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Exacerbate Zoom Fatigue, Particularly for Women

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Video-Conferencing Usage Dynamics and Nonverbal Mechanisms Exacerbate Zoom Fatigue, Particularly for Women

Abstract:

The widespread adoption of video-conferencing has not only transformed communication at scale, but also increased feelings of Zoom fatigue among workers around the world. Although Zoom fatigue is well-documented, it is still unclear what aspects of video-conferencing contribute to this sense of exhaustion. This paper leveraged theory on computer-mediated communication (CMC) to investigate the causes of Zoom fatigue in an online convenience sample of 9,787 participants. We provide empirical evidence that Zoom fatigue is influenced by the dynamics of individuals’ video-conferencing usage and their psychological experience of the meeting. Specifically, our results support Bailenson’s theory of nonverbal overload (2021) that video-conferences are exhausting because maintaining the nonverbal communication cues required in video-based calls (e.g., making eye contact with many people at once) can be draining. We found that people who used video-conferencing more frequently, for longer, and with fewer breaks reported more Zoom fatigue. However, people also experienced more Zoom fatigue when they experienced (1) mirror anxiety from seeing their self-image, (2) hyper-gaze from feeling watched by many faces, (3) feeling physically trapped, and challenges in (4) effort in producing nonverbal cues, and (5) effort in monitoring others’ nonverbal cues, even when controlling for differences in usage dynamics. Relative to men, women also reported greater Zoom fatigue after video-conferencing because they experienced the above nonverbal mechanisms to a greater extent. This work advances theory on CMC by reflecting on how video-conferencing can recreate and reconfigure nonverbal cues present in face-to-face communication. We discuss practical strategies to combat Zoom fatigue to improve digital well-being.

Keywords: video-conference, Zoom fatigue, nonverbal communication, gender, computer-mediated communication
Highlights

- Longer and more frequent meetings are associated with worse Zoom fatigue, but increasing the number of breaks between meetings can reduce Zoom fatigue.
- Zoom fatigue occurs when nonverbal communication cues in video-conferencing make people feel nonverbally overloaded.
- Video-conferences cause Zoom fatigue when people experience the nonverbal elements as causing mirror anxiety, hyper-gaze, feeling physically trapped, and requiring greater effort to produce and monitor nonverbal cues.
- Women experience more Zoom fatigue than men because they are more attuned to the nonverbal elements of video-conferencing.
- Certain personality traits are associated with Zoom fatigue.
- Video-conferences are more fatiguing when conducted for work-related purposes vs. social purposes.
1. Introduction

Video-conferencing is more common than ever before. Catalyzed by the COVID-19 pandemic and the lockdown measures needed to contain it, organizations around the world have rapidly adopted video-conferencing as an alternative to in-person meetings (George et al., 2022). Indeed, platforms like Zoom and Microsoft Teams have seen explosive growth as schools, companies, and communities transition towards remote and hybrid meetings. Zoom usage has grown more than 30 times since 2019, and the platform currently hosts more than 300 million users daily (Georgiev, 2023). As a result, many workplace interactions are now mediated, even after the pandemic.

Indeed, the shift to remote work brings questions about digital well-being into the workplace. The rise of video-conferencing has been matched by public concerns about the exhaustion it may cause, as workers have reported feeling mentally, physically, and psychologically drained from virtual meetings (Fosslien & Duffy, 2020). Fauville and colleagues (2021) defined this feeling of exhaustion after participating in video-conference meetings as “Zoom fatigue.” More recently, numerous studies have raised concerns about the negative ramifications of Zoom fatigue that may accompany transitions to remote or hybrid work (Fauville et al., 2021; Toney et al., 2021; Williams, 2021). For instance, prolonged fatigue can be detrimental to mental health and well-being by not only increasing worker burnout but also increasing depression, stress, and anxiety (Maslach et al., 2001; Corfield et al., 2016).

However, it is still unclear why video-conferences can be so exhausting. Comparisons of face-to-face and video-conferencing meetings indicate that participating in online meetings can be more draining than in-person ones. For instance, a recent experiment found that workers felt more fatigued after video-conferences than meetings held through other modalities, even when controlling for meeting length (Nesher Shoshan & Wehrt, 2021). In a theoretical account, Bailenson (2021)
proposed *nonverbal overload* as a potential explanation. This framework argued that video-conferences are exhausting because they produce nonverbal overload triggered by the need to attend to nonverbal communication cues present in online settings, such as needing to make eye contact with many others synchronously, or monitoring the self through the self-view feature.

In this study, we examined the mechanisms underlying Zoom fatigue and identified the individual and contextual factors influencing increased susceptibility to Zoom fatigue. We analyzed data from a large online survey \(n = 9,787\) to test the theoretical proposition from Bailenson (2021) that video-conferences are exhausting because of five nonverbal mechanisms: (1) mirror anxiety from seeing self-image, (2) hyper-gaze from feeling watched by many faces, (3) feeling physically trapped, and challenges in (4) effort in producing nonverbal cues, and (5) effort in monitoring others’ nonverbal cues. Furthermore, we examine the relationships between gender, personality, and social context on Zoom fatigue through the lens of susceptibility to nonverbal overload.

2. Related Literature

2.1 The role of nonverbal communication cues in video-conferences

Research on computer-mediated communication (e.g., Thurlow et al., 2004) demonstrates how people’s experiences with technology are often shaped by how they perceive the verbal and nonverbal communication cues available to them. For instance, video-based modalities allow people to see and hear one another synchronously whereas email-based communication facilitates asynchronous exchanges of text. Communication scholars have written at length about how the mediation of social interactions can influence people’s motivation, cognition, and mental health, in part by affording the ability to see and share different communication cues, such as facial expressions, text, or gaze (Büchi, 2021; Vanden Abeele, 2021; Meier & Reinecke, 2021). While nonverbal cues can increase a sense of “being there” with others, they also require more cognitive effort for people to produce (e.g., making sure one’s facial expressions align with one’s desired self-
presentation) and interpret (e.g., trying to understand the meaning behind changes in others’ vocal tone) (Walther, 2007). Seminal work on the hyperpersonal model of communication demonstrates that one of the conventional benefits of CMC is the removal of the need to monitor nonverbal cues - therefore allowing people to build relationships with others without needing to expend cognitive energy on the nonverbal elements of communication (Walther, 1996; Walther, 2007).

In contrast, video-conferencing is rich with communication cues: allowing people to see and hear others near-synchronously despite being physically distant. Principles from the hyperpersonal model of communication suggest that the same features that make video-conferences rich with cues may also make them uniquely effortful (Slovacek, 2003; Walther, 2007). Unlike face-to-face contexts, CMC allows people to reallocate the cognitive effort required to manage their self-presentation and attend to nonverbal cues towards the task of message composition (Madell & Muncer, 2007; Walther et al., 2015). Video-conferencing, however, reintroduces these nonverbal cues and reconstructs them into novel configurations that may be more exhausting to engage with.

2.2 Video-conferencing usage dynamics and Zoom fatigue

The ways in which people use video-conferences should influence their Zoom fatigue and exhaustion. Indeed, previous work suggests that using video-conferencing for longer and with greater frequency can contribute to feelings of exhaustion (Fauville et al., 2021; Oducado et al., 2021; Salim et al., 2022). Similar work on social media use found that increased duration and frequency of usage can lead to fatigue (Karapanos et al., 2016; Yao & Cao, 2017).

