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The Fatiguing Effects of Camera Use in Virtual Meetings: A Within-Person Field Experiment

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The COVID-19 pandemic propelled many employees into remote work arrangements, and face-to-face meetings were quickly replaced with virtual meetings. This rapid uptick in the use of virtual meetings led to much popular press discussion of virtual meeting fatigue (i.e., "Zoom fatigue"), described as a feeling of being drained and lacking energy following a day of virtual meetings. In this study, we aimed to better understand how one salient feature of virtual meetings—the camera—impacts fatigue, which may affect outcomes during meetings (e.g., participant voice and engagement). We did so through the use of a 4-week within-person experience sampling field experiment where camera use was manipulated. Drawing from theory related to self-presentation, we propose and test a model where study condition (camera on versus off) was linked to daily feelings of fatigue; daily fatigue, in turn, was presumed to relate negatively to voice and engagement during virtual meetings. We further predict that gender and organizational tenure will moderate this relationship such that using a camera during virtual meetings will be more fatiguing for women and newer members of the organization. Results of 1,408 daily observations from 103 employees supported our proposed model, with supplemental analyses suggesting that fatigue affects same-day and next-day meeting performance. Given the anticipated prevalence of remote work even after the pandemic subsides, our study offers key insights for ongoing organizational best practices surrounding virtual meetings.

Keywords: virtual meetings, remote work, fatigue, gender, field experiment

During 2020, a large portion of the global workforce shifted to remote work in an attempt to reduce the spread of COVID-19. As part of this transition, many organizations relied heavily on virtual platforms with video call capabilities (e.g., Zoom, WebEx, Microsoft Teams, Skype) to replace face-to-face meetings. Although well-intentioned, a few weeks into full-time remote work, the concept of "Zoom fatigue" (Fosslien & Duffy, 2020)—also generically referred to as "virtual meeting fatigue" (Gallo, 2020)—arose in common vernacular, referring to employees feeling fatigued after a day full of virtual meetings. Since the start of the COVID-19 pandemic, the concept of virtual meeting fatigue has received popular press attention (e.g., Denworth, 2020; Fosslien & Duffy, 2020; Jiang, 2020), and a small body of academic research and conceptual work on the topic is emerging (e.g., Bailenson, 2021; Bennett et al., 2021; Nadler, 2020).

Although it is clear that virtual meeting fatigue is occurring (e.g., Wiederhold, 2020), what is less clear is *why* this is the case (Bailenson, 2021). Importantly, virtual meeting fatigue does not seem to be merely a function of time spent in meetings. For example, a global study from the National Bureau of Economic Research found an average increase in the overall number of meetings people attended postpandemic lockdown compared to prepandemic levels, but the length of these meetings was shorter, *netting an overall 11.5% decrease in time spent in meetings* since the start of the pandemic (DeFilippis et al., 2020). This has led researchers to question whether specific properties of virtual meetings might contribute to fatigue, with several scholars discussing how camera usage might be a key fatiguing feature of virtual meetings (e.g., Bailenson, 2021; Wiederhold, 2020), though limited empirical work has considered the topic.

The goal of this study is to theoretically and empirically evaluate the role of camera presence (i.e., turned on vs. off) in contributing to virtual meeting fatigue. To this end, we draw from self-presentation theory and research (e.g., Baumeister, 1982, Goffman, 1959) to test a model (see Figure 1) in which camera use during virtual meetings relates to fatigue, and fatigue relates to meeting outcomes. Specifically, we considered how camera use in virtual meetings indirectly

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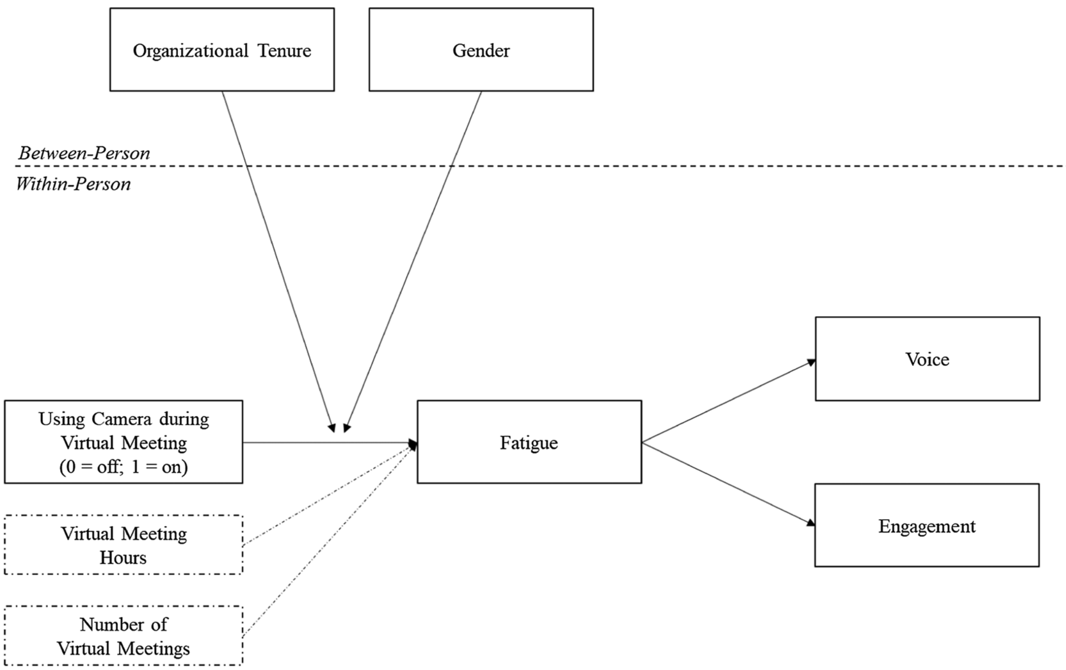
Figure 1
Conceptual Model



Note. All effects are within the same workday, and all relationships depicted in the model within-person (at Level 1) were modeled as random effects. Fixed effects were reserved for Level 1 control variables (not depicted) and the direct effects of using the camera during virtual meetings, virtual meeting hours, and number of virtual meetings on our voice and engagement outcomes (see Table 2 for all results). We did consider the cross-level moderating effect of organizational tenure and gender on virtual meeting hours and number of virtual meetings; these paths are not depicted visually for model parsimony.

relates to two aspects of meeting performance—*voice* and *engagement* (e.g., Allen & Rogelberg, 2013; Morrison, 2011; Rogelberg, 2019).[1] Our investigation helps expand the nomological network of this newly prevalent work phenomenon within a COVID-19 work world, as well as our understanding of how daily fatigue can affect meeting performance, which has generally been understudied in the organizational literature (e.g., Shanock et al., 2013).

We also seek to identify boundary conditions of these effects. Drawing from theory tied to self-presentation (e.g., Baumeister, 1982, Goffman, 1959), we identify how individual differences that are likely to alter self-presentation needs—gender and organizational tenure—can exacerbate the impact of camera use on fatigue. In considering these, our research further elucidates how fatigue is heightened for employees who tend to be more vulnerable in terms of their social position in the workplace—that is, women (e.g., feeling pressure to be "effortlessly perfect"; Flett et al., 2016, p. 246) and newer, less tenured employees (e.g., who often have more uncertainty and lower status compared to seasoned employees; Fang et al., 2017; Rollag, 2004).

To test our model, we ran a 4-week daily field experiment. We randomly assigned remote employees within a single organization to conditions where they were instructed to keep their camera on or off during all virtual meetings (or as much as possible given client calls); participants spent two consecutive weeks in one condition, and then changed at the mid-point in a counterbalanced manner. In doing so, we isolate the effects of camera use on fatigue. A within-person design with daily measurements allowed us to statistically control for stable individual differences (e.g., chronic job demands, chronic fatigue), while also allowing us to understand same-day and next-day effects of camera use on meeting outcomes vis-à-vis fatigue.[2] Further, by conducting our research within one organization, we were able to control for important features of their daily work environments, such as objective records of time spent in virtual meetings and the number of virtual meetings each day. In sum, we aim to shed light on one specific aspect of virtual meetings—camera usage—elucidating why meeting fatigue seems heightened during COVID-19, despite a slight decrease in actual time spent in meetings (DeFilippis et al., 2020).

[1] The focus of the current research is on how camera usage impacts the focal individual (i.e., the individual using or not using their own personal camera). We do not consider how the focal participant having their camera switched on (or off) impacts the engagement of *other* participants in the meeting. Thus, we caution against using the findings from the present study to draw conclusions about the engagement of other meeting participants (e.g., our findings do not suggest that the meeting as a whole will be more engaging when cameras are turned off).

[2] Our theory is focused on the effects of camera usage during virtual meetings on fatigue, and fatigue on meeting voice and engagement. For this reason, we do not hypothesize about camera use on voice and engagement, though we model these effects for completeness. Our results should be interpreted with this theoretical choice in mind.

