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Behind Videoconferencing Fatigue at Work

The Taxing Effects of Self-View and the Mediating Role of Public Self-Awareness

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Abstract A remarkable peculiarity of videoconferencing (VC) applications – the self-view – a.k.a. digital mirror, is examined as a potential reason behind the voiced exhaustion among users. This work draws on technostress research and objective self-awareness theory and proposes the communication role (sender vs. receiver) as an interaction variable. We report the results of two studies among European employees ($n_1 = 176$, $n_2 = 253$) with a one-year time lag. A higher frequency of self-view in a VC when receiving a message, i.e., listening to others, indirectly increases negative affect (study 1 & 2) and exhaustion (study 2) via the increased state of public self-awareness. Self-viewing in the role of message sender, e.g., as an online presenter, also increases public self-awareness, but its overall effects are less harmful. As for individual differences, users predisposed to public self-consciousness were more concerned with how other VC participants perceived them. Gender effects were insignificant.

Keywords Videoconferencing · Self-View · Zoom fatigue · Remote work · Technostress · Self-Awareness

1 Introduction

Videoconference (VC) technology makes it possible to bring geographically separated people together. Since the

COVID-19 pandemic, announced in Europe in March 2020, VCs have become a preferred way of communication within organizations (Pfund et al. 2020, Kuhn 2022). With a 48.7% market share, Zoom alone had over 300 million daily participants in 2021 (Woolf 2022). With undisputable benefits such as saving commuting time and reducing transportation costs, the rapid transition to a remote mode of study and work is associated with adverse psychological outcomes like fatigue (Bailenson 2021; Fauville et al. 2021; Riedl 2021) and VC aversion (Kuhn 2022).

The term “Zoom fatigue” or “videoconference fatigue,” which refers to the “feeling of exhaustion from participating in video conference calls” (Fauville et al. 2021, p.2), has gained widespread recognition as a real phenomenon. About half of U.S. workers (49%) openly report VC fatigue (Woolf 2022).

Numerous newspapers and blogs worldwide, as well as reputable media outlets, like BBC (Jiang 2020), Forbes (forbes.com 2022), CNN (Yuan 2021), Harvard Business Review (Fosslien and Duffy 2020; Gabriel et al. 2021), and Wall Street Journal (McConnon 2021), cover the topic of Zoom fatigue and offer tips on how to prevent it.

Despite the high relevance and ubiquity of the phenomenon, research on adverse VC outcomes is far from conclusive. Out of 45 articles published between April 2020 and May 2021 (for systematic literature review, see Riedl 2021), only 8 present empirical evidence, and 4 are peer-reviewed. Most studies claim the association between VC use and exhaustion, while the rationales remain largely overlooked or introduced at the level of ideas. The theorized fatigue triggers include “flattened” space (Nadler 2020) and nonverbal overload (Bailenson 2021). A conceptual model by Riedl (2021) based on media naturalness theory points to the suboptimality on both edges: some

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VC's characteristics overburden users while others underburden them, creating stress.

To address the need to dig into the reasons and mechanisms behind VC exhaustion and to provide the lacking empirical evidence, this paper focuses on the intriguing peculiarity of the VC environment – the self-view or video feedback. This feature enables users to see their own reflections while interacting, but it is not present in face-to-face interactions (del Valle 2020). We ask the following research questions:

RQ1: How does self-view frequency affect user emotional outcomes after VC use?

RQ2: Does the potential relationship between self-view frequency and VC emotional outcomes differ across communication roles?

Drawing on the transactional model of technostress (Ragu-Nathan et al. 2008) and objective self-awareness theory (Duval and Wicklund 1972), we investigated whether and how self-view feature usage produces negative affect and VC exhaustion. We propose public self-awareness to be the central underlying mechanism. Besides, we tested the intuition that the communication role may moderate the relationship. Across two independent complementary surveys among European employees ($N = 429$), we found converging evidence that self-view intensity in the message receiver role (i.e., while listening to other VC attendees) is associated with a higher state of public self-awareness, which in turn is linked to increased negative affect and VC exhaustion. In contrast, the effects of self-view intensity in the message sender role (i.e., while presenting to other attendees) are not robust. Thus, we suggest a more refined view of the consequences of absorption with immediate video feedback.

2 Background and Hypotheses

2.1 Overview of Research on Videoconferencing Fatigue

Videoconferencing fatigue has been scrutinized and interpreted through multiple theoretical lenses, most of which contrast the computer-mediated-environment with face-to-face exchanges. Nadler (2020) proposes that in a VC, a communication partner, background, and technology merge into the so-called “flattened” third skin. This transformation poses a cognitive challenge to users during the interaction and is presumed to produce exhaustion. Bailenson (2021) introduces the concept of nonverbal overload as an overarching term combining “excessive amounts of close-up eye gaze, cognitive load, increased self-evaluation from staring at video of oneself, and

constraints on physical mobility” (Bailenson 2021, p.1) as the cause for VC fatigue.

Riedl (2021), leaning on media naturalness theory, points to the suboptimality of VCs: on the one hand, VC users experience a lack of information due to communication asynchronicity, lack of body language, lack of eye contact. On the other hand, they encounter information overload due to the camera, which increases self-awareness, interaction with multiple faces, and opportunities to multitask (Riedl 2021). Likewise, pointing to the unnaturalness of VCs, Aagaard (2022) discusses 5 dynamics of VC fatigue: awkward turn-taking, inhibited spontaneity, restricted motility, lack of eye contact, and increased self-awareness.

The 4-dimensional model of VC fatigue (Döring et al. 2022) lists ten factors, clustering them into (1) personal dimension: individual and social factors; (2) organizational dimension: temporal-organizational and context & content factors; (3) environmental dimension: micro- and macro-environmental factors; and (4) technological dimension: presentation-related, communication-related self-related, usability-related factors.

Contrary to the common view of VC fatigue as an undesired consequence rooted in deviations from “natural” face-to-face interactions (Nadler 2020; Bailenson 2021; Riedl 2021; Döring et al. 2022) and to be countered, Wang and Prester (2022) conceptualize VC as labor. In this vein, engaging in labor (or any exchange) implies costs. The authors advocate for performative labor in a VC, which entails space-making, self-surveillance, visual adjustment tasks, and interpretive labor, which denotes user effort to make sense of the information. The summary of theoretical perspectives on videoconference fatigue is presented in Table 1.

Empirical research on VC fatigue (Table 2) complements the conceptual models and further highlights the phenomenon's complexity. First, we identify a cluster of VC organization-related factors. Longer duration and shorter intervals between VCs were significantly correlated with fatigue (Fauville et al. 2023; Oducado et al. 2022). While duration expectedly contributed to fatigue reported in cross-sectional surveys (Fauville et al. 2023; Oducado et al. 2022), a longitudinal investigation by Bennett et al. (2021) suggests its insignificance. Similarly, qualitative studies reveal that VC participants report management issues such as a lack of agenda, late arrivals, as well as excessively long and back-to-back meetings (Karl et al. 2022).