However, there may be more nuanced relationships between video-conference usage and Zoom fatigue. For instance, Shockley et al. (2021) found no relationship between the total time spent on video-conference and fatigue, indicating that more granular analyses may be needed to identify the dynamics of video-conferencing usage that relate to Zoom fatigue. Indeed, recent work shows that structural patterns in the spacing of media use can often shape its impact on individuals (Reeves et al., 2021). In the case of Zoom fatigue, people who use video-conferencing in more concentrated
“bursts” - such as having several back-to-back meetings - may feel more fatigued than those who spread out their video-conferencing throughout the day. Based on this prior work, we predicted that more frequent or longer meetings should increase fatigue while more time in between meetings should reduce fatigue:

\[ H_1: \text{Zoom fatigue will be positively correlated with the (a) frequency and (b) the duration of video-conference, and negatively correlated with the (c) time between meetings.} \]

2.3 Gender and Zoom fatigue

Research on video-conferencing in online learning and collaboration tasks indicates that the affordances of video may interact with sociocultural gender roles (McKnight & McKnight, 2012; Teoh, 2012; Wang & Roubidoux, 2020). Nearly a century of research in psychology has examined how gender influences nonverbal communication (Gates, 1923; Hall & Gunnery, 2016). One concern raised by Bailenson (2021), for example, is that women may be more affected by mirror anxiety than men. A meta-analysis of two decades of psychological work examining how physical mirrors can trigger increased self-focused attention (Fejfar & Hoyle, 2000) indicated a small effect size linking mirror image viewing with negative affect, but this effect is larger for women than for men. Women often report feeling greater levels of self-focused attention (Flory et al., 2000; Ingram et al., 1988), particularly in respect to their appearance in digital contexts (Haferkamp et al., 2012; Rui & Stefanone, 2013). Women are more likely than men to have greater self-focused attention during real-time views of the self, which can increase their negative affect (Ingram et al., 1988). Should a similar process occur with the self-view in video-conferencing, then women may experience more mirror anxiety during video conferencing, which in turn could lead to higher levels of Zoom fatigue.

More generally, there are many gender effects in nonverbal communication that may be related to the other nonverbal mechanisms in video conferencing. Women, for example, tend to display more facial expressions than men (Hall & Gunnery, 2016; Kring & Gordon, 1998), such as smiling more (Hall & Gunnery, 2016; Henley, 1977), with evidence suggesting that this difference is
associated with awareness of being observed and feeling self-consciousness (LaFrance et al., 2003). In terms of interpreting nonverbal behavior, women recall details about other people’s appearance and nonverbal behaviors better than men (Horgan et al., 2004; Hall et al., 2006). These results have been corroborated by studies finding women more accurate at judging emotions based on the eyes (Baron-Cohen et al., 2021), recognizing neutral facial expressions (Sasson et al., 2010), and interpreting someone’s personality or thoughts and feelings (Chan et al. 2011; Thomas & Fletcher, 2003). Video conferencing may increase the cognitive load associated with these nonverbal mechanisms more for women than for men.

As a result, nonverbal communication cues in video-conferencing may exacerbate Zoom fatigue more for women than for men (Ratan et al., 2022). Understanding the differential impact of video-conferencing on well-being is important because the burdens of workplace stressors are already borne unequally across gender (Kelan, 2009; Gander et al., 2010; Smith, 2002). It is therefore important to understand if the widespread use of video-conferencing exacerbates existing gender inequalities by producing a disproportionately more exhausting working environment for women than for men, and if so, why. Thus, this study investigates gender differences in Zoom fatigue and based on earlier work, predicts:

\[H_2: \text{Women will report greater Zoom fatigue than men.}\]

2.3 Nonverbal overload: A framework for understanding the mechanisms of Zoom fatigue

Indeed, Bailenson (2021) predicted that video-conferences cause Zoom fatigue when people experience its affordances of nonverbal communication overload as causing nonverbal overload. First, Bailenson (2021) argued that seeing one’s reflection in an “all day mirror” can be stressful and make individuals expend more cognitive effort on focusing on how they appear to others (Wells et al., 1995). In an experiment, George & Stopa (2008) found that asking individuals to use the self-view feature with a webcam increased concerns about how others might perceive them, resulting in
heightened anxiety and greater cognitive effort to manage their impression upon others. In a similar vein, the self-view feature may cause Zoom fatigue by evoking mirror anxiety.

Second, the challenges of both producing and interpreting nonverbal communication cues in video-conferences may exacerbate Zoom fatigue by increasing nonverbal overload. Bailenson (2021) argued that social interactions in video-conferences can be more cognitively demanding than audio-only calls due to the difficulty of parsing communication through audio and video lag. Interpreting other people’s nonverbal behavior can also be distracting (Tomprou et al. 2021) because cues like head orientation and eye gaze have ambiguous social meanings during video-conferences due to the fixed camera orientation. In addition, video-conferencing often requires producing more nonverbal cues, like exaggerating facial expressions and gestures to make them visible on-screen (Hinds, 1999). The additional emotional and physical energy it takes to create such nonverbal cues should increase fatigue and cause nonverbal overload.

Third, Bailenson (2021) argues that conventional video-conferencing displays can make one feel like many people are making intense, up-close eye contact with them at the same time. This feeling of being intensely watched, which we refer to as hyper-gaze, can be both visually and psychologically stressful. Attempting to fulfill the norm of reciprocal eye contact with many others at once during video-conferences can require more cognitive effort, and thus potentially cause more Zoom fatigue. Feeling watched by others can increase nonverbal overload by making people self-regulate their behavior more vigilantly to avoid social missteps that may hurt their reputation (Keller & Pfattheicher, 2011; Baillon et al., 2013). Media richness theory also argues that we should expect the effects of being watched to be even stronger in video-conferencing because the richness of communication cues means that people will feel watched by many other people in real-time and high-definition (Ishii et al., 2019). We therefore predicted that:

Finally, the lack of physical mobility associated with video-conferencing may exacerbate Zoom fatigue by making participants feel physically trapped. Social norms require individuals to stay
seated facing the camera during a video-conference (Ten Broeke et al., 2020). For instance, the GoToMeeting video-conferencing platform instructions encourage participants to “use attentive body language: sit up straight, don’t make big extraneous movements, and don’t let your eyes wander too much”. While in-person meetings may have similar norms around reduced movement, the tight fixed angle of video-conferencing reduces the range of acceptable movement to an even greater degree. As Bailenson (2021) noted, these restrictions may worsen Zoom fatigue by making participants feel constrained in their actions and choices. Furthermore, maintaining one’s body language in a manner conductive with video-conferencing etiquette can also increase cognitive load: remembering to sit up straight, look at the camera, and remain within the fixed view of the camera can be tiring. Base on the theoretical account of Bailenson (2021) concerning the role of nonverbal mechanisms in Zoom fatigue, we predicted that:

**H3:** Zoom fatigue will be positively correlated with the nonverbal mechanisms of (a) mirror anxiety, (b) production and interpretation of nonverbal cues, (c) hyper-gaze, and (d) feeling physically trapped.

In addition it may be the case that Zoom fatigue is worse for women because they experience the nonverbal elements of video-conferencing as requiring greater cognitive effort. Self-presentational concerns to look attractive, positive, and attentive during social interactions are often more salient for women than men (Gentile et al., 2009; Grogan, 2021), suggesting that the presence of nonverbal cues like facial expressions and gaze in video-conferences may prove to be particularly cognitively effortful for women. The nonverbal elements of video-conferencing may also disproportionately impact women as they tend to be more attuned to the nonverbal communication cues produced by others (Schmid et al., 2011; Hall & Gunnery, 2013). While this information processing style may improve their ability to detect and respond to important interpersonal cues (Hall & Bernieri, 2001), it may worsen fatigue because women are expending more energy attending to others’ reactions. As a result, we predicted:
*H5*: Gender differences in Zoom fatigue will be mediated by (a) mirror anxiety, (b) production and interpretation of nonverbal cues, (c) hyper-gaze, and (d) feeling physically trapped.

Since language analyses have long been used to uncover insights into how people understand their experiences (Pennebaker & Chung, 2013), we decided to triangulate our findings on the potential gender effect on Zoom fatigue. We focus on two dimensions of language that should reflect the survey findings described above.

First, previous work on linguistic analysis has demonstrated that the topics people write about can reveal what aspects of their experience they are focusing on (Tausczik & Pennebaker, 2010; Markowitz, 2021). For instance, someone who writes about video-conference using more emotion-related words (e.g., felt, tired, bored) can be understood as focusing on the affective impact of Zoom, while another person who uses more physicality-related words (e.g., sit, back) may be focusing on its impact on their body. Based on our prior results, we predicted that:

*H5*: The frequency of negative or fatigue-related themes will be higher for women than men.

