.1 Dataset

The dataset consists of **21** recordings of online meetings, uploaded on YouTube between March 2020 and August 2022. All 21 meetings were held and recorded on Zoom. The first author classified the recordings as "work" or "classroom' based on the meeting context, and all authors discussed the classification. Our dataset is comprised of 10 work meetings and 11 classroom ones (see Table 1 in the Appendix).

3.2 Data Analysis

The first author viewed each video to assess the number of participants visible in the meeting and the number of participants with their camera turned on. We sampled data in three 5-minute-long time segments of each video: *start*, *middle* and *end*. Since participants and camera configurations might change relatively quickly, we collected 5 timestamps within each time segment, with one (1) minute intervals. Additionally, we included a column in the data table to identify the presence or absence of screen sharing. We indicated '1' if the meeting was in 'grid view' (see Figure 1a), that is, the video feeds for all participants were visible, and '2' if there was screen sharing at that timestamp (see Figure 1b).

We calculated the averages per video for each time segment as follows:

- We found the average number of participants for each time segment by finding the average over all five timestamps within a given segment. Thus, for each of the 21 videos we arrived at 3 average participant numbers: one each at the start, middle and end of the video.
- We found the average number of participants with camera on for each time segment by finding the average over all five timestamps for that segment. Again, for each of the 21 videos we arrived at 3 averages for how many participants had their cameras on: one each at the start, middle and end of the video.

We also found the average percentage of participants with their cameras turned on for each time segment over all 21 videos. We did this by first finding the percentage of participants with their cameras for each of the 21 videos, and then averaging those percentages over all 21 videos. We analyzed the data using R [32], and assessed the relationship between the data variables. We grouped the data by category and time segment to calculate means and standard deviation.

3.2.1 Camera Configurations. To analyze the camera configurations, we used linear mixed models using the open-source R package lme4 [8, 32]. This allowed us to assess the relationship between the mean percentage of participants with their cameras turned on, and the time segment, video category, and the number of participants in the meeting. The fixed effects for the model were the time segments (start, middle and end), the video category (classroom, work), and the average number of participants for each time segment. The fixed effects were set to factors while the number of participants remained numeric datatype. The video ID was used as random effects in the model. We used Chi-square tests to perform the Analysis of Variance (Anova) on the model. Also using the Tukey method, we compared the estimated marginal means for the effect on the percentage of participants with camera turned on.

4 PRELIMINARY RESULTS

We analyzed 21 videos, sampling 5 time data point per segment (21 videos x 5 time samples x 3 time segments). The data was analyzed by one author and the results discussed among the other authors. We obtained 315 data points for analysis purposes.

4.1 Camera Configurations in Online Meetings

For classroom videos, we observed fewer number of participants at the start and end as compared to the middle, while work videos showed a more constant average over time segments. We observed a similar pattern with the number of participants with their cameras turned on. The results also showed that a higher percentage of participants had their cameras turned on for work videos compared to classroom videos, with almost 100% of participant with cameras turned on during the middle and end of the meeting.

Results from the mixed linear model show that the effect of the average number of participants and the time segment (i.e the start, middle or end of the meeting) was not statistically significant. This result was surprising as prior study [9] showed that depending on the size of the meeting group and the current activity (screen sharing or not), meeting participants would prefer to keep their camera on or off. In small groups, participants found it useful to have their cameras turned on, unlike larger groups especially during screen share. We speculate that the inconsistency in our results may be due to the range of group sizes present in our dataset since in the prior study [9] 'small group' and 'large group' was not numerically defined. The results also showed that the video category (i.e. classroom or work videos), particularly for work meetings, had an impact on the percentage of participants with their cameras turned on ($\chi^2(1) = 10.2990, p = 0.00133$). This shows a statistically significant effect of the type of meeting on the percentage of participants with their cameras turned on. This result is consistent with a recent study [42] on the impact of social norms on the use of webcams during online meetings. The survey results showed higher mean values for the use of webcams in the professional group (work group) compared to means from university students.

5 NEXT STEPS

This study shows promising results on understanding camera configurations in recorded meetings. While YouTube has been shown to be a great source to study learning behavior, recordings are not controlled. We hope to further this study

by conducting more structured experiments with greater control on the context and nature of the meetings. Another avenue we hope to explore is to study participant engagement, for example, through speaker diarization [2, 39] using open source libraries such as the pyannote.

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APPENDIX

Table 1. Our curated dataset of YouTube video recordings. All meetings were held on Zoom.

Category	Link	Channel	Upload Date	Title	# Views	# Likes	# Comments
Classroom	v=uWTDkG1w-cY	Patrick Eagan	17-Aug-20	HIS 101(4)—First Zoom Class	1,204,476	5.8K	1700
	v=rbjyWHedDfw	Patrick Eagan	3-Apr-20	TMU - History 102—Discussion of Nationalism and Anthems	44,328	218	148
	v=i-w2sxYTQbc	Sociology Jason	18-Feb-21	Downing Soc 220	63,622	233	44
	v=qVxb1DKZyvQ	Sociology Jason	25-Jan-21	Downing Soc 100 CSU	4,192	14	1
	v=JpTDF4w-6Yc	Patrick Eagan	25-Mar-20	TMU—History 102	1,890,454	12K	4834
	v=DTTr8pwlnXE	Patrick Eagan	27-Mar-20	TMU—HIS 102	45,835	194	57
	v=2UjVhr2LOjE	ProfessorFoMo	5-Sep-20	Week 2—Meeting for English 1C	251,956	1.2K	175
	v=mjWxYI4oTTw	El Molino Math	8-Apr-20	Calculus Class	455,210	3.2K	off
	v=8cIEmo2nFcQ	Patrick Eagan	4-Sep-20	Prof. Eagan Meets with HIS 101	4,670	25	2
	v=Rl3nBvKMeqA	Sociology Jason	21-Apr-21	Downing Soc	1,270	3	1
	v=ZQ8YSIQfkJ8	Sociology Jason	30-Mar-21	Downing Sociology 220	19,305	53	33
Work	v=NpXkhwFiaF8	Waipa District council	4-May-20	Strategic Planning & Policy Committee	126,753	307	30
	v=Fa-hbpZx6OQ	cityofsantafe	20-Apr-20	Finance Meeting	124,000	391	102
	v=amCcaymQXxI	Waipa District council	26-May-20	Strategic Planning & Policy Committee Annual Plan Hearing	32,736	75	4
	v=lBVtvOpU80Q	GitLab Unfiltered	28-Jun-21	Product Marketing Meeting	64,472	142	32
	v=mgWgMnNcjXw	Waipa District council	20-Apr-20	Service Delivery Committee	41,267	121	27
	v=qGFoZ8yodc4	GitLab Unfiltered	18-Feb-21	[REC] Engineering	18,048	81	6
	v=ogLyKp7Byp0	Saint Louis Public Schools	17-Aug-20	Audit Committee Meeting	2,491	11	2
	v=1E3HF1U6lAU	cityofsantafe	7-Feb-22	Arts Commission Meeting	30	0	off
	v=-1AHD3JSJec	Saint Louis Public Schools	19-Feb-21	SLPS Mayoral Election Q&A	192	2	2
	v=EB3xYp6NiNo	Albany County Legislature	25-Aug-22	Public Safety Committee Meeting	710	0	off

Note: To access a YouTube link simply append the “link” column next to to this URL: https://www.youtube.com/watch?.