The second group covers reasons rooted in user–technology interaction. Having the camera on or off is a matter of hot debate. On the one hand, camera use has evidenced a direct positive association with fatigue (Schockley et al. 2021; Ngien and Hogan 2022). On the other hand, turning

Table 1 Conceptualizations of videoconference fatigue

Source	Primal causes	High-level cause	Outcome
Nadler (2020)	“Flattened” third skin: a communication partner, background, and technology	Cognitive effort	Fatigue
Döring et al. (2022)	Four dimensions (4D) of factors: (1) personal, (2) organizational, (3) technological, (4) environmental	–	
Riedl (2021)	Lack of information due to communication asynchronicity, lack of body language, lack of eye contact & Information overload due to the camera, which increases self-awareness, interaction with multiple faces, and opportunities to multitask	Cognitive effort	
Bailenson (2021)	Excessive amounts of close-up eye gaze, cognitive load, increased self-evaluation from staring at a video of oneself, and constraints on physical mobility	Nonverbal overload	
Aagaard (2022)	Awkward turn-taking, inhibited spontaneity, restricted motility, lack of eye contact, and increased self-awareness	–	
Wang and Prester (2022)	Space-making tasks Self-surveillance tasks Visual adjustment tasks	Performative VC labor & Interpretive VC labor	

off the camera is seen as a sign of disrespect and lurking among peer employees (Karl et al. 2022). Luebster et al. (2023) – as the only study we found that sampled meeting leaders – also suggest that camera non-usage is problematic. Turning a camera on supplies non-verbal cues and helps to feel more connected to the interlocutors, especially in small meetings. In turn, group belongingness reduces fatigue (Bennet et al. 2021). While meeting leaders actively seek out non-verbal cues (Luebster et al. 2023), Fauville et al. (2023) show that producing and interpreting non-verbal cues increase fatigue.

The implications of self-view activated by default in most VC tools are unclear because most studies test camera use as an antecedent. Despite the possibility of hiding the self-view and remaining visible to other participants, we did not find information that scholars controlled whether the self-view was on or off. Focusing on gender, Fauville et al. (2023) report that women experience higher mirror anxiety than males. Mirror anxiety is positively related to VC fatigue (Fauville et al. 2023; Oducado 2022). At the same time, watching oneself was an insignificant predictor of fatigue (Bennet et al. 2021). Self-monitoring was rejected to moderate the camera use—social interaction anxiety relationship (Ngien and Hogan 2022).

The third group of fatiguing factors unites individual differences such as gender, personal dispositions, age, attitude, and job position. Females (Fauville et al. 2023; Schockley et al. 2021), younger users (Fauville et al. 2023), and those who have non-tenure positions (Schockley et al. 2021) appear to be more vulnerable to feeling exhausted after VCs. Extraversion and emotional stability are inversely related to Zoom fatigue (Fauville et al. 2023; Oducado 2022).

2.2 Distinction from Previous Research

Below we describe two main value-adding aspects of this paper, which extend previous views on VC fatigue causes. Multiple observations and polls inform about lower engagement (Peper et al. 2021), boredom in online meetings (Peper et al. 2021; Toney et al. 2021; Fauville et al. 2021), and overall aversion to VCs (Kuhn 2022). Most empirical works test presumable “stimulus-outcome” links, limiting the investigation to direct effects. Consequently, the explanations behind the adverse implications remain inconclusive. The scholars either engage in comprehensive conceptual modeling (e.g., Bailenson 2021; Riedl 2021) and leave empirical verifications for future research or collect data about camera use in general. The one-size-fits-all recommendations to turn off the camera seem problematic because, without video streaming, a VC turns into an audio call, thus not being a VC anymore.

First, from multiple theorized causes of VC fatigue, this study focuses on self-view frequency as technology-conditioned behavior. Compared to other factors of VC fatigue rooted in user–technology interaction (Table 2), watching oneself is completely absent in offline meetings. Our model assumes that the heightened state of public self-awareness mediates the link between intensive self-viewing and undesired psychological consequences (i.e., negative affect and VC exhaustion). We subject these propositions to two empirical verifications based on the experience of European employees with a one-year lag. Though we have not designed our study around habituation effects, the collected data allows comparing VC use patterns after half a year of remote work (end of 2020) with VC use after 1.5 years (end of 2021) of remote work.

Second, we add value by accounting for individual differences, esp. concerning user communication functionality in a VC. Earlier, personality traits, including

Table 2 Empirical studies of videoconference fatigue

Study	Sample	VC organization factors	User–technology interaction factors	Individual factors
<i>Quantitative papers</i>				
Fauville et al. (2023)	Survey of 9 787 VC users worldwide	Frequency (+) duration (+) interval b/w VCs (-)	Mirror anxiety (+) physically trapped (+) hyper gaze (+) producing nonverbal cues (+) interpreting nonverbal cues (+)	Female (+) extraversion (-) agreeableness (n.s.) consciousness (n.s.) emotional stability (-) openness (n.s.) age (-)
Oducado et al. (2022)	Survey of 322 higher education faculty in the Philippines	Duration (+) interval b/w VCs (-)	Physically trapped (+) mirror anxiety (+)	Attitude towards VC (-) emotional stability (-)
Schockley et al. (2021)	4-week field experiment with 103 employees		Camera use (+)	Female (+) non-tenure (+)
Bennet et al. (2021)	Longitudinal survey of 55 employees during 5 days	Duration (n.s.)	Microphone off (-) group belongingness (-) watching self (n.s.) attention (n.s.)	
Ngien and Hogan (2022)	Survey of 210 VC users from the United Kingdom		Camera use (+) social interaction anxiety (+)	
Nesher Shoshan and Wehrt (2022)	2-week survey of 81 employees from Germany and Israel	Duration (n.s.) N participants (n.s.) supervisor presence (n.s.)	vVideo (+)	Morning exhaustion (+)
Anh et al. (2023)	Survey of 429 VC users		Techno complexity (+) pattern adaptation (+)	
<i>Qualitative papers</i>				
Nesher Shoshan and Wehrt (2022)	Qualitative responses of 15 employees from Germany and from Israel	VC administration	Loss of experiences (mimics, gestures, silent others without video) technical problems	
Karl et al. (2022)	549 comments posted to a LinkedIn	Management issues	Camera on vs. off eating during VCs microphone issues camera issues work from home issues	
Luebster et al. (2023)	In-depth phone interviews of 50 meeting leaders from the US and Germany	Early meeting phases	Camera non-usage multitasking	

(+) significant positive association, (-) significant negative association, (n.s.) non-significant

dispositional test anxiety, negative/positive affectivity (Wegge 2006), and dispositional public self-consciousness (Kuhn 2022), were scrutinized as additional explanatory variables. Gender differences were revealed by (Fauville et al. 2023). Our model controls for dispositional public self-consciousness, gender, age, and communication role (message sender vs. message recipient).

Besides, outcome variables like VC fatigue (Toney et al. 2021) and aversion (Kuhn 2022) were previously assessed on the general level as enduring emotions or behavioral tendencies. To reduce the recall bias, this study centers around single, recent events and situational variables (a.k.a. states), though controlling for dispositions (a.k.a. traits).

To deliver the promised added value, in Sects. 2.3 and 2.4, we outline the research model and begin by

summarizing technostress research and adapting it to the VC setting. After that, we provide reasoning for the proposed relationships.