Second, we analyzed pronoun patterns to examine where people were focused when writing about their Zoom experience, on the self or on other people. People that feel more self-conscious about their work performance, for example, tend to use more first-person singular pronouns (e.g., me, my, I) (Morin, 2011), reflective of their increased focus on themselves instead of others (Brockmeyer et al., 2015; Markowitz & Hancock, 2017). Building on the results of our studies and prior work suggesting that mirror anxiety from video-conferencing can be explained by the increase in self-focused attention (Ratan et al., 2022), we examined the production of first-person singular pronouns in relation to mirror anxiety and its role in Zoom fatigue.

*H6*: Women would use more first-person singular pronouns when discussing their experience of video-conferencing.
Research on computer-mediated communication suggests personality traits affect people’s psychological experiences with technology and their subsequent levels of fatigue (Ayyagari et al., 2011). For instance, Lee et al. (2014) found that highly neurotic people felt more fatigued after using social media, in part because they perceived its affordance of constant connectivity as personally invasive and stressful (see also Xiao & Mou, 2019). In contrast, the same affordance was not exhausting for extraverts. Previous work on the use of video-calls in schools and the workplace suggests that personality may play a similar role in shaping how people understand, experience, and respond to video-conferences (Sardeshmukh et al., 2012; Murray et al., 2020; Dikaya et al., 2021).

Based on these prior findings, we asked the following two research questions:

*RQ1*: How does personality influence Zoom fatigue?

*RQ2*: How does personality influence how participants experience the nonverbal elements of video-conferencing.

We were also interested in examining the role of context on Zoom fatigue. The social context of online interactions can also influence people’s emotional and psychological responses to technology (O’Sullivan, 2000). For example, studies conducted on remote work during the pandemic found that people felt differently about virtual meetings with family and friends, versus with coworkers (Bowden-Green et al., 2021). This aligns with previous work that highlights how the perceived context of technology use - such as for work or for socialization - can shape people’s psychological experiences (Bayer et al., 2020; Rhee et al., 2021). Moreover, the detrimental effects of video-based communication appear to be particularly pronounced in work-related contexts, such as telework, and less present in social contexts like Facetime calls or group video-calls (Strouse et al., 2021; Brown & Greenfield, 2021). As a result, we asked:

*RQ3*: How does the context of video-conference (social versus work-related) correlate with Zoom fatigue?
2. Method

2.1 Procedure

We collected data through an online survey from February 22nd to March 12th, 2021. Participants were recruited through an online press release about remote work that was posted on February 22, 2021. Readers were invited to measure their own level of Zoom fatigue online by taking an online Qualtrics survey, which was used to collect data for this study. The press release triggered widespread media coverage both in the news and on social media worldwide (see Supplemental Material for a non-exhaustive list of media coverage), which facilitated recruitment of a large convenience sample over three weeks.

Figure 1 illustrates the timeline of the survey. Initially, the survey included the following measures: (a) demographic questions (gender, age, and race), (b) the Zoom Exhaustion & Fatigue (ZEF) scale, (c) items assessing video-conference usage dynamics and (d) an open-ended question about participants’ video-conference experience (All measures are described in the next section). On February 25th 2021, after collecting more than 2,700 valid responses, questions concerning nonverbal mechanisms were added to the survey. On March 1st 2021, after an additional 5,100 valid responses, we added the Ten Item Personality Inventory questionnaire (Gosling et al., 2003). Moreover, we added an experimental manipulation: two conditions were introduced in which the respondents were asked to respond to the ZEF scale while thinking about video-conferences for social purposes or video-conferences related to work. On March 12th 2021, the data collection was terminated with 9,787 valid responses.

All procedures were approved by the [University] Institutional Review Board. All participants willingly consented to participate in the study. Only responses from participants who reported using video conferences on a daily basis, passed the attention check question (see Supplemental Material), were between 18 and 85 years old, and completed all questions were
considered as valid. Because our core hypotheses and research questions were informed by prior work on gender-based differences between men and women, our analyses focused on the respondents who identified as either men or women. Participants who did not indicate their race were also excluded from the final sample as race was entered as a covariate in all analyses. The final complete dataset included 9,787 participants. As shown in Figure 1, the data were segmented into three datasets based on the measures that participants completed.

**Figure 1. Timeline of Measures in Data Collection**

![Timeline of Measures in Data Collection](image)

*Note.* Data were collected through an online survey from February to March, 2021. All participants completed the Zoom Fatigue & Exhaustion Scale (Fauville et al., 2021), measures relating to video-conferencing usage dynamics, demographic questions, and an open-ended question about experiences with video-conferences. These responses comprise the complete dataset (n = 9,787). From February 25th onwards, participants also completed questions about the nonverbal mechanisms of Zoom fatigue. Responses from individuals who completed these questions comprise Subset 1 (n = 7,436). Finally, on March 1, additional questions regarding personality (the Ten-Item Personality Inventory, Gosling, 2007) and social vs. work contexts of video-conferencing were added to the survey. Responses from individuals who completed these questions comprise Subset 2 (n = 2,638).
2.2 Participants by Dataset

The complete dataset included responses from 9,787 participants, 70.5% of whom identified as women (n = 6,921) and 29.5% men (n = 2,866). The age ranged between 18 and 85 years old (M = 43 years, SD = 13 years). The distribution of races was: 2.5% of African or African-American or Black (n =246), 7.6% of Asian or Asian-American (n = 764), 4.5% of Hispanic or LatinX (n = 437), .3% of Indigenous or Native American (n = 25), .8% of Middle Eastern (n = 79), .3% of Native Hawaiian or Pacific Islander (n = 25), 79.3% of White (n = 7,760), 4.7% as multiracial (n = 461), and .8% as other (n = 8).

Subset 1 included responses from all participants who completed measures regarding the nonverbal mechanisms of Zoom fatigue, in addition to the previous questions (n = 7,436). As in the complete dataset, the majority of participants were White (79.8%; n = 5,935) and female (71.8%, n = 5,336). The average age of the sample was 43.3 years (SD = 13 years). (See Supplemental Materials for full demographic information).

Subset 2 included responses from all participants who completed measures regarding personality and social context. Again, the majority of participants identified as being White (77.8%; n = 2,014) and female (73.3%, n = 1,983). The average age of the sample was 43.5 years (SD = 14 years) (See Supplemental Materials for full demographic information).

2.3 Measures

Video Conference Usage Dynamics

Video-conference usage dynamics were measured through three items (see Supplemental Material for all items). Individuals were asked to estimate the frequency of their video-conferences (from 1 = 1 time to 7 = 7 times or more; M = 3.69, SD = 1.75), the average duration of their video-conferences (from 1 = less than 15 min to 5 = more than an hour; M = 3.91, SD = .79), and the average
time between video-conferences (from 1 = more than an hour to 5 = less than 15 min; reverse-coded; \( M = 3.47, SD = 1.51 \)).

**Zoom Exhaustion & Fatigue Scale**

Individuals’ level of Zoom fatigue was measured with the ZEF scale (Fauville et al., 2021), a 15-item, self-report scale that assesses the “exhaustion individuals feel from participating in video-conferences” along five dimensions: general, visual, emotional, social and motivational (see questions in Supplemental Material). All items were on a 5-point Likert-scale ranging from 1 = “Not at all”, 2 = “Slightly”, 3 = “Moderately”, 4 = “Very” to 5 = “Extremely” except for two frequency questions from 1 = “Never”, 2 = “Rarely”, 3 = “Sometimes”, 4 = “Often” to 5 = “Always”. The ZEF score was measured by computing the mean of the 15 items (\( M = 3.02, SD = .81 \)), and demonstrated good internal reliability (Cronbach’s alpha = .94).

**Open-Ended Description of Video-Conferencing Experiences**

All participants were invited to write down descriptions of their experiences with video conferences (“Is there anything you want to tell us about your experience with video conferences?”) A total of 5,359 participants completed the open-ended question (word count: \( M = 54.5, SD = 51.06 \)). Two natural-language processing techniques were applied to examine the content and linguistic patterns of individuals’ responses.

*Meaning Extraction Method (MEM).* To examine the themes in participants’ descriptions of video-conferencing, we employed the MEM (Chung & Pennebaker, 2008) to identify meaningful word clusters within a corpus of text through factor analysis (Markowitz, 2021). The MEM clustered different words that reflect a common topic together (Boyd & Pennebaker, 2015) by (1) entering the text of each response into the Meaning Extraction Helper, Version 2 (Boyd, 2018) for segmentation, lemmatization, and frequency counts, and (2) conducting a principal components analysis with Varimax rotation, and we retained terms that loaded at .20 or higher. Following Chung and
Pennebaker’s criteria (2008), only root words that were used in at least 5.0% of the responses were retained.