Theoretical Background and Hypotheses

Although journalists and scholars have advanced numerous ideas for why camera usage during virtual meetings might lead to fatigue (e.g., Allison et al., 2015; Bailenson, 2021; Murphy, 2020; Seuren et al., 2021; Weller, 2017), we attest that from a theoretical standpoint they fall under the general umbrella of needs associated with self-presentation. Self-presentation refers to the idea that most people have an innate desire to be viewed in a favorable light and aim to convey positive information about themselves (Goffman, 1959; Schneider, 1981). Self-presentation is prevalent in social exchanges (Klotz et al., 2018) and, while there is evidence that it affords some benefits to employees (e.g., Bolino et al., 2016; Chawla, Gabriel, et al., 2020), it is also a cognitively demanding activity (Vohs et al., 2005), as self-presentation is a form of self-regulation that requires actors to carefully monitor and actively manage their expressive (i.e., observable) behavior during social interactions (Klotz et al., 2018). Importantly, demands associated with self-presentation have been identified as a precursor to fatigue and related deficits in self-regulation and performance (Johnson et al., 2018; van der Linden et al., 2003).

When a virtual meeting participant has their camera switched on, the need for self-presentation is salient. In particular, owing to the layout of popular virtual meeting platforms, participants with their camera on are likely to feel a heighted sense of being watched (Allison et al., 2015; Bailenson, 2021), which has been linked to greater impression management as they attempt to "achieve desired images in the eyes of others" (Klotz et al., 2018, p. 1145). Likewise, the presence of one's own video image on the screen has been linked to greater self-evaluation and self-focus (Gonzales & Hancock, 2011), both of which place demands on participants to divert cognitive resources (i.e., energy and attention) away from the meeting and to the self. Further, participants in virtual meetings have much more prolonged gazes and are less likely to look away from the speaker than in face-to-face interactions (Andrist et al., 2013; Bailenson, 2021), which can further contribute to cognitive demands associated with feeling watched (Takac et al., 2019). Importantly, all of these effects would occur based on the participant's *camera being on*, regardless of how many other meeting attendees also have their cameras on.

As a counter to these ideas, some perspectives (e.g., media richness theory, Daft & Lengel, 1986) suggest that communication is enhanced with higher fidelity mediums such as video due to the increased nonverbal cues. However, Bailenson (2021) recently argued that the role of nonverbal cues is quite complex—while they may enhance certain aspects of communication, they can also lead to greater cognitive load, thus affecting fatigue of virtual meeting participants. Specifically, when the camera is switched on during virtual meetings, users are constantly receiving nonverbal cues that are hard to interpret (e.g., one person casts a meaningful glance to another in reaction to a comment but the different configurations of video grids make it impossible for other attendants to know what they were glancing at), and these vague cues contribute to a lack of message clarity and uncertainty (Bailenson, 2021; Daft et al., 1987). Such cues would not be observed at all in audio-only interactions. Regardless of the camera status of others in the meeting, meeting participants who have their cameras switched on tend to send extra intentional nonverbal cues (e.g., nodding exaggeratedly to indicate agreement, speaking louder, trying to show they are making eye contact by looking in the camera), which require additional cognitive effort on their behalf. In sum, although it is possible that using the camera may contribute positively to meetings, we surmise that its effects on self-presentation and related demands are likely to contribute to daily feelings of fatigue. As such, we hypothesize:

> *Hypothesis 1:* On days when employees use a camera during virtual meetings (vs. not use a camera during virtual meetings), they will experience greater feelings of daily fatigue.

In addition to exploring the impact of camera usage on fatigue, we also consider the outcomes that may occur as a result of employees feeling fatigued. Specifically, we focused on indicators of performance specific to meetings—voice and engagement (e.g., Allen & Rogelberg, 2013; Morrison, 2011; Rogelberg, 2019). Both outcomes are likely to be tied to self-presentation in virtual meetings, as coworkers are able to observe and evaluate others' voice-related behaviors (e.g., Farh et al., 2020; McClean et al., 2013) and engagement (e.g., Venz & Sonnentag, 2015). Further, being engaged and voicing ideas requires the deployment of cognitive resources (e.g., Bennett et al., 2018; Chawla, MacGowan, et al., 2020; Lanaj et al., 2014), meaning that fatigue (stemming from camera use) may not only make employees more visibly fatigued to their exchange partners (e.g., Trougakos et al., 2015) but also unable to voice ideas and stay engaged.

Lending some empirical support to this idea outside of the context of virtual calls, daily feelings comparable to fatigue (e.g., cognitive depletion) have been linked to reduced work engagement (e.g., Garrick et al., 2014; Lanaj et al., 2014); longitudinal studies have also found that experiences related to fatigue contribute to decreases in voice (e.g., Lin & Johnson, 2015). Interestingly, prior research on self-presentation in customer service settings has demonstrated that regulating one's emotional displays (i.e., presenting a smile to customers regardless of one's internal state) can induce feelings of fatigue and exhaustion that, in turn, hinder one's ability to perform (for a meta-analytic review, see Hülsheger & Schewe, 2011). Thus, in light of our theoretical assertions that (a) camera usage during virtual calls is associated with heightened self-presentation demands that contribute to fatigue and (b) fatigue is associated with reduced voice and engagement during virtual meetings, we hypothesize the following:

> *Hypothesis 2:* Compared to days when employees do not use a camera during virtual meetings, using a camera will reduce daily voice via fatigue.

> *Hypothesis 3:* Compared to days when employees do not use a camera during virtual meetings, using a camera will reduce daily engagement via fatigue.

Beyond these effects, we assert that certain employees may be more fatigued from the camera. Drawing from the self-presentation effects of the camera noted previously, we theorize that women and employees who are newer (i.e., lower organizational tenure) are likely to have higher self-presentation costs that make them experience more fatigue. With regard to gender, expectations states theory (Berger et al., 1977) suggests that gender acts as a form of status that conveys meaning about ability in social interactions (Ridgeway, 1997;

Ridgeway & Bourg, 2004). Specifically, women are generally viewed as less competent than men (Eagly & Mladinic, 1994) and ascribed lower status (Eagly & Wood, 1982), which often manifests in women being judged more harshly (Foschi, 1996; Thomas-Hunt & Phillips, 2004). When on camera, women may feel more pressure to engage in effective self-presentation, thus contributing to a heightened relationship between camera use and fatigue. Indeed, research has found that women were more likely to direct attention internally when viewing themselves on live video (Ingram et al., 1988).

Additionally, using the camera requires users to maintain a professional appearance. In the workplace, the two salient indicators of professionalism are grooming and attire (Ruetzler et al., 2012). Importantly, there are pronounced gender differences in grooming norms—an idea known colloquially as the "grooming gap" (e.g., Isser, 2020)—with greater pressure for women (Dellinger & Williams, 1997). Given the closer ties between physical appearance and self-worth in women versus men (e.g., Crocker et al., 2003; Wade & Cooper, 1999), this likely creates an additional demand for women when using the camera. COVID-19 may have exacerbated these differences, as many services that are more heavily used by women to maintain professional appearances (e.g., hair and nail salons, dermatological services) closed, or involved high health risks (e.g., Fakuade, 2020). Lastly, there are gender differences in family-related interruptions to work during COVID-19 (e.g., Andrew et al., 2020; Shockley et al., 2021). As such, women, particularly mothers, are generally at higher risk of having family members walk into virtual calls, which may create additional concerns about career implications and professionalism, leading to greater fatigue throughout the day. These ideas lead us to pose the following:

> *Hypothesis 4:* The positive within-person relationship between using a camera during virtual meetings (vs. not using a camera) and fatigue for employees is moderated by gender, such that the relationship is stronger for women than for men.

Virtual meetings with the camera on may also be fatiguing for employees who are newer to the organization. Drawing from ideas of self-presentation, employees with longer tenure have had more time to create and refine their organizational image compared to newer employees (e.g., Fang et al., 2017; Rollag, 2004). Said otherwise, employees who have been with the organization longer carry "assigned status" (e.g., Howell et al., 2015) that contributes to them being viewed as more reputable at work (e.g., Moser et al., 1999). Moreover, their tenure is likely to give them greater behavioral latitude than newer employees who are still trying to establish their professional image (Rollag, 2004). As such, employees who have been with the company longer will likely experience less fatigue in processing and managing how they are being perceived on camera, feeling that it is less critical to their impression. This, of course, is compared to newer members who must break from their "fledgling" status and establish that they are qualified (Howell et al., 2015; Rollag, 2004), heightening the self-presentation pressure that is felt when they are being watched on virtual calls. Thus, we pose the following hypothesis:

> *Hypothesis 5:* The positive within-person relationship between using a camera during virtual meetings (vs. not using a camera) and fatigue for employees is moderated by organizational tenure, such that the relationship is stronger when employees' organizational tenure is lower versus when it is higher.