2.3 Technostress Research and its Contextualization to the VC Setting

We draw on the transactional model of technostress (Ragu-Nathan et al. 2008) as an overarching theoretical framework to examine the effect of self-view on emotional outcomes. This research strand is premised on the idea that today's ICT demands frequently outpace the human's ability to adapt to technological innovations and create the feeling of lost control and stress in users, widely known as technostress (Tarafdar et al. 2007). The transactional model

of technostress (Ragu-Nathan et al. 2008) conceptualizes the process of stress creation as a sequence of “ICT conditions – stressors – strain and outcomes,” similar to a broader “stimulus–response – outcome” logic. ICT conditions, such as the starting chain link, are represented by features such as usability features such as complexity, dynamic features like the high speed of updates, or intrusive features like 24/7 reachability. Technology-induced events or demands are generally referred to as technostressors and manifest as feelings of overload, invasion, and insecurity to the point of job loss. Finally, strain refers to psychological, physiological, and behavioral outcomes of stress that can be observed in individuals. The most widely studied term in the technostress literature is behavioral strain. Examples include job dissatisfaction and lack of creativity. Strain can lead to other organizational outcomes, such as absenteeism and increased turnover.

Applying this line of reasoning to the VC setting, we propose that the self-view feature, which calls the users’ attention to themselves in a way never experienced in face-to-face communication, operates as an ICT condition that imposes substantial cognitive demands on users. While initially intended to overcome the web-cameras constraints to capture only a range of angles and to ensure parties are visible to each other (del Valle 2020), the constant video feedback may exceed an individual’s ability to cope with the self-referential information while simultaneously effectively performing in a communication process. In the following, we explain why self-views can trigger a stressor, which is manifested in the VC context through public self-awareness, and how the latter is likely to be associated with unfavorable emotional responses like negative affect and VC exhaustion. Table 3 displays the definitions of the core variables of our study.

2.4 Self-View and Public Self-Awareness

Producing an image of whatever is in front of the camera, the self-view in a VC has the functionality of a mirror. The

latter has been shown to increase the state of human consciousness in which attention is concentrated upon the self, i.e., objective self-awareness (Duval and Wicklund 1972). On the trait-state continuum, scholars perceive self-awareness as a state that individuals enter due to situational conditions, disposition, or both. Chronic self-directed attention is coined dispositional self-consciousness or a trait of self-consciousness (Fenigstein et al. 1975). While self-awareness per se is of neutral connotation, some people may find themselves scrutinizing their own behavior and perceptions for a prolonged period and to the point of obsessiveness (Fenigstein et al. 1975). Later researchers point to the distinction between attending to one’s own thoughts and feelings, i.e., being privately self-aware or privately self-conscious, which is often observed in meditation or psychotherapy, and attending to the self as a social object that has an effect on other people, i.e., publicly self-aware or publicly self-conscious (Carver and Scheier 1981). Especially public self-awareness, which has developed into a prevailing tendency of self-consciousness, may, in its unhealthy form, turn into a nervous or uncomfortable feeling when a person worries about what the people around them think about them or their actions (Cambridge Dictionary 2022).

In the context of VCs, encountering one’s own reflection via a self-view window in the presence of an audience is likely to provoke thoughts about how a person appears to others, hence public self-awareness. People cannot stay neutral in this state and will evaluate themselves according to some standards (Duval and Wicklund 1972). A body of empirical evidence suggests that the outcome of such an evaluation tends to be negative.

Long before the mass adoption of VCs, the pioneering experiments by Wegge (2006) showed that the VC environment amplifies the detrimental effect of anxiety on performance and affective states. During a simulated online exam, students with high dispositional test anxiety reported less calm, higher activation, and lower performance. Moreover, a large size of the self-view amplified the

Table 3 Variables definition

Variable	Definition and source
Self-view frequency	The extent to which an individual looks at self via a self-view window in a VC (Pfund et al. 2020; Kuhn 2022)
Negative affect	Feelings of emotional distress. More specifically, it is a construct defined by the common variance between anxiety, sadness, fear, anger, irritability, and other unpleasant emotions (Stringer 2013)
VC exhaustion	A user’s feeling of being tired of activities related to the usage of VCs (Maier et al. 2015)
Public self-awareness	The state where a user’s attention is directed towards the self as a social object that has an effect on others, e.g., “I’m very concerned about the way I present myself.” (Fenigstein et al. 1975)
Dispositional public self-consciousness	The consistent tendency of a person to direct attention to the self as a social object that has an effect on others, e.g., “I usually worry about making a good impression.” (Fenigstein et al. 1975)

adverse effect of anxiety on the performance of high-anxious individuals, but not on arousal. In a simulated legal consultation, self-view increased dislike, anger, and shame compared to those who did not see their own reflection. While Wegge's (2006) participants were inexperienced VC users, a decade later the manipulations of video feedback yielded a similar impact. In the presence of self-view, participants used more anxiety-expressing words like "worried" and "fearful" and less certainty-expressing words like "always" and "never" (Miller et al. 2017).

The second wave of research is marked by VC's rapid adoption due to the necessity to maintain operations under physical distance, resulting in VC ubiquity starting from the mid-2020s. Aesthetic medicine experts in the USA, after the Snapchat- and selfie-dysmorphia in 2018–2019, envisioned the increased demand for facial treatment because of a self-critical response to your own video feedback on VC, coined as "Zoom-dysmorphia" (Rice et al. 2021). Concerns about their looks in a VC motivated 40% of respondents who had never undergone a facial cosmetic treatment to consider one (Cristel et al. 2020).

As for the salience of self-viewing, the sample of U.S. women claimed to spend between 36 and 42% of VC time looking at themselves. The self-view time was significantly positively correlated with the comparison of one's own appearance to the others' in a video chat and self-objectification, which captured appearance surveillance thoughts (Pfund et al. 2020). Besides, Australian users asked to recall their recent VC admitted that 27% paid attention primarily to their own face/body, 53% to both their own face and that of others, and 16% mainly to the appearance of others (Pikoos et al. 2020). Thus, we assume that intensive absorption with self-view in a VC will be linked to public self-awareness:

H1 Higher self-view frequency is associated with higher public self-awareness.

At its core, a videoconference is a communication process whereby the sender initiates and transmits a message, and a recipient decodes it and submits the feedback (Al-Fedaghi 2012). Naturally, these roles may alternate, but it is a sequential process. At any given point in time, a person takes one of these roles. Conceptual studies in Table 1 (Bailenson 2021; Riedl 2021; Aagaard 2022) and empirical studies in Table 2 (Fauville et al. 2023; Luebstorff et al. 2023) agree that both producing and interpreting non-verbal cues in a VC is "costly" in terms of cognitive effort. Given that a typical VC message contains both verbal and non-verbal components, we surmise that producing, a.k.a. sending a message, as well as interpreting, a.k.a. receiving a message in a VC, entails effort (Abramova et al. 2021; Fauville et al. 2023). This view also aligns with VC participation as performative and interpretive labor (Wang and

Prester 2022). Though both roles are equally important for VC success, we believe that accounting for the difference between these roles might provide the missing piece of the puzzle to understand how fatiguing self-view effects occur.

The primary goal of sending a message is to convey the original thought in an intact form. In the educational domain, instructors – who mainly talk in a VC – are concerned with keeping the audience engaged (Toney et al. 2021; Peper et al. 2021). In this vein, the state of public self-awareness seems well-grounded for message senders because they are the target of others' attention. At the same time, assuming thoughts about the self as a social object require cognitive resources, message senders may avoid the state of public self-awareness for the sake of keeping their speech uninterrupted.