*Linguistic Inquiry and Word Count (LIWC)*. To examine patterns in the style of participants’ writing, we used the standard analytic tool LIWC (Tausczik & Pennebaker, 2010). Each participant’s response was analyzed by LIWC, which checked each word against a dictionary of more than 2,000 word stems. As a measure of self-focused attention (Morin, 2011), we calculated the number of first-person singular pronouns (e.g., me, my, I) as a percentage of total word count. On average, participants used approximately six first-person singular pronouns (SD = 5 words) in their responses.

**Nonverbal Mechanisms**

In addition to the variables described above, Subsets 1 and 2 included measures assessing respondents’ perception of five nonverbal mechanisms that were theorized to be related to Zoom fatigue: mirror anxiety, feeling physically trapped, hyper-gaze, and challenges in the production of nonverbal cues and interpretation of nonverbal cues (Bailenson, 2021).

The influence of viewing the self on *mirror anxiety* while video-conferencing was assessed with three questions (M = 3.16, SD = .99, Cronbach’s alpha = .79). Three questions investigated how the restricted movements while video-conferencing would produce a feeling of being physically *trapped* (M = 4.12, SD = .69, Cronbach’s alpha = .56). The perception of *hyper-gaze* of other participants on feelings of being watched was examined with one question (M = 3.10, SD = 1.21). Finally, two questions explored the role of the challenges of *producing nonverbal cues* (M = 3.36, SD = 1.09) and *interpreting nonverbal cues* (M = 3.62, SD = .90) on Zoom fatigue.

**Personality**

Subset 2 also included measures regarding personality traits. We used the Ten-Item Personality Inventory (TIPI) (Gosling et al., 2003) to examine five personality domains: extraversion (M = 3.16, SD = 1.00), agreeableness (M = 3.78, SD = .71), conscientiousness (M = 4.02, SD = .75), emotional stability (M = 3.45, SD = .86), and openness to experience (M = 3.86, SD = .71).
Work versus social conditions

Subset 2 also randomly assigned\(^1\) participants to one of the two conditions: (a) in the Work condition, participants answered the questions about video-conferencing while thinking about their experiences with work-related video conference calls (e.g., having a work meeting or taking/giving a class); (b) in the Social condition, the participants answered questions about video-conferencing while thinking about their experiences with video conference calls for social purposes (e.g., virtual parties with friends).

3. Results

3.1 Hypothesis 1: Video-conferencing usage dynamics and Zoom fatigue

The complete dataset (\(n = 9,787\)) was used to investigate the first hypothesis stating that Zoom fatigue will be positively correlated with the (a) frequency and (b) the duration of video-conference, and negatively correlated with the (c) time between meetings. We examined the relationship between the dynamics of video-conferencing usage and Zoom fatigue using multiple linear regression, controlling for age and race (see Supplemental Material).

As predicted, all three measures of video-conferencing usage were significantly associated with fatigue. The results of the overall model were significant, \(F(3, 10445) = 227, p <.001\), Adj. \(R^2 = .11\). Meeting duration (\(\beta = .18, SE = .01, p <.001\)) and meeting frequency (\(\beta = .15, SE = .01, p <.001\)) were associated with greater Zoom fatigue. Time between meetings was negatively associated with

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\(^1\) After pilot testing, we decided that randomly assigning each participant to one condition, instead of asking them to complete the same survey once for the social and once for the work conditions, seemed to be less time consuming for the participants. Indeed, participants taking a survey twice as long might have felt increased fatigue, disinterest or distraction (Krosnick, 1991).
Zoom fatigue ($\beta = -.11, \ SE = .01, \ p < .001$), such that having longer breaks between video-conferences was correlated with less exhaustion.

Together, these results indicate that Zoom fatigue is shaped by the ways people engage with video-conferencing. While longer and more frequent video-conference meetings can worsen exhaustion, having more time in between video-conferences can offset some of its negative effects. Building on previous work suggesting that the impact of technology use on well-being is more complex than duration alone (Parry et al., 2021; Orben, 2020; Reeves et al., 2021), these findings indicate that understanding the impact of video-conferencing on fatigue requires consideration of temporal dynamics. Whereas Bennett et al. (2021) found that video-conferencing is more fatiguing later in the day, we found that video-conferencing length, frequency, and spacing throughout the day can also worsen exhaustion.

3.2 Hypothesis 2: Gender and Zoom fatigue

Next, we tested the hypothesis that women would report greater Zoom fatigue than men, using the complete dataset ($n = 9,787$). To do so, we conducted another multiple linear regression where video-conferencing usage dynamics and gender were predictor variables, Zoom fatigue was the outcome variable, and age and race were entered as covariates (see Supplemental Material).

Results supported our hypothesis that women would experience more Zoom fatigue than men. The omnibus model was significant, ($F(13, \ 9649) = 122, \ \text{Adj. } R^2 = .14$), and including gender as a predictor significantly improved the model fit, ($F(1, \ 9649) = 325.5, \ p < .001$). Again, video-conferencing frequency ($\beta = .16, \ SE = .01, \ p < .001$) and duration ($\beta = .15, \ SE = .01, \ p < .001$) were associated with more Zoom fatigue, and time between meetings ($\beta = -.09, \ SE = .01, \ p < .001$) was associated with less Zoom fatigue. However, even when controlling for differences in video-conferencing usage dynamics, women reported more Zoom fatigue than men ($\beta = .40, \ SE = .02, \ p < .001$, see Figure 2).
Gender differences in Zoom fatigue and video-conferencing usage dynamics

These results suggest that women felt more fatigued than men even when controlling for the frequency, duration, and time between meetings. Our next objective was to examine the factors that make video-conferencing fatiguing, especially for some people relative to others.

3.3 Hypothesis 3: Mechanisms of Zoom fatigue

Subset 1 was used to investigate the hypothesis stating that Zoom fatigue will be positively correlated with the nonverbal mechanisms of (a) mirror anxiety, (b) production and interpretation of nonverbal cues, (c) hyper-gaze, and (d) feeling physically trapped. To do so, we used multiple regression analyses where the predictor variables were mirror anxiety, production of nonverbal cues,
interpretation of nonverbal cues, hyper-gaze, and feelings of being physically trapped; the outcome variable was Zoom fatigue score; and age, gender, race, and video-conferencing usage dynamics were covariates.

The omnibus model was significant, indicating that the nonverbal mechanisms explained 34% of the variance in Zoom fatigue, \((F(18, 7321) = 215.3, p < .001)\). All five mechanisms were significantly associated with greater Zoom fatigue, controlling for differences in video-conferencing usage. These results indicate that when people used video-conferencing, they felt significantly more fatigued if they experienced mirror anxiety \((\beta = .18, SE = .01, p < .001)\), feelings of being physically trapped \((\beta = .24, SE = .01, p < .001)\), hyper-gaze \((\beta = .14, SE = .01, p < .001)\), and challenges from producing \((\beta = .07, SE = .01, p < .001)\) and interpreting nonverbal cues \((\beta = .07, SE = .01, p < .001)\). Again, women experienced more Zoom fatigue than men \((\beta = .14, SE = .02, p < .001)\) and older people experienced less than younger people \((\beta = -.11, SE = .01, p < .001)\).

These findings support our hypothesis that nonverbal communication cues like eye gaze and facial expressions can be exhausting when they evoke self-evaluation, feelings of constraint, and challenges in producing and perceiving others’ cues. As proposed by Bailenson (2021), Zoom fatigue can be at least partly explained by how people experience the nonverbal aspects of video-conferencing (see Figure 3).

**Figure 3.**

Multiple mediation model of gender on Zoom fatigue through nonverbal mechanisms
Figure displays the paths between gender, nonverbal mechanisms, and Zoom fatigue. Multiple mediation was conducted in R using the “lavaan” package where gender was entered as predictor variable (1 = women, 0 = men); the nonverbal mechanisms of mirror anxiety, feeling physically trapped, hyper-gaze, and difficulty of producing nonverbal communication cues were entered as indirect mediators; and Zoom Fatigue and Exhaustion score was entered as the outcome variable. Standard errors of the path are reported in parentheses. * indicates a p-value < .05, ** indicates p-value < .01, and *** indicates p-value <.001.