Method

Participants and Procedure

Participants were recruited from BroadPath, a company within the healthcare sector that employs several thousand remote workers throughout the United States, in August–September 2020. The workforce was largely remote before the pandemic and has a camera optional policy; estimates were that 40%–50% of staff turned their cameras on during a meeting prior to the study. The company agreed to enroll their employees in a field experiment surrounding camera use during virtual meetings. Employees were told the company was launching a study to better understand the benefits and drawbacks of video during meetings. The study lasted 19 days (four work weeks; 1 day was off due to a holiday), in which participants were asked to participate in virtual meetings with cameras on or off. One hundred and thirty full-time employees were invited; 11 declined, resulting in 119 beginning the study. Of the 119, we removed 16 additional participants; 15 did not provide at least 3 days of data for study variables for appropriate statistical modeling (e.g., Gabriel et al., 2019), and one person's data could not be identified for day-to-day linkage. This resulted in a sample of 103 employees, who provided 1,408 days of data out of a possible 2,033 (69.3% completion rate; 13.7 days per person). Participants were largely female (56.3%) and White (71.8%). Average age was 41.3 years ($SD = 9.28$), and average organizational tenure was 2.92 years ($SD = 2.59$). Participants held many jobs (e.g., Information technology [IT] specialist, software engineer, Human Resources [HR] coordinator, director of operations), with 48.8% in managerial roles.

Information about the study was presented through a live 20-min information session 4–6 days before the study began to familiarize participants with study procedures. Participants were then randomly assigned to one of two conditions: half of the participants kept their camera on (off) for the first 2 weeks of the study, and then switched to keeping their cameras off (on) for the last 2 weeks. They were sent an initial email before the study launched showing them their condition for each of the 4 weeks. They were then reminded of the change in condition before the third week of the study. At 6:30 p.m. each day, participants were sent a text message containing a link to the daily survey assessing fatigue, voice, and engagement for that workday. The study was determined exempt by the University of Georgia IRB # PROJECT00003290.

Study Measures

Our independent variable was *camera study condition*, coded 0 for camera off (726 Level 1 observations), and 1 for camera on (682 Level 1 observations). In cooperation with BroadPath, we asked brief, single-item questions each day; although there are limitations with single-items, this was part of the partnership agreement, and single-items are common in within-person research (e.g., Conway et al., 2009). We chose an item per construct that most aligned with our conceptualization; items were on a 5-point scale (1 = *strongly disagree*; 5 = *strongly agree*).

Beginning with our manipulation check, we asked a single item—"Today, I was able to be on (off) video"—based on participants' daily condition. We could not force participants to always keep their camera off, as some met with clients who required camera use. Nonetheless, results suggested that the manipulation was effective (camera on: $M = 4.47$, $SD = .83$; camera off: $M = 4.19$, $SD = .96$). For *fatigue*, participants responded: "Right now, I feel fatigued." For *engagement*, participants rated: "In meetings today, I felt engaged." Finally, for *voice*, participants rated: "In meetings today, when I had something to say, I felt like I had a voice."[3] *Gender* and *organizational tenure* were obtained directly from the company via HR records.

Control Variables

We recognize that hours spent in virtual meetings and the number of virtual meetings, regardless of camera status, could be fatiguing. To control this, BroadPath provided data from participants' work calendars; on average, participants spent 3.06 hr ($SD = 2.21$) in 4.88 virtual meetings ($SD = 3.50$) daily. In addition, given our experience sampling method, we followed Beal and Weiss (2003) and controlled for several time-related variables at Level 1: day of the week, coded Monday (0) through Friday (4), day of the study (coded as Day 1—Day 20), as well as sine and cosine (calculated over one five-day work week); these account for spurious relationships due to time and the repeated nature of our measures. Further, given that fatigue, voice, and engagement were assessed at the same time, we controlled for the prior day's level of these variables to better proxy change (Gabriel et al., 2019). Finally, at Level 2 we controlled for which condition participants started in to account for possible fatigue-related effects associated with starting with the camera on (1) or off (0; Song et al., 2018). Importantly, all of the results qualitatively replicate with and without control variables, but we retained them for completeness.

Analytic Approach

We tested our hypotheses with multilevel path analysis in Mplus 8.1 (Muthén & Muthén, 1998–2015). Prior to conducting analyses, we first partitioned the variance in our Level 1 constructs to determine the percentage that resided within-person (see Table 1); results indicated that the majority of variance in our focal Level 1 constructs resided within-person. We within-person centered Level 1 predictors, including study condition. As noted by Song et al. (2018), this was done "to remove between-person variance in estimating the within-person effect of our model" (Enders & Tofighi, 2007, p. 1004; see also Lanaj et al., 2019).[4] All effects related to time (e.g., day of the week, study day, sine, cosine) were modeled uncentered to preserve their original form (cf. da Motta Veiga & Gabriel, 2016). Our Level 2 moderators and control variable were grand-mean centered (Enders & Tofighi, 2007). Hypothesized effects, that is, the effect of using the camera (study condition) on fatigue; the effect of fatigue on voice; the effect of fatigue on engagement, at Level 1 were modeled as random effects, as were the effects of virtual meeting hours and number of virtual meetings on fatigue given their centrality to participants' experiences in virtual meetings (e.g., Bennett et al., 2021). All control variables and direct effects (i.e., the direct effect of using the camera on voice and fatigue) were modeled as fixed effects to reduce model complexity (e.g., Wang et al., 2011). Importantly, we recognize that controlling for the prior day's fatigue, voice, and engagement will necessarily create missing data; because of this, we used full information maximum likelihood (FIML) to retain as much data as possible (e.g., Enders, 2010; Enders & Bandalos, 2001). For our cross-level interactions, we modeled gender and organizational tenure as cross-level predictors of the random slope of study condition on fatigue, as well as the direct effect on fatigue; for completeness, we also considered the cross-level moderating effects of gender and organizational tenure on the relationships between virtual meeting hours and number of virtual meetings on fatigue. We tested multilevel mediation with a Monte Carlo bootstrap simulation with 20,000 replications to create our bias-corrected 95% confidence intervals (CIs) around our indirect effects using formulas from Efron (1987; see Koopman et al., 2019). Although not hypothesized, we also calculated the conditional indirect effects via fatigue at higher and lower ± 1 *SD*) tenure, as well as for women and men. As a note, unstandardized coefficients are reported with maximum likelihood in Mplus; following Koopman et al. (2020; see Lorah, 2018), we manually calculated standardized coefficients.[5]

Results

Means, standard deviations, and correlations are in Table 2; multilevel results are in Table 3,[6] with indirect effects and conditional indirect effects (see below for further detail) in Table 4. Hypothesis 1, which proposed that using a camera would positively relate to fatigue, was supported ($\gamma = .45$, $\gamma' = .18$, $p < .001$). Supporting our self-presentation theory surrounding using the camera, neither virtual meeting hours ($\gamma = -.01$, $\gamma' = -.01$, $p = .746$) nor

[3] Importantly, there is a slight misalignment, such that fatigue was "right now," and meeting engagement and voice were "in meetings today." To understand whether the referent for fatigue could have affected our results, we ran a brief study comparing fatigue "right now" to fatigue "in meetings today." We recruited participants from Prolific who were working full-time in the U.S., regularly interacting with others at work, and working remotely on the day the study took place. A total of 240 participants met these criteria, of whom 230 passed attention checks and provided valid data. The final sample was largely male (58.8%), white (82.6%), and with an average age of 34.7 years ($SD = 9.9$). On average, employees worked 42.6 hr per week ($SD = 4.8$) and had been in their organization for 4.9 years ($SD = 3.7$). Participants came from a variety of industries, including educational services (16.5%), professional, scientific, and technical services (14.3%), and finance and insurance (13.9%). We distributed our survey towards the end of the day (5:00PM). We included our original item in addition to "In meetings today, I felt fatigued" (1 = *strongly disagree*; 5 = *strongly agree*). Findings revealed a large correlation (Cohen, 1988) between our item "right now" and the item referencing meetings ($r = .67$, $p < .01$). Thus, although the "right now" wording with our mediator creates a potential concern with temporal precedence with our outcomes "in meetings today," these findings, paired with our supplemental analyses presented in Appendix B, help probe this issue further.

[4] Leaving our study condition variable uncentered did not change the statistical significance of the results, but it did change the meaning of the variable, such that we were no longer focusing on one's own experience of using the camera or not, but variance that is a mixture of within- and between-person variance. Thus, we followed Enders and Tofighi (2007), who stated: "CWC is preferable for examining cross-level interactions and interactions that involve a pair of Level 1 variables, and CGM is appropriate for interactions between Level 2 variables" (p. 136). CWC corresponds to centering within cluster (i.e., within-person centering); CGM refers to centering at the grand mean.

[5] We thank the authors from Koopman et al. (2020) for assisting us in this specific part of our analysis.