In contrast, the role of the message receiver offers more opportunities to be in a state of public self-awareness imperceptibly to other participants. Especially over a long time, which happens to the audience at webinars, online lectures, and big business meetings, active message processing is quickly replaced with a "present absence," as hinted by multitasking in VCs (Riedl 2021). The statistics on activities that take place at the same time as VC are impressive: about 90% of U.S. respondents practice this; at work, 32% of employees are prone to it when the video and microphone are turned off (Woolf 2022). Longer phases of a publicly self-aware state are more feasible for information receivers. Nevertheless, being concerned with the self as a social object appears less grounded for a message if we assume that VC attendees gather for business matters and attend to a message sender.

All in all, we rely on the heterogeneity of communication roles in a VC and speculate that these differences might moderate the "self-view frequency – public self-awareness" link without holding a strong assumption about the direction:

H2 The association between self-view frequency and public self-awareness differs for the message recipient vs. the message sender role.

Psychological research has provided considerable evidence of maladaptive aspects of self-awareness, including associations with depression and amplification of adverse events' experiences (for review, see Pyszczynski et al. 1991; Silvia and O'Brien 2004). In social encounters like VCs, heightened *public* self-awareness may be devastating. Conceptual models assume it to be part of unnecessary cognitive load (Bailenson 2021; Riedl 2021) or linked directly to VC fatigue (Aagaard 2022). Users primed with the constant mirror in the presence of others might be fast to scrutinize their mannerisms, voice, and behavior. Rather than evoking pride or admiration, past evidence hints at concerns based on the appearance perceived in VCs.

Indirectly, these appearance comparison concerns manifest themselves through the increased demand for facial treatments (Cristel et al. 2020) or digital treatments via the retouching feature “touch up my appearance” (Pfund et al. 2020). Explicitly, among 613 U.S. employees who worked from home and completed at least two VCs on the day of the survey, facial dissatisfaction was significantly correlated with VC fatigue (Ratan et al. 2022). Thus, we assume heightened public self-awareness to be linked to unpleasant emotions like anxiety, sadness, and fear, and also to the feeling of exhaustion after a VC:

H3 Higher public self-awareness is associated with higher negative affect (H3a) and VC exhaustion (H3b).

Our hypotheses above construct the following chain: self-view frequency heightens public self-awareness (H1), and public self-awareness increases negative affect and exhaustion (H3). According to this train of thought, self-view frequency confers vulnerability to undesirable emotional outcomes indirectly through public self-awareness. Hence, we hypothesize its potential mediating role:

H4 Public self-awareness mediates the relationship between self-view frequency and negative affect (H4a) and the relationship between self-view frequency and VC exhaustion (H4b).

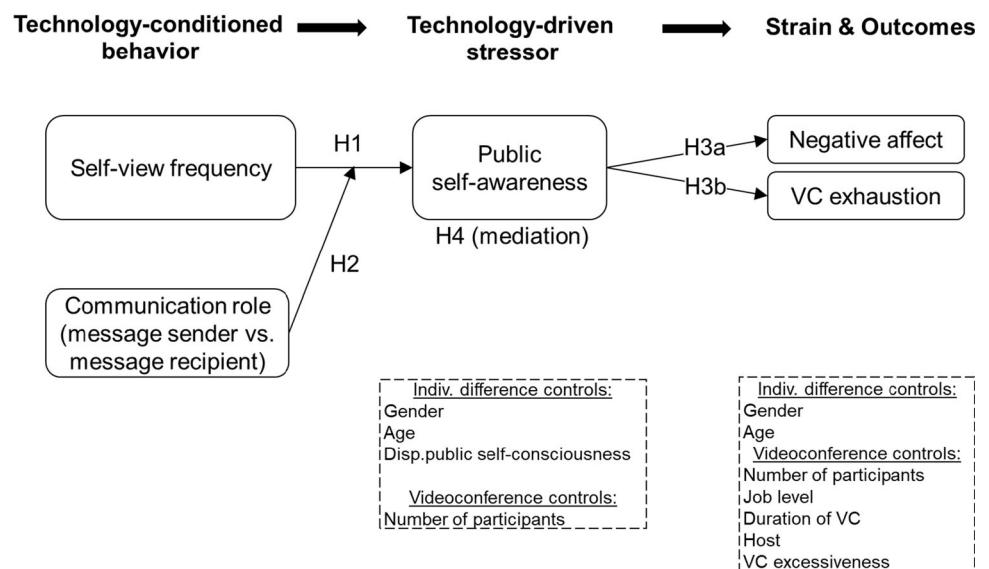
Based on the findings of previous empirical studies, we control for the following relevant variables: gender (Fauville et al. 2023; Schockley et al. 2021), age (Fauville et al. 2023), job level (Schockley et al. 2021), the dispositional trait of public self-consciousness (Kuhn 2022), VC duration (Fauville et al. 2023), number of participants and being a meeting manager (Luebstorf et al. 2023) a.k.a. a host. Figure 1 visualizes the assumed relationships.

3 Research Synopsis

To test the research model (Fig. 1), we rely on two studies of European employees. In study 1, the VC experiences of 176 European employees in autumn 2020 were analyzed. At the beginning of the second lockdown, most users were relatively new to fully remote work and viewed it as a temporary response to the crisis (Hafermalz and Riemer 2021). The raw data on outcome variables was qualitative. To allow for statistical testing of our hypotheses, we first pre-processed qualitative responses with two human coders, who counted the number of words expressing negative affect and exhaustion. Thereafter, we tested our model using the PROCESS macro of Hayes (2018) in R, which allowed for verifying direct links and mediation (bootstrapping mediation technique with a 95% bias-corrected confidence interval (CI), 10 000 samples). We used the observations from study 1 to establish the baseline effect of a specific technology-conditioned behavior (self-view frequency) on negative affect and VC exhaustion via public self-awareness.

In study 2, a gender-balanced sample of 253 European employees delivered responses in early winter 2021, almost a year since remote work and regular VCs had become a “new normal.” Negative affect and exhaustion after a VC were assessed quantitatively on a 7-point Likert scale. The model proposed in Fig. 1 was again tested with the PROCESS macro of Hayes (2018) in R. This follow-up study tested the robustness of our findings concerning possible habituation and different ways of measuring the same thing. Appendix A (available online via <http://link.springer.com>) elaborates on the measurement instrument. Table 8 presents a comparative summary of the studies.

Fig. 1 Proposed research model



4 Study 1

4.1 Materials and Methods

4.1.1 Measures

We presume each VC at work is a single event that might evoke different emotions. Therefore, instead of asking about VCs in general, participants in our study called to mind their last VC (online meeting at work) and described it briefly in 2–3 sentences. Self-viewing frequency was assessed with the questions: “How often did you look at the self-view (video of yourself) window when you were speaking?” and “How often did you look at the self-view (video of yourself) window when you were listening?” with anchors 1 = (almost) never, 4 = about half the time, 7 = (almost) always.