3.4 Hypothesis 4: Gender differences and mechanisms of Zoom fatigue

Subset 1 was used to investigate the hypothesis stating that gender differences in Zoom fatigue will be mediated by the nonverbal mechanisms of (a) mirror anxiety, (b) production and interpretation of nonverbal cues, (c) hyper-gaze, and (d) feeling physically trapped. We investigated whether the disproportionate impact of Zoom fatigue on women would stem from gender differences in the experience of nonverbal mechanisms related to video-conferencing. We conducted a series of mediation analyses, with each nonverbal mechanism as the mediator, gender as the predictor, video-
conference usage measures as covariates, and Zoom fatigue score as the dependent variable using the R “mediation” package (Tingley et al., 2014) built under the potential outcome framework.

The results revealed that nonverbal mechanisms partially mediated the impact of gender on Zoom fatigue. Women felt more Zoom fatigue than men in part because they felt higher levels of mirror anxiety (ACME = .18, 95% CI = [.16, .20], p < .001), more feelings of being physically trapped (ACME = .12, 95% CI = [.10, .14], p < .001), more hyper-gaze (ACME = .09, 95% CI = [.07, .11], p < .001), and greater challenges in producing nonverbal communication cues (ACME = .07, 95% CI = [.05, .08], p < .001). The impact of gender on Zoom fatigue, however, was not mediated by challenges in interpreting others’ nonverbal communication cues (ACME = .004, 95% CI = [.01, .02], p = .20).

To understand the relative impact of each mechanism on Zoom fatigue, we ran another mediation analysis with multiple mediators using “lavaan” in R using bootstrap estimation (1000 samples). As shown in Figure 2, the strongest mediators of the gender effect on Zoom fatigue were mirror anxiety (β = .09, SE = .01, 95% CI = [.08, .11], p < .001) and feeling physically trapped (β = .08, SE = .01, 95% CI = [.07, .09], p < .001). Hyper-gaze (β = .03, SE = .01, 95% CI = [.03, .05], p < .001) and feeling greater difficulty producing nonverbal communication cues (β = .01, SE = .01, 95% CI = [.01, .02], p = .06) also explained why women felt more fatigued. Overall, the total indirect effect including all the mediators and covariates was significant (β = .22, SE = .01, 95% CI = [.20, .24]), p < .001), and accounted for approximately 58% of the total effect (β = .38, SE = .02, 95% CI [.29, .38], p < .001).

3.5 Hypothesis 5: Linguistic analysis of negative and fatigue-related themes

A total of 5,359 participants out of the complete dataset answered the open-ended question. These responses were used to explore the hypothesis that the frequency of negative or fatigue-related
themes will be higher for women than men. Three themes that emerged from participants’ writing were their focus on (1) scheduling and fatigue, (2) video-conferencing platforms, and (3) social connection. As shown in Table 1, the results of the MEM analysis (Kaiser-Meyer-Olkin (KMO) = .659, Bartlett’s test = 16322.03, \( p < .001 \)) revealed three factors of words accounted for 11.7% of the variance in participants’ writings.

**Table 1**

*Meaning Extraction Method (MEM) Factors, Terms and Loadings*

<table>
<thead>
<tr>
<th>Topic 1</th>
<th>Topic 2</th>
<th>Topic 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduling and Fatigue</td>
<td>Video-Conferencing</td>
<td>Social Connection</td>
</tr>
<tr>
<td>( \lambda )</td>
<td>%</td>
<td>( \lambda )</td>
</tr>
<tr>
<td>1.87</td>
<td>4.2</td>
<td>1.76</td>
</tr>
<tr>
<td>Term</td>
<td>Loading</td>
<td>Term</td>
</tr>
<tr>
<td>day</td>
<td>0.649</td>
<td>conference</td>
</tr>
<tr>
<td>hour</td>
<td>0.648</td>
<td>video</td>
</tr>
<tr>
<td>break</td>
<td>0.469</td>
<td>Zoom</td>
</tr>
<tr>
<td>exhaust</td>
<td>0.415</td>
<td>connect</td>
</tr>
<tr>
<td>time</td>
<td>0.400</td>
<td></td>
</tr>
<tr>
<td>work</td>
<td>0.288</td>
<td></td>
</tr>
</tbody>
</table>
Note: This table provides the eigenvalues (λ) for each factor (or topic), percent variance explained (\%) by the topic, the loadings for each term on that topic. The last row describes the mean and (standard deviation) by gender of each participant’s standardized composite score of the factor loadings (e.g., someone who has a 2.0 score on component 1 is 2 SD’s above the mean on how frequently they used terms from that topic).

<table>
<thead>
<tr>
<th>Term</th>
<th>Women</th>
<th>Men</th>
<th>Women</th>
<th>Men</th>
<th>Women</th>
<th>Men</th>
</tr>
</thead>
<tbody>
<tr>
<td>long</td>
<td>0.271</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>meeting</td>
<td>0.252</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A closer examination of the words in each thematic category provided deeper insight into what people focused on. For example, the first factor of scheduling and fatigue included words relating to time spent on video-conferencing (e.g., “hour”, “long”, “time”) and the impact it had on their lives (e.g., “exhaust”), highlighting the role of usage dynamics like duration and frequency of video-conferencing on Zoom fatigue. The second factor, included terms that related to video-conferencing generally versus the platform “Zoom” specifically. Finally, the third factor of social connection included words about relationships (e.g., “friend”, “family”) and interactions (e.g., “connect”), indicating that others focused on using video-conferencing to support social needs.

We also examined group differences in how men and women wrote about their experiences. In line with our previous findings, we found that women \((M = .05, SD = 1.02)\) were significantly more likely to focus on scheduling and fatigue than men \((M = -.13, SD = .90)\). In addition, however, women \((M = .01, SD = 1.02)\) were also more likely to write about the positive impact of video-conferencing for social connection than men \((M = -.02, SD = .92)\). Together, these results suggest
that women not only experience more Zoom fatigue, but may be more attuned to both the positive and negative effects of video-conferencing.

3.6 Hypothesis 6: First-person singular pronouns and gender

A total of 5,359 participants out of the complete dataset answered the open-ended question. These responses were used to investigate the hypothesis that women would use more first-person singular pronouns when discussing their experience of video-conferencing. We examined the role of self-focused language in the relationship between gender and Zoom fatigue. As predicted, we found that women exhibited more self-focus \((M = 6.4, SD = 5.2)\) than did men \((M = 4.8, SD = 5.2)\). This difference in self-focused language was significant, as demonstrated by a multiple regression showing that women used more first-person singular pronouns than men \((\beta = 1.56, SE = .06, p < .001)\), controlling for total word count \((\beta = 0, SE = 0, p = .08)\).

Finally, we found first-person singular pronouns were correlated with mirror anxiety \((r = .09, p < .001)\) and Zoom fatigue \((r = .06, p < .001)\). These results suggest that usage of self-focused language is an indicator that someone is experiencing increased mirror anxiety, and thus worse Zoom fatigue. To test this, we conducted a mediation analysis to test the mediation effect of first-person singular pronouns in the association between gender and Zoom fatigue, controlling for word count. Results revealed that the total effect of gender on Zoom fatigue was partially mediated by the use of first-person singular pronouns \((ACME = .01, 95\% CI = [0, .02], p = .01)\).

These results allow us to triangulate our prior findings through our survey instruments by examining the words that the participants provided in describing their video-conferencing. In this triangulation we replicate the gender effect, and find evidence for the nonverbal mechanism of mirror anxiety, with women using more self-reference in their descriptions, suggesting an increased focus on the self when describing their video-conference experience.
3.7 Research question 1: Personality and Zoom fatigue

Subset 2 (n = 2,704) was used to investigate how personality influenced Zoom fatigue. We fit a multiple regression model to examine the role of personality on Zoom fatigue, with personality traits and gender entered as predictors, ZEF score as the outcome variable, and age, race, and video-conference usage dynamics as covariates.