[6] Output for multilevel path analyses (focal and supplemental) and regressions (see Appendices A–D) can be found in an Open Science Framework repository: https://osf.io/6qwsx/.

Table 1
Variance Decomposition for Within-Person Variables

Variable	Within-person variance (σ^2)	Between-person variance (τ_{00})	Percentage of total variance within-person (%)
Study condition (1 = camera on; 0 = camera off)	0.250	0.000	100.0
Virtual meeting hours	1.462	3.378	30.2
Number of virtual meetings	3.214	9.068	26.2
Fatigue	1.055	0.414	71.8
Voice	0.419	0.231	64.4
Engagement	0.508	0.226	69.2

Note. Percentage of total variance within-person was calculated as the following: $\sigma^2/(\sigma^2 + \tau_{00})$. Estimates are based on the total Level 1 sample size (n = 1,408). Within- and between-person variance estimates of lagged variables are available upon request.

number of virtual meetings (γ = .02, γ' = .03, p = .424) related to fatigue. To understand whether the lack of effect for meeting hours was due to our experiment, we considered how this would replicate in a typical field study with participants from a variety of organizations. See Appendix A for details.

In line with Hypotheses 2 and 3, there were negative indirect effects of camera use on voice and engagement via fatigue, respectively. Fatigue negatively related to voice (γ = −.12, γ' = −.19, p < .001) and engagement (γ = −.18, γ' = −.26, p < .001), with indirect effects showing that using a camera indirectly and negatively related to both employee voice (estimate: −.054, 95% CI = −.1073, −.0195) and engagement (estimate: −.080, 95% CI = −.1428, −.0352). Of note, study condition did not directly relate to voice (γ = .04, γ' = .03, p = .402) nor engagement (γ = .10, γ' = .06, p = .086); meeting hours did not relate to both outcomes (voice: γ = .03, γ' = .05, p = .179; engagement: γ = .01, γ' = .02, p = .642), nor did number of virtual meetings (voice: γ = −.004, γ' = −.01, p = .812; engagement: γ = .02, γ' = .05, p = .086). The lack of direct effects from study condition to voice and engagement meant that the total effect (i.e., the direct effect plus the indirect effect) was not significant, total effect for voice: −.011, 95% CI [−.1284, .1058]; total effect for engagement: .023, 95% CI [−.1152, .1672]. Thus, our results should be interpreted with caution, as we cannot conclude that using the camera itself has an unfavorable direct effect on either voice or engagement; rather, it largely affects within-person fatigue.

Hypotheses 4 and 5 focused on cross-level moderation for gender and organizational tenure. Both gender (γ = .40, γ' = .08, p = .033) and tenure (γ = −.09, γ' = −.09, p = .017) moderated the within-person relation between camera use and fatigue. Supporting Hypothesis 4, the positive relation between using a camera during virtual meetings and fatigue was stronger for women (simple slope = .65, p < .001) than for men (simple slope = .24, p = .046; difference = .40, p = .033; see Figure 2). Further, in support of Hypothesis 5, the positive relation between camera use and fatigue was stronger for those with lower (simple slope = .67, p < .001) versus higher tenure (simple slope = .22, p = .089; difference = −.45, p = .017; see Figure 3).

We also tested conditional indirect effects. Beginning with voice, the negative indirect effect was stronger for women (estimate: −.078, 95% CI = −.1541, −.0296) than men (estimate: −.029, 95% CI = −.0784, −.0021; difference = −.049, 95% CI = −.1135, −.0077); for tenure, the negative indirect effect of using the camera voice via fatigue was significant at lower (estimate: −.081, 95% CI = −.1602, −.0316) versus higher tenure (estimate: −.027, 95% CI = −.0744, .0014; difference = .055, 95% CI = .0023, .0249). A similar pattern emerged for engagement, with the negative indirect effect stronger for women (estimate: −.117, 95% CI = −.2058, −.0529) than men (estimate: −.044, 95% CI = −.1037, −.0021; difference = −.073; 95% CI = −.1588, −.0108); it was also significant at lower tenure (estimate: −.121, 95% CI = −.2128, −.0562) and nonsignificant at higher tenure (estimate: −.039, 95% CI = −.0988, .0035; difference = .082, 95% CI = .0032, .0329). Combined, these results illustrate that using the camera is particularly fatiguing for women and newer employees; fatigue, in turn, can then hinder both voice and engagement.

Supplemental Analysis

Given the concurrent nature of fatigue and our outcome, and the fact that using "right now" for fatigue and "in meetings today" for outcomes may create temporal precedence issues, we conducted two supplemental analyses to determine whether (a) effects from camera use carry over to the next day and (b) there is reverse causality. In regards to next day effects, results (see Appendix B) suggest that camera use positively relates to fatigue, and fatigue negatively relates to next day voice and engagement. For reverse causality, results (see Appendix C) were not supportive, as camera use did not relate to voice or engagement; meeting hours, nor number of meetings, related to voice or engagement. Finally, given the lack of total effects, we considered a model in which fatigue, voice, and engagement were simultaneous outcomes (see Appendix D).

Discussion

Drawing from theory pertaining to self-presentation (e.g., Goffman, 1959; Schneider, 1981), we empirically tested whether a prominent feature of virtual meetings—whether one's camera is on or off—affects fatigue above and beyond time spent in virtual meetings, or the number of virtual meetings. Using a within-person experience sampling study in which the use of the camera was manipulated, our results suggest that: (a) using the camera is fatiguing; (b) the fatigue effect is not attributable to time spent in or number of virtual meetings; (c) fatigue by itself is problematic for employee voice and engagement in meetings; and (d) women and newer employees were more fatigued by the use of cameras, perhaps due to self-presentation costs during calls on camera (e.g., Eagly & Wood, 1982; Fang et al., 2017; Howell et al., 2015).

Theoretically, our findings clarify that self-presentation and its fatigue-related costs are exacerbated when the camera is on during

Table 2

Means, Standard Deviations, and Within- and Between-Person Correlations

Variable	Within-person *M*	Within-person *SD*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Between-person *M*	Between-person *SD*
Level 1 variables																				
1. Day of the week (Monday–Friday)	2.12	1.37	—	.33**	−.11	.13	.10	−.13	.11	−.15	−.09	.24*	−.02	−.21*	−.11	−.07	−.08	.11	2.10	0.29
2. Study day (Day 1–20)	10.35	5.75	.24**	—	.25*	.10	.11	.12	−.12	.08	.11	−.13	.03	−.06	−.22*	.09	.08	.13	10.16	1.68
3. Study condition (0 = camera off; 1 = camera on)	0.48	0.50	.02	.02	—	.10	.12	.12	−.12	.08	.11	−.13	.03	.15	.04	.33**	.06	.00	0.49	0.14
4. Virtual meeting hours	3.06	2.21	.16**	.18**	.03	—	.95**	−.17	.15	.19	−.20*	.16	.23*	.16	.14	.00	.16	.04	3.00	1.88
5. Num. of virtual meetings	4.88	3.50	.18**	.16**	.01	.83**	—	−.11	.13	.20*	−.14	.14	.21*	.13	.21*	−.02	.13	−.00	4.77	3.07
6. Fatigue (prior day)	3.29	1.21	.06	.11**	.25**	−.05	−.01	—	−.36**	−.30**	.94**	−.41**	−.42**	.05	.05	.09	.05	.02	3.25	0.79
7. Voice (prior day)	3.96	0.76	.04	−.10**	.02	.05	.07*	−.12**	—	.60**	−.32**	.93**	.70**	−.00	−.03	−.19	−.08	.02	3.95	0.53
8. Engagement (prior day)	3.77	0.85	.05	−.06	.04	.04	.05	−.17**	.53**	—	−.26*	.50**	.86**	.02	.07	−.07	−.05	−.14	3.78	0.58
9. Fatigue	3.24	1.21	.02	.07*	.22**	.44	.03	.36**	−.13**	−.11**	—	−.37**	−.40**	.08	.06	.06	−.00	.09	3.22	0.72
10. Voice	3.97	0.79	.04	.05*	−.01	.05	.04	−.14**	.24**	.28**	−.16**	—	.70**	−.07	−.04	−.17	−.06	.07	3.94	0.55
11. Engagement	3.81	0.85	.06*	−.03	.02	.07**	.08**	−.14**	.29**	.25**	−.21**	.58**	—	.03	.03	−.10	.03	−.07	3.81	0.52
Level 2 variables																				
12. Organizational tenure														—	.02	.01	.22*	−.00	2.92	2.59
13. Gender (0 = male; 1 = female)															—	.02	−.07	−.12	0.56	0.50
14. Starting condition (0 = camera off; 1 = camera on)																—	.02	−.01	0.48	0.50
15. Age																	—	−.05	41.33	9.28
16. Race (0 = non-white; 1 = white)																		—	0.71	0.45

Note. Level 1 $n = 1{,}408$; Level 2 $n = 103$. Correlations below the diagonal reflect within-person centered correlations; correlations above the diagonal reflect between-person correlations. Level 1 (uncentered) variables were aggregated to Level 2 to calculate the correlations with Level 2 variables.