The state of public self-awareness was measured using the public self-consciousness scale by Fenigstein et al. (1975), originally formulated to reflect personal disposition (i.e., a trait), with necessary adjustments: During this online meeting... PUBSA1: I was concerned about my style of doing things; PUBSA2: I was concerned about the way I presented myself; PUBSA3: I was self-conscious about the way I looked; PUBSA4: I was worried about making a good impression; PUBSA5: I was concerned about what other people thought of me. Answer options ranged on a 7-point Likert scale (1 = strongly disagree, 4 = neither agree nor disagree, 7 = strongly agree).

To assess emotional outcomes, we asked: “What did you feel after this meeting? Which emotions have you experienced?” leaving an open field for text response (Table 4). Two independent researchers processed the text responses to obtain the number of words with negative

emotional intent (Krippendorff alpha = 0.914). Exemplary keywords include: frustrated, bored, irritated, stressed, tired, drained, anxious, overwhelmed, deflated, sad, unsatisfied, unsure, annoying, disengaged, and angry. A binary variable was also constructed to signify the mere presence of a negative affect (Krippendorff alpha = 0.884). Among negative words, we distinguished markers of exhaustion and composed a binary variable (Krippendorff alpha = 0.805) in the presence of words such as bored, tired, drained, shattered, exhausted, fatigued, needed a break, or sleepy. Control variables included age, gender, number of VC participants, duration, perceived VCs’ excessiveness, VC layout, and dispositional self-consciousness (see Appendix A for exact question formulations). An attention check with the instruction “please answer ‘often’ for this question” in the middle of the survey served to screen out inattentive participants in the analytical phase.

We conducted a post-hoc power analysis using G*power 3.1. (Faul et al. 2007). For a model with 11 predictors, with an effect size of 0.06 for the statistical test “Linear multiple regression R^2 increase”, alpha of 0.05, and a power of 0.80, the minimum sample size was 164. The sensitivity analysis is given in Appendix B.

4.1.2 Recruiting and Sample

We recruited participants via the platform Prolific Academic (Prolific.co 2022) in the fall of 2020, explicitly targeting West European employees from the UK, Ireland, Austria, Germany, France, the Netherlands, Belgium, Luxembourg, and Switzerland, which were fluent in English because it was the language of the survey. The

Table 4 Exemplary answers on emotions following a VC at work and the coding of negative affect and exhaustion

What did you feel after this meeting? Which emotions have you experienced?	Negative affect		Exhaustion (binary)
	N words expressing negative affect	Negative affect (binary)	
Frustrated. Bored. Irritated	3	1	1
Like almost all meetings, this was a time sink that would be fine as just an email	1	1	0
Drained. Too much information. Not enough participation/activity. Just information and discussion, not much achieved. Too sedentary	5	1	1
I was exhausted because I feel video meetings do the job (meaning, they serve the intended purpose of talking with the other participant), but somehow doesn’t feel like we are face-to-face. Video meetings somehow don’t fully simulate the full experience of sitting around a table and talk	2	1	1
Good feeling. But also tired, because of the misunderstandings and the technical issues	1	1	1
I felt motivated after the meeting	0	0	0

Original spelling of respondents is kept

remuneration comprised €2.07 or \$2.43, corresponding to the hourly rate of €8.27 or \$9.43.

We received 322 answers and sorted out employees who had no online meetings during a usual work week ($n = 5$), who failed the attention check ($n = 6$), or who had missing values for the core variables ($n = 3$). Of the remaining 308 cases, 68 joined without video, and 240 participated in the VC streaming their video, thus ensuring maximum telepresence. Of those, 64 people reported that their self-view was turned off. The remaining 176 employees had the self-view turned on during a recent VC and are the main focus of our analysis. The sample size has sufficient power to support the statistical findings (Appendix B).

118 (67%) respondents were female, and the age ranged from 18 to 69 with a mean of 33.26 (median = 30; SD = 10.12). In the corporate hierarchy, our sample is dominated by mid-level employees: on a scale from 1 (lowest) to 5 (highest), 82 respondents (46.6%) marked the mid-point of 3. 17 (9.6%) hold an entry-level job, 47 (26.7%) identify their positions as intermediate, 25 (14.2%) have the second-highest position and 5 (2.8%) reported to have the highest-level occupation in the organization they work for.

A quarter of the respondents (25%) hosted or co-hosted a recent VC they recalled. In terms of layout, 122 (69.3%) attendees chose gallery/ grid view, 31 (17.6%) used speaker view, and 17 (9.7%) switched between the layouts. An average meeting included between 7 and 8 attendees (mean = 7.40; median = 5; SD = 8.05). A typical meeting lasted about 1 h (mean = 58.79 min; median = 57.5; SD = 37.29).

4.2 Results

Table 5 presents the mean values, standard deviations, and correlations. In 41% of cases, participants experienced negative emotions after a recent meeting, and in 29% of the observations, these explicitly revealed tiredness. Self-view frequency when sending ($M = 3.81$, Median = 4.0, SD = 1.69) is slightly higher than when receiving a message ($M = 3.19$, Median = 3.0, SD = 1.58); the difference was statistically significant (Appendix D). Most participants scored high on dispositional self-consciousness ($M = 5.18$, SD = 1.16 on a 7-point scale). The average value of the situational variable public self-awareness was around the mid-point ($M = 4.46$, SD = 1.42 on a 7-point scale) and positively correlated with the disposition (Spearman's $\rho = 0.49$), as expected. Moreover, public self-awareness was positively correlated with the self-view frequency when sending a message (Spearman's $\rho = 0.39$) and the self-view frequency when receiving a message (Spearman's $\rho = 0.44$) as well as with the number of negative

words describing feelings after a recent VC (Spearman's $\rho = 0.25$).

Before modeling, we checked for possible effects of a VC layout because these settings define the size of the self-view window. We observed that differences in self-view frequency when sending information ($\chi^2(4) = 1.898$, $p = 0.755$) and when receiving information ($\chi^2(4) = 3.035$, $p = 0.552$) were insignificant across the VC layouts based on the Kruskal-Wallis test. The details are reported in Appendix C.

We checked the main assumptions of regression analysis. The smoothed scatter plots revealed that continuous predictor variables are all quite linearly associated with the corresponding outcomes. There were no influential values according to Cook's distance and standardized residuals. Multicollinearity was not present as assessed with the variance inflation factors.¹ When possible, we relied on statistical techniques that do not impose restrictions on distribution, e.g., bootstrapping. For tests that assume a certain distribution (e.g., comparison of regression coefficients), we deem our sample size large enough for the Central Limit Theorem to apply.

H1 suggested the effect of self-view frequency on public self-awareness, while H3a suggested the effect of public self-awareness on negative affect. Together, H1 and H3a imply that the effect of self-view frequency on negative affect is mediated by public self-awareness. A mediation analysis using the bootstrapping mediation technique with a 95% bias-corrected confidence interval (CI) and 10 000 samples based on PROCESS model 4 of Hayes (2018) was performed. Control variables were entered in the model as covariates. The values for age, number of VC participants, and duration were log-transformed. Because each participant reported self-view frequency when receiving and sending a message, we included both as explanatory variables in regressions and assessed differences across roles by comparing the coefficients. Models for negative affect, assessed as a number of negative words and as a binary variable, as well as VC exhaustion as a binary variable, are reported in Fig. 2.