Results indicated that personality traits explained 12% of the variance in Zoom fatigue, ($F(15, 2502) = 25.1, p < .001$). Agreeableness ($\beta = .08, SE = .02, p < .001$), and openness to experience ($\beta = .06, SE = .02, p = .01$) were associated with more Zoom fatigue, while emotional stability ($\beta = -.20, SE = .02, p < .001$) and extraversion ($\beta = -.05, SE = .02, p < .001$) were associated with less Zoom fatigue. There was no significant association of conscientiousness ($\beta = .03, SE = .02, p = .13$).

3.8 Research question 2: Personality and the mechanisms of Zoom fatigue

Subset 2 was used to investigate how personality influences how participants experience the nonverbal elements of video-conferencing. To better understand the impact of personality on Zoom fatigue, we examined how personality influenced how people experienced the nonverbal elements of video-conferencing.

We conducted a series of multiple mediation analyses where each personality trait was the predictor, the nonverbal mechanisms were mediators, and ZEF score was the outcome. Our results demonstrated that personality affects Zoom fatigue by making people more sensitive to nonverbal overload through certain nonverbal mechanisms. People who were less emotionally stable (i.e., more neurotic) were more exhausted because they were particularly sensitive to mirror anxiety ($\beta = .05, SE = .007, 95\% CI = [.04, .06.], p < .001$) and feeling physically trapped ($\beta = .03, SE = .006, 95\% CI = [.02, .07], p < .001$). They also experienced hyper-gaze ($\beta = .01, SE = .004, 95\% CI = [.01, .02], p <
and the difficulties of producing nonverbal cues ($\beta = .01, SE = .003, 95\% CI = [.00, .01], p < .001$) more acutely, indicating that video-conferencing makes them more sensitive to the efforts to attend to and engage with nonverbal communication cues. This may be because people who are more neurotic tend to be more sensitive to the demands of their environments, virtual or otherwise (Ng, 2015; Bowden-Green et al., 2021). While people high in neuroticism were sensitive to multiple nonverbal mechanisms, the impact of agreeableness on Zoom fatigue was only significantly mediated by the feeling of being trapped ($\beta = .02, SE = .007, 95\% CI = [.01, .04], p < .001$). This suggests that personality traits predict the extent people experience specific elements of video-conferencing as constraining or exhausting.

On the other hand, certain personality traits also appear to protect individuals from experiencing Zoom fatigue. For instance, people who were more extraverted felt less exhausted after video-conferencing because they experienced significantly less mirror anxiety ($\beta = -.01, SE = .004, 95\% CI = [-.02, -.004], p = .005$). This may be because introverts experience the process of seeing and managing their self-image in a video-conferencing as more cognitively demanding than extraverts.

Together, these results indicate that individual differences in personality traits can shape their psychological experience with video-conferencing platforms with important implications for digital well-being. Notably, the gender effect remained such that women reported significantly higher levels of Zoom fatigue than men even when controlling for the role of personality and other covariates ($\beta = .33, SE = .06, p < .001$). These results suggest that individual differences such as personality and gender play an important role in shaping Zoom fatigue outcomes.

3.9 Research question 3: Social context and Zoom fatigue

Subset 2 was used to investigate how the context of video-conference (social versus work-related) correlates with Zoom fatigue. We fitted another multiple regression to predict ZEF score using
gender and context as predictors, and video-conference usage measures, age, and race as covariates $(F(15, 2473) = 39.9, \text{ Adj. } R^2 = .19, p < .001)$.

Overall, people were significantly more fatigued when they used video-conferencing for work than for social purposes ($\beta = .40, SE = .06, p < .001$). The gender effect remained significant when controlling for differences in context ($\beta = .32, SE = .06, p < .001$), suggesting that women tend to feel more fatigued by video-conferences in both work and social contexts. However, an exploratory interaction term between condition and gender was not significant, indicating that women did not respond to the social context of video-conferences in different ways from men, ($\beta = -.03, SE = .07, p = .70$).

We also examined whether contextual differences affected how people experienced the nonverbal elements of video-conferencing. We fit another series of multiple mediation analyses where condition (context) was the predictor, the nonverbal mechanisms were mediators, and ZEF was the outcome. Results showed that the impact of contextual differences on Zoom fatigue is mediated by people’s experience of nonverbal mechanisms (total indirect effect, $\beta = .10, SE = .017, 95\% CI = [.07, .14], p < .001$). Relative to social calls, people reported more Zoom fatigue in professional video-conferences because they felt more physically trapped ($\beta = .08, SE = .01, 95\% CI = [.06, .10], p < .001$) and that it was more difficult to produce nonverbal communication cues ($\beta = .01, SE = .004, 95\% CI = [.07, .14], p < .001$). This indicates that the social context of people’s video-conferencing can also influence the extent to which they are exhausted. For instance, social calls with close friends may produce less nonverbal overload than professional calls with colleagues because there are fewer self-presentational demands to manage and people feel less trapped.
3.10 Out-of-sample replication

The analysis of the main dataset demonstrated a robust gender difference in Zoom fatigue. In order to replicate the gender effect observed in our large convenience sample we conducted an out-of-sample replication.

A power analysis indicated a new sample of $n = 788$ participants to detect a small effect size ($d = .20$) with 80% power, using a two-sample t-test with alpha at .05. A total of $n = 1,203$ participants were recruited online on Amazon Mechanical Turk. Participants were required to be located within the United States and to have a minimum task approval rate of 97%. To minimize selection bias, participants answered a survey on their usage of video-conferencing tools rather than on Zoom fatigue. Using exclusion criteria from the previous studies, we excluded 425 participants for incomplete responses, failing attention checks, or not using video-conferencing on a daily basis. In line with the exclusion criteria used in the previous study, we also excluded 8 people who did not identify as either men or women, or who did not provide their race.

After data exclusion using the same criteria as the main study, the sample included $n = 770$ participants. Approximately 59.7% of the sample identified as men ($n = 460$) and 40.3% as women ($n = 310$). Ages ranged from 18 to 77 years old ($M = 35.6$ years old; $SD = 10$ years). The sample was predominantly White (69.3%, $n = 534$), with 10.6% identifying as African American / Black ($n = 82$), 9.2% as Asian ($n = 71$), 4.8% as Hispanic or Latinx ($n = 37$), 0.4% as Middle Eastern ($n = 3$), 4.7% as multiracial ($n = 36$), .5% as Native American ($n = 4$), 0.4% as Pacific Islander ($n = 3$).

Participants responded to questions about their video-conference usage, their levels of Zoom fatigue, and their demographics. The same items were used to assess these variables as in the main study.

Women ($M = 2.64, SD = .92$) reported more Zoom fatigue than men ($M = 2.49, SD = .98$) ($t(776) = -2.00, p = .03, d = -.16$). In addition, we replicated the effect of gender on Zoom fatigue by
repeating the multiple regression analyses used above. The overall model was significant \( F(12,756) = 13.1, p < .001, \text{Adj. } R^2 = .16 \), as was the impact of gender \( (\beta = .20, SE = .07, p = .003) \). This replicates the impact of gender on Zoom fatigue found in our convenience sample, replicating the finding that women experience disproportionately worse amounts of fatigue after video-conferencing than men.