$^{*}p < .05$. $^{**}p < .01$.

Table 3
Simultaneous Multilevel Path Analysis Results for Hypothesized Model

Effect type	Coefficient	*SE*
Fatigue		
Random intercept		
Intercept	3.10**	.11
Organizational tenure	.02	.03
Gender	.07	.14
Starting condition	.08	.14
Random slope for condition		
M	.45**	.10
Organizational tenure	−.09*	.04
Gender	.40*	.19
Random slope for virtual meeting hours		
M	−.01	.04
Organizational tenure	.00	.02
Gender	.15	.09
Random slope for number of virtual meetings		
M	.02	.03
Organizational tenure	.00	.01
Gender	−.08	.07
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.01	.04
Study day (Day 1–20)	.01	.01
Sine	.01	.06
Cosine	−.06	.04
Fatigue (prior day)	.14*	.06
Residual variance at Level 2	*.44*	
Residual variance at Level 1	*.74*	
Voice		
Intercept	4.40**	.12
Random slope for fatigue		
M	−.12**	.03
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.00	.02
Study day (Day 1–20)	−.01	.00
Sine	−.03	.04
Cosine	.02	.02
Condition	.04	.05
Virtual meeting hours	.03	.02
Number of virtual meetings	−.00	.02
Voice (prior day)	.08	.06
Residual variance at Level 2	*.11*	
Residual variance at Level 1	*.38*	
Engagement		
Intercept	4.36**	.12
Random slope for fatigue		
M	−.18**	.03
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.04	.02
Study day (Day 1–20)	−.01	.01
Sine	.02	.04
Cosine	−.01	.03
Condition	.10	.06
Virtual meeting hours	.01	.02
Number of virtual meetings	.02	.01
Engagement (prior day)	.10	.05
Residual variance at Level 2	*.07*	
Residual variance at Level 1	*.45*	

Note. Level 1 n = 1,408; Level 2 n = 103. Condition refers to Study Condition where 0 = camera off and 1 = camera on. Gender was coded such that 0 = male and 1 = female; Starting Condition was coded such that 0 = camera off and 1 = camera on. Following recommendations from LaHuis et al. (2014), we calculated the percentage of within-person variance explained in each of our criteria using the following formula from Bryk and Raudenbush (1992): $(\sigma^2_{\text{null}} - \sigma^2_{\text{predicted}})/\sigma^2_{\text{null}}$. The σ^2_{null} was taken from the within-person variance obtained from the null model; $\sigma^2_{\text{predicted}}$ was taken from the residual variance from the within portion of the model with all predictors included. The within-person variance explained was 29.6% for fatigue, 9.0% for voice, and 12.0% for engagement. Coefficients are unstandardized, which is standard for Mplus models using maximum likelihood estimation as is the current model. Standardized coefficients were manually calculated and are reported in the text for the hypothesized effects. Italicized values represent the Residual varience.
* $p < .05$. ** $p < .01$.

virtual meetings. Our results align with popular press ideas and an emerging body of research which suggest that being "watched" enhances the need to manage impressions and directs focus inward, inducing fatigue. As such, encouraging employees to use the camera may inadvertently harm positive virtual work behaviors (Ferrazzi, 2015; Frisch & Greene, 2020), as fatigue had a hindering effect on voice and engagement. Of course camera use by itself did not directly hinder these outcomes, though fatigue in and of itself can be highly problematic for employee well-being (Wharton, 1993). Nonetheless, it would be interesting to explore if different cameras, such as side-view and/or wide-angle cameras (e.g., Sidekick and Bhive products), that give the user more distance are less fatiguing because the self-presentation effects are not as readily apparent. That said, although we focused on fatigue, there may be other mechanisms at play, such as perceived control, feelings of accountability, or feelings of connection. Overall, future research would benefit from testing both variants of the camera as well as additional mechanisms to gain a clearer picture of the effects of camera use.

We also considered whether certain people—women and those newer to the organization would be more likely to feel fatigued from camera use. For women, we proposed that they would feel heightened pressure to demonstrate competence (Eagly & Wood, 1982) while also feeling the need to meet societal appearance standards (Isser, 2020). For newer employees, we posited that they may feel the need to present themselves more effectively in order to shed the status of an organizational fledgling implicitly ascribed to newcomers (Howell et al., 2015). Thus, our results clarify *why* using the camera is problematic (i.e., heightened fatigue with fatigue then affecting outcomes), as well as *for whom* using a camera is disadvantageous. As women have historically been disadvantaged at work, and with the added pressures COVID-19 has created for women (e.g., Shockley et al., 2021), it is critical for organizations to understand that "camera on" mandates may be creating unintentional harm. Further, given that newer employees are likely to look for social cues to determine whether or not to remain with the organization (e.g., Kammeyer-Mueller et al., 2013), making virtual meetings a more positive social

Table 4
Results of Indirect, Conditional Indirect, and Total Effects From Multilevel Path Analysis

Indirect effect	Gender	Estimate	95% CI
Using camera during virtual meeting → Voice (via fatigue)		−.054	[−.1073, −.0195]
	Men	−.029	[−.0784, −.0021]
	Women	−.078	[−.1541, −.0296]
Using camera during virtual meeting → Engagement (via fatigue)		−.080	[−.1428, −.0352]
	Men	−.044	[−.1037, −.0021]
	Women	−.117	[−.2058, −.0529]
	Organizational tenure	**Estimate**	**95% CI**
Using camera during virtual meeting → Voice (via fatigue)	Low	−.081	[−.1602, −.0316]
	High	−.027	[−.0744, .0014]
Using camera during virtual meeting → Engagement (via fatigue)	Low	−.121	[−.2128, −.0562]
	High	−.039	[−.0988, .0035]

Note. Bias-corrected indirect effects and conditional indirect effects confidence intervals were calculated using 20,000 Monte Carlo bootstrap samples. All indirect effects were calculated accounting for direct effects. Unstandardized effects are reported in the table.

experience is crucial. Allowing for flexible camera use could therefore be one useful supportive signal.

Practically, our results highlight how organizations can best support their employees—especially women and those who are newer—when it comes to virtual meetings. Our findings suggest that using a camera can be fatiguing for employees and may inadvertently detract from helping employees stay engaged in virtual work, which counters conventional wisdom on the topic (e.g., Kanter, 2017). For instance, in a piece written before the pandemic (Ferrazzi, 2015), it was noted that turning the video on "humanizes the room," arguing that facial expressions matter. Although such sentiments were likely relevant pre-pandemic when virtual meetings were less prevalent, our results suggest that the use of video in virtual meetings poses an additional burden. Our results suggest that employees are likely to feel better when given the option to turn their camera off. That said, while our work helps illustrate that using a camera may induce fatigue in the focal employee, and their fatigue may harm voice and engagement in virtual meetings, we caution against over-extrapolating our findings to conclude that virtual meetings with the camera off are universally more engaging, as our research did not consider how other virtual meetings participants are affected by focal employee camera usage.

Of course, there are limitations. First, all measures were within the same day. This made the most conceptual sense, as we were interested in how camera use and fatigue *today* directly affected voice and engagement *today*. We do, however, recognize that the measured effects could be carried over from 1 day to the next (see Appendix B), suggesting that these processes may be more

Figure 2
Cross-Level Moderating Effect of Gender on the Within-Person Relationship Between Being Required to Use the Camera During Video Call Meetings and Fatigue