Both self-view frequency when receiving a message ($b = 0.19$, $p = 0.006$) and when sending a message ($b = 0.13$, $p = 0.044$) are significantly associated with public self-awareness, supporting H1. The effect size of self-view frequency was close to medium ($f^2 = 0.13$). The effect size of dispositional public self-consciousness ($f^2 = 0.19$) surpassed the medium threshold of 0.15 (Cohen 1992). The effect of controls (gender, age, and number of participants) was insignificant at $\alpha = 0.05$.

¹ The details on assumptions checks and other analyses are available for interested readers in the HTML report written in Rmarkdown upon request.

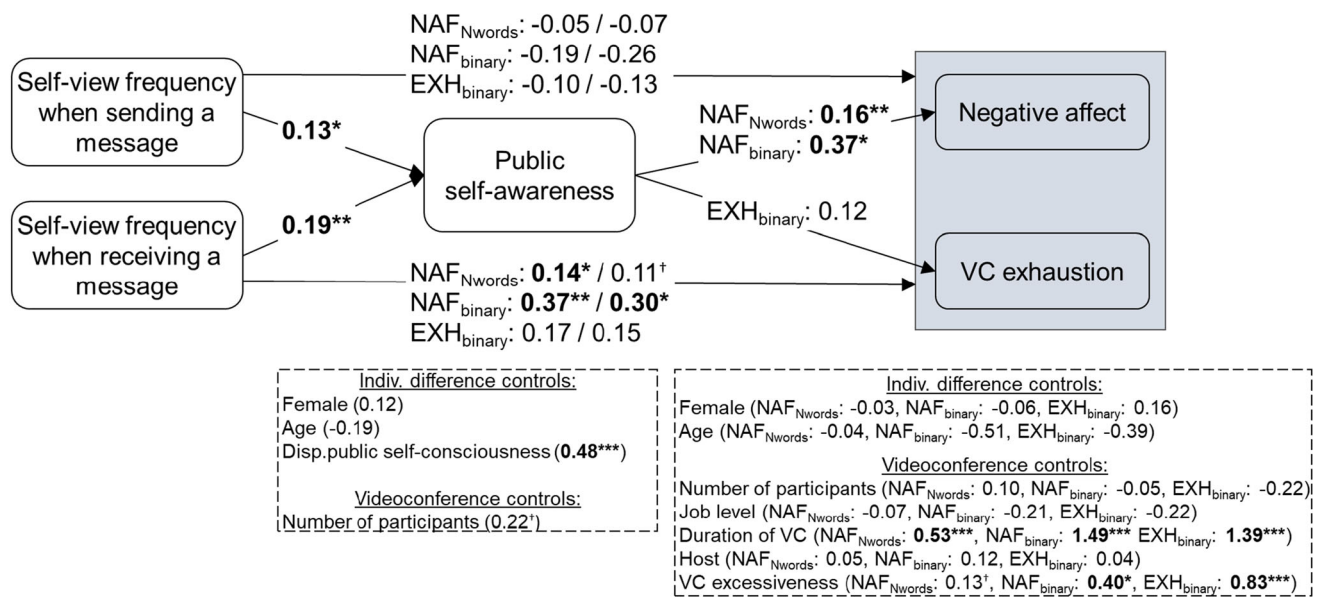


Fig. 2 Study 1 regression results

Moreover, public self-awareness was significantly negatively related to negative affect assessed as a number of negative words ($b = 0.16$, $p = 0.007$; $f^2 = 0.05$ meaning small effect size) and as a binary variable ($b = 0.37$, $p = 0.015$; standardized OR = 1.69 meaning to small effect size). Therefore, H3a is supported. The effect on VC exhaustion, also a binary variable, was insignificant ($b = 0.12$, $p = 0.469$); this means that H3b is rejected.

The results of mediation analysis confirmed a statistically significant mediation effect of self-view frequency on negative affect (assessed as a number of negative words) via public self-awareness for the message receiver role (standardized indirect effect = 0.045; SE = 0.024; bias-corrected CI [0.004; 0.10]), but not for message sender role (standardized indirect effect = 0.048; SE = 0.041; bias-corrected CI, [-0.004; 0.155]).

We observed a statistically significant mediation effect of self-view frequency on negative affect (assessed as a binary variable) via public self-awareness for the message receiver role (indirect effect = 0.069; SE = 0.043; bias-corrected CI [0.007; 0.176]) but not for a message sender role (indirect effect = 0.058; SE = 0.046; bias-corrected CI, [-0.0004; 0.1764]).

A mediation effect of self-view frequency on VC exhaustion (assessed as a binary variable) via public self-awareness was insignificant: (for the message receiver role, indirect effect = 0.022; SE = 0.042; bias-corrected CI [-0.057; 0.113]; for a message sender role, indirect effect = 0.015; SE = 0.033; bias-corrected CI, [-0.040; 0.097]).

In H2, we speculated about the difference originating from the communication role (receiving a message and

sending a message) for the link “self-view frequency – public self-awareness.” The comparison of standardized coefficients suggests that the effect of self-view frequency when receiving a message on public self-awareness is higher than the effect of self-view frequency when sending a message ($\beta_R = 0.21$ vs. $\beta_S = 0.15$). To test whether the difference is statistically significant, we followed Clogg et al. (1995) and assessed z :

$$z = \frac{b_1 - b_2}{\sqrt{(SE_{b1})^2 + (SE_{b2})^2}} = \frac{0.187 - 0.129}{\sqrt{(0.067)^2 + (0.064)^2}} = 0.626,$$

which follows a standard unit normal distribution under the null hypothesis of equality of the two coefficients. b_i denotes unstandardized coefficient and SE_{bi} is a corresponding standard error. Given that the critical value z^* for a 95% confidence interval is 1.96, the observed difference in coefficients is statistically insignificant, contrary to H2.

Although the statistical test points to no differences between self-viewing when receiving vs sending a message for public self-awareness, we do observe differences in the mediation analysis. The mediation of public self-awareness is significant for self-view only when receiving a message. Noteworthy is the difference in direct effects of self-view on outcome variables of interest, with direct effects significant only for the link “self-view when receiving a message – negative affect.” The effect of self-view when sending a message is insignificant on negative effect and exhaustion, and the sign of coefficients is even positive.

As for controls, the duration of VC was significantly positively related to negative affect (NAF_{Nwords}: $b = 0.53$, $p < 0.001$; NAF_{binary}: $b = 1.49$, $p < 0.001$) and VC

exhaustion (EXH_{binary} : $b = 1.39$, $p < 0.001$). Perceived VC excessiveness was also positively correlated with psychological outcomes (NAF_{Nwords} : $b = 0.13$, $p = 0.097$; NAF_{binary} : $b = 0.40$, $p = 0.04$; EXH_{binary} : $b = 0.83$, $p < 0.001$). The effects of gender, age, number of participants, job level, and being a host were insignificant.

We checked whether our results are robust to alternative analytical choices due to the count nature of the outcome variable “negative affect” assessed as a number of negative words. The PROCESS macro uses ordinary least squares (OLS) regression to estimate variables on the left sides of model equations, except for dichotomous outcome variables estimated with logistic regression (Hayes 2023). In our case, negative affect assessed as a number of negative words is a count variable for which the mean of the count is smaller than the variance of the count ($M = 0.75$, $\text{Variance} = 2.08$). Therefore, negative binomial regression is often recommended to test for the link between a predictor and a count outcome variable. Hierarchical regression analysis (Appendix E) leads to the same conclusions.