4. Discussion

This study focuses on the causes and mechanisms of Zoom fatigue from the perspective of computer-mediated communication. We surveyed almost 10,000 individuals to understand why video-conference is fatiguing, especially for certain individuals (see Table 2 for an overview of Hypotheses and Research questions and associated findings). This study demonstrates that people who spent more time on video-conferences with fewer breaks felt significantly more exhausted than those who used video-conference more sporadically. Beyond usage dynamics, Zoom fatigue is partially explained by the nonverbal mechanisms of video-conference. People felt more exhausted on video-conferences when they experienced the affordance of nonverbal communication cues (e.g., gaze) as heightening self-presentational concerns, increasing the effort they put into attending to others’ communication cues, or constricting their ability to move and act freely. Individual and contextual differences also affected people’s sensitivity to experiencing the nonverbal elements of video-conferencing as more exhausting. People were more fatigued by work-related video-conferences, relative to more social ones. In addition, women consistently experienced substantially higher levels of Zoom fatigue than men because they perceived the nonverbal aspects of communication in video-conferences as requiring more energy. This effect was also observed in the language women used to describe their experience with video-conferencing, in which they used more words related to fatigue than men.
Table 2. *Overview of the hypotheses and research questions along with the results obtained and the conclusions drawn.*

<table>
<thead>
<tr>
<th>Hypotheses</th>
<th>Sub-hypotheses</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_1$: Zoom fatigue will be positively correlated with the (a) frequency and (b) the duration of video-conference, and negatively correlated with the (c) time between meetings.</td>
<td>Frequency</td>
<td>Supported</td>
<td>More frequent meetings tend to increase Zoom fatigue</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>Supported</td>
<td>Longer meetings tend to increase Zoom fatigue</td>
</tr>
<tr>
<td></td>
<td>Time between meetings</td>
<td>Supported</td>
<td>Less time between meetings tend to increase Zoom fatigue</td>
</tr>
<tr>
<td>$H_2$: Women will report greater Zoom fatigue than men.</td>
<td></td>
<td>Supported</td>
<td>Women reported significantly higher levels of Zoom fatigue than men</td>
</tr>
<tr>
<td>$H_3$: Zoom fatigue will be positively correlated with the nonverbal mechanisms of (a) mirror anxiety, (b) production and interpretation of nonverbal cues, (c) hyper-</td>
<td>Mirror anxiety</td>
<td>Supported</td>
<td>Mirror anxiety significantly predicts Zoom fatigue</td>
</tr>
<tr>
<td></td>
<td>Production of nonverbal cues</td>
<td>Supported</td>
<td>Challenges for producing nonverbal cues significantly predicts Zoom fatigue</td>
</tr>
<tr>
<td></td>
<td>Interpretation of nonverbal cues</td>
<td>Supported</td>
<td>Challenges for interpreting nonverbal cues significantly predicts Zoom fatigue</td>
</tr>
</tbody>
</table>
gaze, and (d) feeling physically trapped.

<table>
<thead>
<tr>
<th>Hyper-gaze</th>
<th>Supported</th>
<th>Hyper-gaze significantly predicts Zoom fatigue</th>
</tr>
</thead>
</table>

| Physically trapped | Supported | Feelings of being physically trapped significantly predicts Zoom fatigue |

| Mirror anxiety | Supported | Women felt more Zoom fatigue than men in part because they felt higher levels of mirror anxiety |
|----------------|-----------|-----------------------------------------------------------------

| Production of nonverbal cues | Supported | Women felt more Zoom fatigue than men in part because they felt greater challenges in producing nonverbal communication cues |
|-----------------------------|-----------|-----------------------------------------------------------------

| Interpretation of nonverbal cues | NotSupported | Women did not feel more Zoom fatigue than men when they felt greater challenges in interpreting nonverbal communication cues |
|----------------------------------|-------------|-----------------------------------------------------------------

| Hyper-gaze | Supported | Women felt more Zoom fatigue than men in part because they felt more hyper-gaze |
|------------|-----------|-----------------------------------------------------------------

| Physically trapped | Supported | Women felt more Zoom fatigue than men in part because they felt greater feeling of being physically trapped |
|--------------------|-----------|-----------------------------------------------------------------

<table>
<thead>
<tr>
<th>H5: The frequency of negative or fatigue-related themes will be higher for women than men.</th>
<th>Supported</th>
<th>Women were more likely than men to focus on scheduling and fatigue</th>
</tr>
</thead>
</table>
### RQ1: How does personality influence Zoom fatigue?

Agreeableness and openness to experience were associated with more Zoom fatigue. Emotional stability and extraversion were associated with less Zoom fatigue.

### RQ2: How does personality influence how participants experience the nonverbal elements of video-conferencing?

People less emotionally stable experienced more mirror anxiety, feeling of being physically trapped, hyper-gaze and difficulty in producing nonverbal cues. People more extraverted experienced less mirror anxiety.

### RQ3: How does the context of video-conference (social versus work-related) correlate with Zoom fatigue?

People were significantly more fatigued when they used video-conferencing for work than for social purposes.

#### 4.1 Nonverbal overload: Nonverbal mechanisms drive Zoom fatigue

We find that Zoom fatigue can be partly explained by how people perceive and respond to nonverbal communication dynamics in video-conferencing, in line with Bailenson’s (2021) theory of Zoom fatigue being caused by nonverbal overload. Unlike traditional forms of computer-mediated...
communication like email or texting, platforms like Zoom allow individuals to see, hear, and engage with one another through nonverbal means (Biehl et al., 2015; Vidolov, 2022). While such affordances help people feel present with others, video-conferences required to monitor others’ nonverbal cues and to manage one’s own appearance seem uniquely exhausting (Bailenson, 2021). In addition to reintroducing cues like facial expressions to computer-mediated communication, video-conference reconfigures and intensifies these cues while introducing new ways of perceiving the self (e.g., self-view) and others (e.g., multiple faces on screen at once). Five nonverbal mechanisms explain Zoom fatigue: mirror anxiety, hyper-gaze, feeling physically trapped, and perceiving greater challenges to producing and interpreting nonverbal cues.

Video-conference worsens Zoom fatigue when it triggers mirror anxiety because seeing the self can heighten people’s focus on their appearance and increase the effort spent regulating their expressions and emotions. This aligns with past work showing that the presence of self-images can provoke more self-evaluation (Duval & Wicklund, 1972), trigger negative affect (Fejfar & Hoyle, 2000; Wegge, 2006) and heighten self-presentational concerns (George & Stopa, 2008; Govern & Marsch, 2001). This effect is perhaps not surprising given that this is a novel nonverbal cue. Indeed, one is rarely able to see an “all day mirror” of one’s own reflection during in-person meetings.

In addition, video-conferencing can worsen nonverbal overload if it makes people feel intensely watched by other meeting participants. This experience of hyper-gaze may be activating the “watchful eyes” phenomenon, a widely observed state of heightened self-focus that arises from having eyes fixed on the individual (Keller & Pfattheicher, 2011). While this mechanism can motivate people to take more prosocial actions (Bateson et al., 2006), it can also take a toll on individuals’ energy and performance. By causing people to self-monitor their own behavior more closely, the feeling of being watched can reduce executive functioning (Keller & Pfattheicher, 2011; Baillon et al., 2013), and produce negative affect like stress and anxiety (Panagopoulos & van der
Linden, 2017). Our findings build on prior work demonstrating that the feeling of being watched can be stressful even when mediated (George & Stopa, 2008).

Furthermore, video-conferences cause fatigue when they are experienced as constraining. While the feeling of being trapped in a meeting is certainly not limited to Zoom meetings, the affordances of the video-conferencing environment can feel particularly limiting – such as feeling forced to stay in view of the webcam (Nadler, 2020). This restriction may be particularly detrimental to workers’ well-being, particularly if maintained for long periods of time. Indeed, the feeling of being trapped is a fundamental component of job-related burnout (Malach-Pines, 2005).

Finally, video-conferencing can cause fatigue when people feel that it is more challenging to produce and interpret nonverbal communication cues. Like face-to-face settings, video-conferencing requires participants to signal that they are attending to the conversation, while also scanning and responding to others’ facial expressions and gestures. As a result, they must reallocate cognitive resources (Walther, 2007) to attend to a greater amount of stimuli in the communication context - a process that can contribute to exhaustion. Furthermore, the effort required to make nonverbal communication cues visible on camera may be particularly unnatural and draining (e.g., smiling or nodding vigorously) (Hinds, 1999). These enhanced nonverbal cues can be understood as surface acting, namely faking one's emotional displays in a way that can be strenuous and feel inauthentic (Blanchard, 2021; Brodsky, 2021). In turn, the emotional dissonance created by the surface acting can trigger fatigue (Grandey, 2003). Together, these results suggest that computer-mediated communication can have meaningful, and disproportionate, impacts on digital well-being as mediated communication methods, like video-conferencing, become more common in the workplace and beyond.
4.2 Individual and contextual differences in sensitivity to Zoom fatigue

These mechanisms help explain why video-conferencing is particularly fatiguing for some individuals. Women in particular report experiencing substantially more Zoom fatigue in part because they report being more sensitive to these nonverbal mechanisms. Self-presentational concerns to look attractive, positive, and attentive during social interactions are often more salient for women than men (Connell, 2009; Gentile et al., 2009; Grogan, 2021; Rui & Stefanone, 2013; Hawes et al., 2020), suggesting that the reintroduction of nonverbal cues like facial expressions and gaze in video-conferencing are particularly tiring for women. The mediating effect of mirror anxiety on the gender fatigue effect is consistent with the psychological research on self-focused attention and negative affect (Ingram et al., 1988). This mediation pattern was observed in both the self-reported and linguistic data, with women using more first-person singular pronouns than men, with this pronoun difference mediating the gender fatigue effect. Given that production of first-person singular has been used extensively as a measure of self-focused attention (Morin, 2011; Pennebaker, 2011; Wegner & Giuliano, 1980), these are compelling behavioral data that women were more self-focused when describing their video conference experience than men.