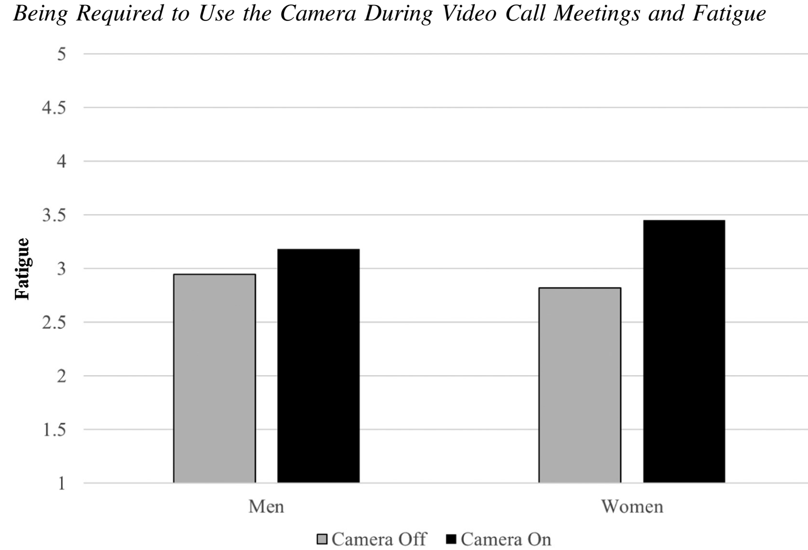
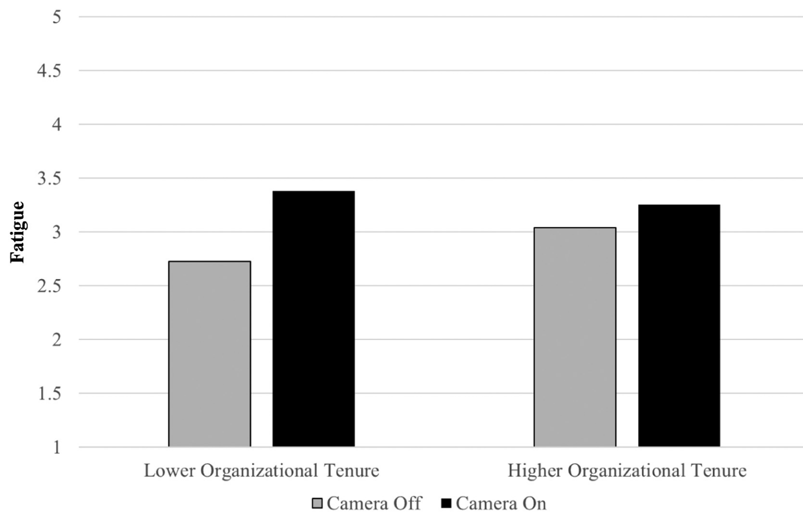


Figure 3
Cross-Level Moderating Effect of Organizational Tenure on the Within-Person Relationship Between Being Required to Use the Camera During Video Call Meetings and Fatigue



pervasive than we originally expected (e.g., Wang et al., 2013). Thus, future work could take a more fine-grained approach, capturing assessments within "video call episodes" to examine how effects from camera use not only operate within a single meeting, but potentially accumulate within a given workday or across days (e.g., Beal & Gabriel, 2019). Second, our participants were cognizant of our study manipulation (i.e., being required to use the camera or not), which could introduce demand characteristics; however, this was necessary given the nature of the study design and for participant consent. Nonetheless, replication of our findings would bolster further confidence. Third, we were not able to capture the percentage of other people in calls that were also on camera, which could have distinct theoretical implications for self-presentation and fatigue. This, along with other characteristics of the meeting such as meeting size and group comfort, would be useful extensions. Finally, we did not collect other-reports of performance during meetings, though we recognize that coworkers could provide informative assessments of how engaged employees appear and their level of voice in terms of frequency and quality (e.g., Huang et al., 2018; McClean et al., 2018). Multisource assessments were not possible with our organizational partnership, but we hope they are included in future work.

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Appendix A

Supplemental Investigation of Hours Spent in Virtual Meetings on Fatigue

Our focal study results did not demonstrate that time in virtual meetings, nor number of virtual meetings, related to fatigue. To bolster confidence in these null relationships and consider how these relationships may manifest in field versus experimental settings, we report a supplemental investigation at a different level of analysis (i.e., between-person) with multi-item measures to further explore these effects. Specifically, we recruited participants from Prolific (Peer et al., 2017) to capture a sample of employees across a variety of occupations who would have different experiences working during the pandemic. Participants had to be working full-time (i.e., at least 30 hr per week) in a traditional job setting in the United States and regularly interact with others at work (i.e., supervisor and coworkers). Pm articipation involved completing three surveys that were each sent 1 week apart; Time 1 assessed employees' virtual meeting hours and work hours, Time 2 assessed fatigue, and Time 3 assessed voice and engagement. Participants could earn up to \$9.60 based on their level of study participation; those who completed all three surveys were entered into a drawing to win one of five \$100 bonus payments.

A total of 795 participants qualified, of whom 558 participants passed attention checks, provided valid data (i.e., completed the survey in the appropriate time frame and without unusual responses), and responded to all three surveys. The final sample was largely male (56.3%), White (76.5%), and with an average age of 34.8 years ($SD = 9.1$). Employees worked 41.5 hr per week ($SD = 6.3$) and had been in their current organization for 6.0 years ($SD = 4.8$). Employees were from a number of industries, including healthcare and social assistance (15.8%), professional, scientific, and technical services (13.6%), and educational services (11.8%).

At Time 1, we asked employees to report the number of weekly hours they were interacting with other people through virtual meetings (e.g., Zoom, Skype, or FaceTime) or on the phone; we also assessed number of hours worked on average during the pandemic and treated that as a control (results reported were unchanged without the inclusion of this variable). At Time 2, we captured employees' fatigue using three items adapted from Wharton (1993; $\alpha = .96$). At Time 3, employees rated their work engagement with 5 items adapted from Rich et al. (2010; $\alpha = .95$) and their voice using 6 items adapted from Van Dyne and LePine (1998; $\alpha = .93$). Items at Time 2 and Time 3 and were rated on a 5-point scale (1 = *not at all*; 5 = *a great deal*). All measures referred to employees' experiences working during the pandemic.

We tested our hypotheses using path analysis in Mplus 8.1 (Muthén & Muthén, 1998–2015).[A1] Descriptive statistics and correlations are presented in Table A1. Results (see Table A2) indicated that the number of virtual meeting hours was not related to fatigue ($b = .003$, $\beta = .025$, $p = .557$). Results also indicated a significant and negative effect of fatigue on voice ($b = -.094$, $\beta = -.124$, $p < .01$) and engagement ($b = -.251$, $\beta = -.331$, $p = .005$). Thus, these results are similar to those reported in the focal experience sampling investigation such that amount of time did not relate to fatigue, but feelings of fatigue did negatively relate both voice and engagement.[A2]

[A1] Results from a confirmatory factor analysis indicated that our data fit the hypothesized model well, $\chi^2(74) = 161.69$, CFI = .98, TLI = .98, RMSEA = .05, SRMR = .04. This model exhibited better fit than an alternative model that collapsed work engagement and voice into a single factor, $\chi^2(76) = 2056.86$, CFI = .62, TLI = .55, RMSEA = .22, SRMR = .17, $\Delta\chi^2(2) = 1895.17$, $p < .01$.

[A2] We also examined the interactive effects of virtual meeting hours and gender, as well as virtual meeting hours and organizational tenure, on fatigue. Gender was coded such that 0 = male and 1 = female. We centered virtual meeting hours, gender, and organizational tenure to create the interaction terms. Although both gender ($b = .457$, $p < .01$) and organizational tenure ($b = -.050$, $p < .01$) were associated with emotional exhaustion, the corresponding interactive effects with videoconferencing hours were nonsignificant ($b = -.009$, $p = .420$ and $b = .000$, $p = .987$, respectively). All other effects remained qualitatively unchanged. Results are available upon request.

(*Appendices continue*)

Table A1
Means, Standard Deviations, and Correlations

Variable	*M*	*SD*	1	2	3	4	5	6	7	8	9
1. Virtual meeting hours	8.72	9.54	—								
2. Fatigue	2.65	1.34	.03	(.96)							
3. Engagement	3.28	1.02	.05	−.31**	(.95)						
4. Voice	2.83	1.01	.13**	−.11*	.43**	(.93)					
5. Number of work hours	41.51	6.32	.07	.13**	.11*	.08	—				
6. Organizational tenure	5.98	4.84	−.07	−.19**	.20**	.08	.04	—			
7. Gender (0 = male; 1 = female)	.44	.50	.00	.16**	−.02	.00	−.13**	−.07	—		
8. Age	34.79	9.05	−.01	−.17**	.17**	.05	.01	.59**	.03	—	
9. Race (0 = non-white; 1 = white)	.77	.42	−.01	−.03	.03	.03	−.11*	.09*	−.01	.15**	—

Note. $N = 558$. Number of work hours are the number of hours employees worked per week and virtual meeting hours refers to the number of hours employees are interacting with other people virtually (e.g., Zoom, Skype, or FaceTime) or on the phone.
* $p < .05$. ** $p < .01$.

Table A2
Path Analysis Results

Predictor	Fatigue (Time 2)			Voice (Time 3)			Engagement (Time 3)		
	b	*SE*	β	*b*	*SE*	β	*b*	*SE*	β
Intercept	1.49**	.39	1.12	2.38**	.26	2.36	2.91**	.37	2.87
Virtual meeting hours	.00	.01	.03	.01**	.01	.13	.01	.01	.05
Number of work hours	.03**	.01	.13	.01*	.01	.09	.02**	.01	.15
Fatigue				−.09**	.03	−.12	−.25**	.03	−.33
R^2		.02			.04			.12	

Note. $N = 558$. Number of work hours refers to the number of hours employees were working per week and videoconferencing hours refers to the number of hours employees were interacting with other people via phone or videoconferencing (e.g., Zoom, Skype, or FaceTime). The R^2 value was obtained using the StdYX command in Mplus given that standardized path coefficients are available in non-multilevel analyses.
* $p < .05$. ** $p < .01$.