To sum up, study 1 tentatively provides support for H1 and H3a, but no support for H2 and H3b. Initially, our outcome variables were of qualitative nature (open-field responses) and were quantified by counting the number of words expressing negative affect. As the results converge for both ways of assessing negative affect (number of words and presence/absence), we are quite confident about the H3a test. The measurement of VC exhaustion as the presence of words expressing exhaustion, though a respondent was asked to describe feelings after VC in general, was somewhat suboptimal for definitive conclusions. In the subsequent study, we measured both outcome variables quantitatively.

5 Study 2

To enhance the validity of our findings, we conducted Study 2, which replicates Study 1 in terms of the target group, i.e., European employees, and offers methodological triangulation for the measurements of target variables, i.e., negative affect and VC exhaustion. Moreover, Study 1 was conducted shortly after the first COVID-19 outbreak, while Study 2 was completed a year later, thus checking whether the associations are sustainable over time.

5.1 Materials and Methods

5.1.1 Measures

In Study 2, the same measurement of self-view frequency, the state of public self-awareness, and dispositional self-consciousness was employed as in Study 1. Negative affect

was measured with the short version of the PANAS scale (Thompson 2007), asking: “After this recent online meeting, I felt... NAF1: nervous; NAF2: upset; NAF3: afraid; NAF4: ashamed; NAF5: hostile (7-point Likert scale, 1 = not at all, 4 = to a moderate extent; 7 = extremely). To capture VC exhaustion, we contextualized the scale of SNS exhaustion (Maier et al. 2015): EXH1: I felt drained from videoconferencing; EXH2: I felt tired from my videoconferencing activities; EXH3: Working with the videoconferencing software was a strain for me (7-point Likert scale, 1 = strongly disagree, 4 = neither agree nor disagree; 7 = strongly disagree). For the common method bias (CMB) check, the marker variable “blue attitude” (Simmering et al. 2015) was included (for details, see Appendix A).

5.1.2 Recruiting and Sample

Participants for Study 2 were recruited via the Prolific Academic platform (Prolific.co 2022) in early winter 2021 using the same pre-screening criteria as in study 1. Because of the closed-ended question, the survey completion time was shorter, and was compensated with €2.05 or \$2.32 (an hourly rate of €8.78 or \$9.95). In the cover letter, we wrote: “We specifically target employees who regularly use videoconferencing tools (for example, Zoom, Microsoft Teams, Skype) at work” to reduce the number of participants who mistakenly fill in the survey while not being regular VC users.

From 360 complete responses, we excluded participants who described their experiences in an audio call ($n = 12$), who failed one or two attention checks ($n = 34$), or who completed the survey in less than 7 full minutes ($n = 13$). Of the remaining 301 observations, 255 had their self-view switched on and thus represented the main interest for the analysis. 2 observations were deleted because of the failed plausibility check. Thus, 253 observations remained for further hypotheses testing. The sample size provides sufficient power to support the statistical findings (Appendix B).

The sample is gender-balanced, with 48.2% of females. Age varied between 19 y.o. and 70 y.o., being 34.5 y.o. on average (median = 33; $SD = 10.71$). At the time of the survey, 85 (33.6%) were working entirely from home, 97 (38.3%) worked from home several days a week, and 71 (28.1%) went to the workplace. The respondents largely had intermediate-level jobs on the corporate ladder on a scale from 1 to 5 (mean job level within a company = 2.41; median = 2; $SD = 0.84$). In a typical week, meetings occupy 0–20% of work time for 101 respondents (39.9%) and 21–40% for 103 respondents (40.7%). 36 employees (representing 14.2% of the total sample) disclosed that they spent between 41 and 60% of their working hours in

Table 5 Means, standard deviations, and correlations (Spearman's ρ) for variables in study 1

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
Duration of VC	58.79	37.29													
Perceived VC excessiveness	4.38	0.95	0.05												
Number of participants	7.40	8.05	0.30 ^{***}	0.12											
Age	33.26	10.12	0.14 [†]	0.14 [†]	0.06										
Female	0.67		-0.04	-0.19 [*]	-0.08	< 0.01									
Dispositional public self-consciousness	5.18	1.16	-0.07	-0.06	-0.20 ^{***}	-0.14 [†]	0.20 ^{**}								
Self-view when sending a message	3.81	1.69	-0.10	-0.04	-0.04	-0.26 ^{**}	0.19 [*]	0.28 ^{***}							
Self-view when receiving a message	3.19	1.58	0.01	-0.07	-0.03	-0.10	0.16 [*]	0.35 ^{***}	0.52 ^{***}						
Public self-awareness	4.46	1.42	-0.03	0.02	-0.01	-0.15 [†]	0.17 [*]	0.49 ^{***}	0.39 ^{***}	0.44 ^{***}					
N words expressing negative affect	0.75	1.04	0.38 ^{***}	0.18 [*]	0.17 [*]	0.01	-0.02	0.18 [*]	0.00	0.18 [*]	0.25 ^{**}				
Negative affect (binary)	0.44	0.50	0.37 ^{***}	0.16 [*]	0.13 [†]	0.00	-0.02	0.17 [*]	-0.02	0.16 [*]	0.23 ^{**}	0.96 ^{***}			
Exhaustion (binary)	0.26	0.44	0.30 ^{***}	0.27 ^{***}	0.12	0.01	-0.02	0.08	-0.04	0.04	0.10	0.70 ^{***}	0.67 ^{***}		
Host	0.25	0.43	0.04	0.09	-0.20 ^{***}	0.17 [*]	0.04	-0.01	-0.05	0.05	0.07	0.05	0.05	0.04	
Job level	2.74	0.92	0.02 [*]	0.16 [*]	-0.07	0.31 ^{***}	-0.07	-0.13 [†]	-0.03	0.05	0.02	-0.03	-0.04	-0.04	0.26 ^{***}

N = 176, SD – standard deviation. [†]p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001

meetings. 11 employees estimated to spend 61–80% of their work time in meetings, and for 2 employees, the share of meetings in their worktime reached 81–100%.

One fifth of the respondents (20.2%) hosted or co-hosted a recent meeting. As for the VC layout, 142 (56.1%) attendees chose gallery/grid view, 71 (28.1%) used speaker view, and 31 (12.3%) switched between the layouts during the VC. The effect of layout on self-view frequency was insignificant (Appendix C). The difference between self-view frequency when sending a message ($M = 3.60$, Median = 3.0, $SD = 1.66$) and when receiving a message ($M = 3.64$, Median = 3.0, $SD = 1.52$) was insignificant (Appendix D). On average, the size of a VC was equal to 10 participants, including a respondent (mean = 9.8; median = 6; $SD = 16.05$), and the average duration was 62 min (median = 50; $SD = 45.75$).