The nonverbal mechanisms of video-conferencing may also disproportionately impact women as they tend to be more attuned to the nonverbal communication cues produced by others (Schmid et al., 2011; Hall & Gunnery, 2013; for a meta-analysis, see Hall, 1984). While this information processing style may improve their ability to detect and respond to important interpersonal cues (Hall & Bernieri, 2001), it may worsen fatigue because women are more effortful in how they perceive and interpret others’ reactions.

Personality traits also influenced the extent to which people experienced video-conferencing as psychologically constraining and exhausting. For instance, people high in neuroticism were more sensitive to the cognitive demands exerted by the rich nonverbal communication cues available,
relative to their more emotionally stable peers. These results support prior work demonstrating that neurotic individuals are more attuned to the negative aspects of their experiences, in both online and offline contexts (Gleason et al., 2012; Bowden-Green et al., 2021). Furthermore, they suggest that one reason that neuroticism is linked to worse well-being, particularly at work, is because it predisposes individuals to feeling more fatigued by the elements of their communication context.

4.3 Implications for Theory and Practice

Pioneering work on CMC demonstrated that online communication could reduce the strain of attending to cues in synchronous or face-to-face conversations (Walther, 2007; Walther & Whitty, 2021). However, in addition to asynchronous, text-based channels like email and instant messaging, CMC now comprises media like video-conferencing that allow many people to see and hear one another at the same time. Indeed, seminal work on CMC centered on the ways in which mediated forms of communication did not afford the same access to rich, nonverbal cues as face-to-face channels (Walther, 2007). Modern communication technologies now afford the ability to recreate many of the nonverbal cues that once made face-to-face communication fundamentally distinct from mediated modalities - at the cost of some of the benefits of CMC. For instance, video-conferencing platforms like Zoom can now capture many of the nuances in face-to-face interactions with relatively high fidelity. This affords many benefits including increased social presence (Lowenthal et al., 2020) and flexibility with virtual meetings (Schur et al., 2020), particularly during the age of COVID-19 (Contreras et al., 2020). However, paying attention to synchronous, nonverbal cues can prove cognitively draining and result in Zoom fatigue. Rather than merely reproducing nonverbal mechanisms present in face-to-face contexts, video-conferencing reconfigures and intensifies these nonverbal cues in a manner that is often more exhausting.

While these mechanisms can make video-conferencing fatiguing at the individual level, it can also have negative collective and organizational ramifications. For instance, Tomprou et al. (2021)
demonstrate that using video-conferencing software made it harder for teams to synchronize and communicate on a team-based task. In fact, teams without visual cues had an easier time coordinating with one another because they were less distracted by others’ images. Indeed, a recent field experiment by Brucks & Levav (2022) found that virtual meetings hindered creativity and limited idea generation by focusing individuals’ attention to the small space of their screens. Together, these findings demonstrate that individuals’ psychological experience of nonverbal processes related to CMC cues can influence individual and collective outcomes, including Zoom fatigue.

In addition to being mindful to reduce the frequency, duration, and continuity of peoples’ video-conferencing schedules, teams can adopt more flexible policies that specifically target and reduce the nonverbal overload of video-conferencing. For instance, while mandating meeting participants to turn on their cameras while joining a Zoom may increase engagement (Kushlev & Epstein-Shuman, 2022), at least in the short term, our findings suggest it may have the unwanted consequence of exacerbating Zoom fatigue - particularly for certain individuals. Instead, managers may consider implementing flexible strategies that allow individuals to turn their cameras on and off based on their comfort level (Dhawan et al., 2021). Just as people have learned to adapt to the nuances of communication via computers, it is likely that people will find ways to adapt to the reintroduction of these nonverbal cues via video-conferencing. As video-conferencing, and future communication modalities, increasingly offer more ways to communicate and connect with one another, it is vital that we not only update our theoretical models of CMC but also identify pathways to protect digital well-being in each new context.

4.4 Limitations and Future Directions

There are several limitations to our research. Our convenience sample, though large, likely resulted in a sample already holding an interest in the topic, which may have biased Zoom fatigue to be higher than the average population. Another limitation is our reliance on self-reported measures of
Zoom fatigue and video-conference usage as opposed to behavioral measures given that several studies have found people tend to overestimate media use when self-reporting (Douwes et al., 2007; Timotijevic et al., 2009). In some cases, our linguistic measures correlated with their self-reported counterparts: the frequency of first-person singular pronouns in the open-ended responses were not only correlated with self-reported mirror anxiety, but also mediated the gender effect on fatigue in the same way that mirror anxiety did. Future research should use different methods to evaluate Zoom fatigue, such as interviews and behavioral studies.

Another important limitation is our focus on gender differences between men and women. Although our sample did not have enough individuals who identified as non-binary, gender-non-conforming, or gender fluid to draw conclusions, future work should further explore how people of diverse gender identities navigate the psychological experience of video-conferencing.

The mechanisms associated with interpreting and producing nonverbal cues were each measured with one question. Moreover, the three items measuring feeling physically trapped had a low reliability (Cronbach’s alpha = .56). We recognize that the psychometric field has a tradition of using multiple items for a given construct as a way to increase validity (Churchill, 1979). Nevertheless, some scholars are arguing that a single item might, in some cases, be as valid as multiple and save time both for the respondents and the researchers (Bergkvist & Rossiter, 2007; Rossiter, 2002). It will be important in future studies to strengthen the measurement tools used.

We cannot exclude the possibility that some participants took the survey several times, although this seems highly unlikely as participants were invited to complete the survey to find out their own level of Zoom fatigue. It seems unlikely that the same person would want to find out their own level of Zoom fatigue multiple times during the data collection period. In order to address this limitation, future work might collect identifying data in order to prevent participants from responding to the survey multiple times.
Finally, we acknowledge that the prevalence of video-conferencing might differ between different lines of work. In this way, questions inquiring about the work of our participants might have contributed interesting information. We would encourage future studies to add this kind of question into their methodology. We see many potential directions for future studies. For example, following individuals’ Zoom fatigue during a working week would provide insight into how Zoom fatigue accumulates and dissipates over time. It is also imperative to examine Zoom fatigue with children, given that many children must use video-conferencing for school and to maintain family and friend relationships.

4.5 Conclusion

Zoom fatigue is an important challenge to digital well-being as video-conferencing becomes increasingly prevalent in personal and institutional contexts. In this paper, we find that Zoom fatigue is partly triggered by a sense of nonverbal overload caused by the affordance of rich communication cues through video-conferencing: (1) mirror anxiety from seeing one’s self-image, (2) hyper-gaze from feeling watched by many faces, (3) feeling physically trapped, and challenges in (4) producing nonverbal cues, and (5) monitoring others’ nonverbal cues. In addition, we demonstrate that Zoom fatigue disproportionately impacts certain groups, and highlight pathways for individuals and organizations to protect the mental health of teleworkers and video-conferencing participants.

Authors’ notes

Anonymous data and R code can be found in the OSF project [Redacted for anonymity]. The SOM includes further information about statistical analyses.

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Dear Professor Guitton,
There are no conflicts of interest to disclose for the manuscript entitled “Nonverbal Mechanisms Predict Zoom Fatigue and Explain why Women Experience Higher Levels than Men”.

Thank you for your consideration.

Best,

Géraldine Fauville, Mufan Luo, Anna Queiroz, Angela Lee, Jeremy Bailenson, Jeffrey Hancock