Appendix B

Next-Day Effects of Video Camera Use and Fatigue

Given possible concerns with our fatigue measure being assessed "right now" and our outcomes being assessed "in meetings today," we sought to examine whether the effects of using one's camera during virtual meetings and fatigue on day t had effects that carried over to day $t + 1$ (for a similar example of next-day effects, see Wang et al., 2013). More specifically, we considered lagged effects for consecutive days in our data only (e.g., Monday → Tuesday, Tuesday → Wednesday, Wednesday → Thursday, Thursday → Friday), removing any nonconsecutive days (e.g., Monday → Wednesday, Friday → Monday). Similar to our focal study, we used FIML given that this analysis did create added missing data due to the removal of nonconsecutive days. We followed the same analytic approach detailed for our focal study with slight changes to the control variables. Specifically, we no longer controlled for prior day fatigue on our mediating variable, but still controlled for prior day voice and engagement (at day t) on our outcomes (at day $t + 1$). Further, we controlled for next day fatigue (at day $t + 1$) on our outcomes to account for same-day fatigue effects.

Results are in Table B1, and replicated the results for the focal analysis. Specifically, we continued to find a positive relationship between camera use and fatigue ($\gamma = .49$, $\gamma' = .20$, $p < .001$), with no relation between the number of hours spent in virtual meetings ($\gamma = -.02$, $\gamma' = -.02$, $p = .612$) or the number of virtual meetings ($\gamma = .03$, $\gamma' = .04$, $p = .381$). Further, fatigue negatively related to next day voice ($\gamma = -.12$, $\gamma' = -.19$, $p < .001$) and engagement ($\gamma = -.12$, $\gamma' = -.17$, $p < .001$), controlling for the prior day's voice and engagement, respectively, and next day fatigue. There was a significant indirect effect camera use on next day voice via fatigue (estimate: −.058, 95% CI = −.1108, −.0222) as well as on next day engagement, (estimate: −.059, 95% CI = −.1133, −.0216). These results add further support to the previously identified indirect effects modeled within the same workday.

Additionally, gender ($\gamma = .43$, $\gamma' = .09$, $p = .038$) and organizational tenure ($\gamma = -.10$, $\gamma' = -.10$, $p = .015$) moderated the within-person relation between camera use and fatigue. Simple slopes revealed that there was a stronger positive relationship for women (simple slope = .71, $p < .001$) than for men (simple slope = .28, $p = .033$; difference = .43, $p = .038$); there also was a stronger positive relationship for those with lower organizational tenure (simple slope = .74, $p < .001$), than those with higher tenure (simple slope = .24, $p = .073$; difference = .50, $p = .015$). These interactions resemble those for the focal study and are not reported here for brevity.

Again, for completeness, we tested conditional indirect effects for gender and organizational tenure on the within-person relationships of camera use during virtual meetings on next day outcomes via fatigue. Beginning with our conditional indirect effects for voice, the negative indirect effect was stronger for women

(*Appendices continue*)

(estimate: −.083, 95% CI = −.1555, −.0340) than men (estimate: −.033, 95% CI = −.0869, −.0035; difference = −.050, 95% CI = −.1173, −.0083); for tenure, the negative indirect effect of being required to use the camera on voice via fatigue was stronger at lower (estimate: −.087, 95% CI = −.1645, −.0339) versus higher levels of tenure (estimate: −.029, 95% CI = −.0771, −.0002; difference = .059, 95% CI = .0024, .0265). A similar pattern emerged for engagement, with the negative indirect effect being stronger for women (estimate: −.084, 95% CI = −.1645, −.0320) than for men (estimate: −.033, 95% CI = −.0844, −.0038); difference = −.051; 95% CI = −.1238, −.0068); it was also stronger at lower organizational tenure (estimate: −.088, 95% CI = −.1706, −.0337) and nonsignificant at higher tenure (estimate: −.029, 95% CI = −.0780, .0003; difference = .059, 95% CI = .0023, .0268). Thus, our results are robust to whether our outcomes are modeled same day or next day.

Table B1
Simultaneous Multilevel Path Analysis Results for Supplemental Model

Effect type	Coefficient	*SE*
Fatigue		
Random intercept		
Intercept	3.09**	.11
Organizational tenure	.02	.03
Gender	.07	.14
Starting condition	.08	.14
Random slope for condition		
M	.49**	.11
Organizational tenure	−.10*	.04
Gender	.43*	.21
Random slope for virtual meeting hours		
M	−.02	.04
Organizational tenure	−.00	.02
Gender	.14	.09
Random slope for number of virtual meetings		
M	.03	.03
Organizational tenure	.00	.01
Gender	−.07	.07
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.01	.04
Study day (Day 1–20)	.01	.01
Sine	−.00	.06
Cosine	−.05	.04
Residual variance at Level 2	*.44*	
Residual variance at Level 1	*.74*	
Next-day voice		
Intercept	4.47**	.15
Random slope for fatigue		
M	−.12**	.03
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	−.03	.07
Study day (Day 1–20)	−.01	.01
Sine	−.07	.10
Cosine	.00	.04
Condition	.06	.05
Virtual meeting hours	−.01	.03
Number of virtual meetings	.00	.02
Voice (prior day)	.07	.05
Fatigue (same day as voice)	−.07*	.03
Residual variance at Level 2	*.08*	
Residual variance at Level 1	*.37*	
Next-day engagement		
Intercept	4.24**	.16
Random slope for fatigue		
M	−.12**	.03
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.01	.08
Study day (Day 1–20)	.00	.01
Sine	−.02	.11

(*table continues*)

(*Appendices continue*)

Table B1 (*continued*)

Effect type	Coefficient	*SE*
Cosine	.04	.04
Condition	.14	.06
Virtual meeting hours	.02	.03
Number of virtual meetings	−.01	.02
Engagement (prior day)	.09	.05
Fatigue (same day)	−.14**	.03
Residual variance at Level 2	*.06*	
Residual variance at Level 1	*.42*	

Note. Level 1 n = 1,408; Level 2 n = 103. Condition refers to Study Condition where 0 = camera off and 1 = camera on. Gender was coded such that 0 = male and 1 = female. Starting Condition was coded such that 0 = camera off and 1 = camera on. Following recommendations from LaHuis et al. (2014), we calculated the percentage of within-person variance explained in each of our criteria using the following formula from Bryk and Raudenbush (1992): $(\sigma^2_{null} - \sigma^2_{predicted})/\sigma^2_{null}$. The σ^2_{null} was taken from the within-person variance obtained from the null model; $\sigma^2_{predicted}$ was taken from the residual variance from the within portion of the model with all predictors included. The within-person variance explained was 29.5% for fatigue, 11.0% for voice, and 18.0% for engagement. Coefficients are unstandardized, which is standard for Mplus models using maximum likelihood estimation as is the current model. Standardized coefficients were manually calculated and are reported in the text for the hypothesized effects. Italicized values represent the Residual varience.
* $p < .05$. ** $p < .01$.

Appendix C

Reverse Causal Model

Given that all study variables were collected in the same survey, it is important to explore possible reverse causality such that camera use during virtual meetings related to voice and engagement, which in turn contributed to feelings of fatigue. To do so, we retained our analytic approach detailed in the focal experience sampling study, but made voice and engagement simultaneous mediators, with fatigue as the outcome. For consistency across analyses, we modeled gender and organizational tenure as cross-level moderators of the within-person relationship between camera use during virtual meetings and both voice and engagement. We also controlled for prior day voice, engagement, and fatigue. Results are in Table C1. Here, camera use during virtual meetings did not significantly relate to voice ($\gamma = -.04$, $\gamma' = -.03$, $p = .565$), nor engagement ($\gamma = -.02$, $\gamma' = -.01$, $p = .840$). Meeting hours also did not relate to either variable (voice: $\gamma = .04$, $\gamma' = .06$, $p = .123$; engagement: $\gamma = .02$, $\gamma' = .02$, $p = .551$), nor did the number of meetings (voice: $\gamma = -.01$, $\gamma' = -.03$, $p = .519$; engagement: $\gamma = .02$, $\gamma' = .04$, $p = .264$). Finally, although engagement was negatively related to fatigue ($\gamma = -.26$, $\gamma' = -.18$, $p < .001$), voice was unrelated ($\gamma = -.06$, $\gamma' = -.04$, $p = .315$). No cross-level moderating effects were found. Thus, although our constructs were assessed at the same point in time, the results are more supportive of our model as theorized with fatigue as the mediating variable.

Table C1
Simultaneous Multilevel Path Analysis Results for Reverse Causal Model

Effect type	Coefficient	*SE*
Voice		
Random intercept		
Intercept	3.98**	.07
Organizational tenure	−.01	.03
Gender	−.03	.10
Starting condition	−.17	.10
Random slope for condition		
M	−.04	.07
Organizational tenure	.01	.03
Gender	−.04	.14
Random slope for virtual meeting hours		
M	.04	.03
Organizational tenure	−.01	.01
Gender	.03	.06
Random slope for number of virtual meetings		
M	−.01	.02
Organizational tenure	.01	.01
Gender	−.03	.04

(*Appendices continue*)

Table C1 (*continued*)

Effect type	Coefficient		*SE*
Fixed slopes			
Day of the week, Monday (0)–Friday (4)	.01		.02
Study day (Day 1–20)	−.00		.01
Sine	−.03		.04
Cosine	.03		.02
Voice (prior day)	−.01		.04
Residual variance at Level 2		*.23*	
Residual variance at Level 1		*.33*	
Engagement			
Random intercept			
Intercept	3.78**		.08
Organizational tenure	.00		.02
Gender	.03		.10
Starting condition	−.11		.10
Random slope for condition			
M	−.02		.09
Organizational tenure	.01		.04
Gender	−.06		.17
Random slope for virtual meeting hours			
M	.02		.03
Organizational tenure	−.01		.01
Gender	−.04		.07
Random slope for number of virtual meetings			
M	.02		.02
Organizational tenure	.01		.01
Gender	.02		.04
Fixed slopes			
Day of the week, Monday (0)—Friday (4)	.04		.02
Study day (Day 1–20)	−.01		.01
Sine	.02		.04
Cosine	.01		.03
Engagement (prior day)	−.05		.05
Residual variance at Level 2		*.24*	
Residual variance at Level 1		*.38*	
Fatigue			
Intercept	4.33**		.26
Random slope for voice			
M	−.06		.05
Random slope for engagement			
M	−.26**		.05
Fixed slopes			
Day of the week, Monday (0)–Friday (4)	.03		.04
Study day (Day 1–20)	.01		.01
Sine	.02		.06
Cosine	−.07		.05
Fatigue (prior day)	.29**		.06
Condition	.35**		.07
Virtual meeting hours	−.01		.04
Number of virtual meetings	.03		.03
Residual variance at Level 2		*.07*	
Residual variance at Level 1		*.85*	

Note. Level 1 $n = 1{,}408$; Level 2 $n = 103$. Condition refers to Study Condition where 0 = camera off and 1 = camera on. Gender was coded such that 0 = male and 1 = female. Starting Condition was coded such that 0 = camera off and 1 = camera on. Following recommendations from LaHuis et al. (2014), we calculated the percentage of within-person variance explained in each of our criteria using the following formula from Bryk and Raudenbush (1992): $(\sigma^2_{null} - \sigma^2_{predicted})/\sigma^2_{null}$. The σ^2_{null} was taken from the within-person variance obtained from the null model; $\sigma^2_{predicted}$ was taken from the residual variance from the within portion of the model with all predictors included. The within-person variance explained was 19.8% for fatigue, 21.0% for voice, and 26.0% for engagement. Coefficients are unstandardized, which is standard for Mplus models using maximum likelihood estimation as is the current model. Standardized coefficients were manually calculated and are reported in the text for the hypothesized effects. Italicized values represent the Residual varience.
* $p < .05$. ** $p < .01$.

(*Appendices continue*)

Appendix D

Simultaneous Outcomes Model

Given that we did not find a significant direct effect in our focal analyses of study condition, that is, using the camera (1) or not (0), on voice or engagement, this resulted in nonsignificant total effects in our model (i.e., the indirect effect was significant but the direct and total effects were not). Because of this, it was of value to model fatigue, voice, and engagement as simultaneous outcomes, removing all tests of mediation. In this analysis, we elected to retain our cross-level moderating effects of gender and organizational tenure on the within-person relationship between camera use and fatigue; for completeness, we also modeled these cross-level moderating effects on the relation between camera use and both voice and engagement. Results of this analysis are presented in Table D1 below, and suggest that study condition had a significant, positive relationship with fatigue ($\gamma = .44$, $\gamma' = .18$, $p < .001$), suggesting that using the camera was more fatiguing daily for participants than not using the camera. This effect was moderated by gender ($\gamma = .40$, $\gamma' = .08$, $p = .033$) and organizational tenure ($\gamma = -.09$, $\gamma' = -.09$, $p = .016$) similar to the original analyses. However, we did not find that study condition related to voice ($\gamma = -.04$, $\gamma' = -.03$, $p = .572$) or engagement ($\gamma = -.02$, $\gamma' = -.01$, $p = .853$), and there were no cross-level moderating effects for the within-person relationship between study condition and voice (study condition x gender: $\gamma = -.04$, $\gamma' = -.01$, $p = .778$; Study condition × Organizational tenure: $\gamma = .01$, $\gamma' = .01$, $p = .852$), nor study condition and engagement (Study condition × Gender: $\gamma = -.06$, $\gamma' = -.02$, $p = .739$; study condition x organizational tenure: $\gamma = .01$, $\gamma' = .02$, $p = .731$). These results continue to emphasize the fatiguing effect associated with camera use during virtual meetings, particularly for women and newer employees.

Table D1
Multilevel Path Analysis Results for Simultaneous Outcomes Model

Effect type	Coefficient	*SE*
Fatigue		
Random intercept		
Intercept	3.10**	.11
Organizational tenure	.02	.03
Gender	.07	.14
Starting condition	.08	.14
Random slope for condition		
M	.44**	.10
Organizational tenure	−.09*	.04
Gender	.40*	.19
Random slope for virtual meeting hours		
M	−.01	.04
Organizational tenure	.00	.02
Gender	.15	.09
Random slope for number of virtual meetings		
M	.02	.03
Organizational tenure	.00	.01
Gender	−.08	.07
Fixed slopes		
Day of the week, Monday (0)–Friday (4)	.01	.04
Study day (Day 1–20)	.01	.01
Sine	.01	.06
Cosine	−.06	.04
Fatigue (prior day)	.14*	.06
Residual variance at Level 2	*.44*	
Residual variance at Level 1	*.75*	
Voice		
Random intercept		
Intercept	3.98**	.07
Organizational tenure	−.01	.03
Gender	−.03	.10
Starting condition	−.17	.10
Random slope for condition		
M	−.04	.07
Organizational tenure	.01	.03
Gender	−.04	.14

(*Appendices continue*)

Table D1 (*continued*)

Effect type	Coefficient		*SE*
Random slope for virtual meeting hours			
M	.04		.03
Organizational tenure	−.01		.01
Gender	.03		.06
Random slope for number of virtual meetings			
M	−.01		.02
Organizational tenure	.01		.01
Gender	−.03		.04
Fixed slopes			
Day of the week, Monday (0)–Friday (4)	.01		.02
Study day (Day 1–20)	−.00		.01
Sine	−.03		.04
Cosine	.03		.02
Voice (prior day)	−.01		.04
Residual variance at Level 2		*.23*	
Residual variance at Level 1		*.33*	
Engagement			
Random intercept			
Intercept	3.79**		.08
Organizational tenure	.00		.02
Gender	.03		.10
Starting condition	−.11		.10
Random slope for condition			
M	−.02		.09
Organizational tenure	.01		.04
Gender	−.06		.17
Random slope for virtual meeting hours			
M	.02		.03
Organizational tenure	−.01		.01
Gender	−.04		.07
Random slope for number of virtual meetings			
M	.02		.02
Organizational tenure	.01		.01
Gender	.02		.03
Fixed slopes			
Day of the week, Monday (0)–Friday (4)	.04		.02
Study day (Day 1–20)	−.01		.01
Sine	.02		.04
Cosine	.01		.03
Engagement (prior day)	−.04		.05
Residual variance at Level 2		*.24*	
Residual variance at Level 1		*.38*	

Note. Level 1 $n = 1{,}408$; Level 2 $n = 103$. Condition refers to Study Condition where 0 = camera off and 1 = camera on. Gender was coded such that 0 = male and 1 = female. Starting Condition was coded such that 0 = camera off and 1 = camera on. Following recommendations from LaHuis et al. (2014), we calculated the percentage of within-person variance explained in each of our criteria using the following formula from Bryk and Raudenbush (1992): $(\sigma^2_{\text{null}} - \sigma^2_{\text{predicted}})/\sigma^2_{\text{null}}$. The σ^2_{null} was taken from the within-person variance obtained from the null model; $\sigma^2_{\text{predicted}}$ was taken from the residual variance from the within portion of the model with all predictors included. The within-person variance explained was 29.3% for fatigue, 20.0% for voice, and 25.0% for engagement. Coefficients are unstandardized, which is standard for Mplus models using maximum likelihood estimation as is the current model. Standardized coefficients were manually calculated and are reported in the text for the hypothesized effects. Italicized values represent the Residual varience.
$^{*}p < .05$. $^{**}p < .01$.

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