5.2 Results

As all the constructs were reflective, the 4-step measurement model assessment procedure (Hair et al. 2021) was performed. In the initial step, the reliability of the indicators was evaluated. Acceptable indicator reliability > 0.708 was observed for all items (Appendix F), except NAF5: hostile with the loading of 0.589 on the construct “negative affect.” This item was excluded from further analysis because the loadings of the remaining items increased after removal and for the sake of content validity. In step 2, internal consistency reliability values of composite reliability (CR), Cronbach’s α (CA), and exact reliability coefficient (ρ_A) were within the recommended interval [0.7–0.9]. In step 3, all constructs’ AVE was greater than 0.5, satisfying the convergent validity criterion. In step 4, the discriminant validity checks with heterotrait–monotrait ratio (HTMT) did not reveal problematic constructs surpassing the threshold value of 0.90. Altogether, the measurement model was well specified (Table 6). For multi-item measures, we computed the mean value of their indicators to produce Table 7 with the means, standard deviations, median, and correlations.

Regressions were estimated using bootstrapping of 10 000 samples (Fig. 3). Mediation analysis was performed using model 4 (PROCESS macro of Hayes (2018), relying on a 95% bias-corrected confidence interval (CI). Our model explains 42.9% of the variance in public self-awareness, 17.6% of the variance in negative affect after a VC, and 25.5% of the variance in VC exhaustion. Looking at path coefficients, self-view frequency when receiving a message was significantly correlated with public self-awareness ($b = 0.12$, $p = 0.03$), while self-view frequency when sending a message was significant at $\alpha = 0.1$ only ($b = 0.09$, $p = 0.06$). The effect size of self-view frequency was small ($f^2 = 0.05$). Higher public self-awareness in a VC was linked to higher negative affect after a VC ($b = 0.13$, $p < 0.001$; $f^2 = 0.07$) and higher exhaustion ($b = 0.23$, $p < 0.001$; $f^2 = 0.05$). Therefore, H3a and H3b are supported.

As for controls, an individual characteristic – dispositional public self-consciousness – is significantly positively related to the state of public self-awareness in a VC ($b = 0.64$, $p < 0.001$; $f^2 = 0.47$). At the same time, the effect of gender, age, and the number of attendees can be neglected for public self-awareness. A higher perception of the VCs excessiveness also corresponds to a higher negative affect and exhaustion after a VC. Duration of VC is significantly positively related to exhaustion. Younger respondents reported higher VC exhaustion. Other potential covariates of outcome variables were statistically insignificant.

To test the difference between self-view frequency when sending vs. receiving a message (H2), we used the same technique as in study 1 (Clogg et al. 1995). The observed difference in coefficients of self-view frequency when receiving vs. sending a message is statistically insignificant ($z = 0.346 < z^* = 1.96$), contrary to H2.

$$z = \frac{b_1 - b_2}{\sqrt{(SE_{b1})^2 + (SE_{b2})^2}} = \frac{0.121 - 0.095}{\sqrt{(0.056)^2 + (0.050)^2}} = 0.346.$$

Table 6 Measurement model

Construct	CR	α	ρ_A	AVE	Cross-correlations using HTMT		
					1	2	3
1. Dispositional public self-consciousness	0.91	0.84	0.85	0.76			
2. Public self-awareness	0.92	0.90	0.90	0.71	0.72		
3. Negative affect	0.88	0.82	0.83	0.65	0.20	0.36	
4. VC exhaustion	0.93	0.89	0.89	0.82	0.28	0.30	0.38

Composite reliability (CR), Cronbach’s α (CA), exact reliability coefficient (ρ_A), average variance extracted (AVE), cross-correlations using HTMT

Table 7 Means, standard deviations, and correlations (Spearman's ρ) for variables in study 2

Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
Self-view when receiving a message	3.64	1.52												
Self-view when sending a message	3.60	1.66	0.36***											
Public self-awareness	4.36	1.55	0.36***	0.27***										
Duration of VC (ln)	3.92	0.65	0.01	-0.04	0.04									
Number of participants	1.88	0.81	0.10	0.02	0.15*	0.23***								
Host	0.20	0.40	-0.05	0.05	-0.04	0.01	-0.36***							
Female	0.48	0.50	0.21**	0.12†	0.17**	-0.02	0.06	-0.05						
Age (ln)	3.50	0.30	-0.28***	-0.25***	-0.11†	0.08	-0.02	0.06	-0.07					
Perceived VC excessiveness	4.56	1.14	0.09	0.06	0.00	0.07	0.10	-0.05	-0.09	< 0.01				
Job level	2.41	0.84	-0.17**	-0.05	-0.21**	0.17**	-0.06	0.23***	-0.24***	0.33***	-0.01			
Dispositional public self-consciousness	4.69	1.38	0.36***	0.22***	0.62***	0.09	0.14*	-0.02	0.24***	-0.20**	0.01	-0.19***		
VC exhaustion	3.45	1.63	0.10†	0.14*	0.27***	0.20**	0.13*	0.02	0.12†	-0.19**	0.34***	-0.11†	0.23***	
Negative affect	1.48	0.77	0.17**	0.15*	0.33***	-0.04	< 0.01	0.01	0.11†	-0.20**	0.17**	-0.24***	0.18***	0.31***

N = 253, SD – standard deviation. †p < 0.1, *p < 0.05, **p < 0.01, ***p < 0.001

The mediation analysis results confirmed a statistically significant mediation effect of self-view frequency on negative affect via public self-awareness for the message receiver role (standardized indirect effect = 0.031; SE = 0.016; bias-corrected CI [0.002; 0.067]). Together with the insignificant direct effect (point estimate for the direct effect = -0.006, SE = 0.03, p = 0.87, CI [-0.072; 0.061]), the results suggest full mediation (Zhao et al. 2010). For the message sender role, the indirect effect of public self-awareness was insignificant (standardized indirect effect = 0.026; SE = 0.016; bias-corrected CI [-0.005; 0.061]).

A mediation effect of self-view frequency on VC exhaustion via public self-awareness was significant for the message receiver role (standardized indirect effect = 0.026; SE = 0.015; bias-corrected CI [0.002; 0.058]). Together with the insignificant direct effect (point estimate for the direct effect = -0.11, SE = 0.06, p = 0.10, CI [-0.247; 0.023]), the results suggest full mediation (Zhao et al. 2010). The indirect effect of self-view in a message sender role on VC exhaustion via public self-awareness was insignificant (indirect effect = 0.021; SE = 0.015; bias-corrected CI [-0.003; 0.055]).

Table 8 provides a summary of study 1 and study 2.

6 Discussion

The rapid transition to remote work and the subsequent euphoria of time-saving got quickly overshadowed by the voiced feelings of tiredness (Woolf 2022). Multiple observations, own experience, and the literature summary resulted in several conceptualizations of what can make VC users feel unnatural (Nadler 2020) and overloaded (Bailenson 2021; Riedl 2021). Reinforcing the previous theoretical visions (Table 1), this paper intends to illuminate why videoconferences at work are associated with adverse emotional outcomes, spotlighting the use of the self-view feature. Following the logic of technostress research (Tarafdar et al. 2007; Ragu-Nathan et al. 2008) and objective self-awareness theory (Duval and Wicklund 1972), we modeled self-view frequency as a trigger of public self-awareness, which drives negative affect and exhaustion after a VC. Also, we speculated that the effects differ for communication roles (i.e., sending and receiving a message).

We run two empirical studies with European employees (N = 429) with a one-year lag (fall 2020 and winter 2021) to see how our findings about the primary hypothesized relationships, namely the “technology-conditioned behavior of self-viewing in a VC → stressor → strain” link, converge, or diverge across different ways of assessing the psychological outcomes and data collection

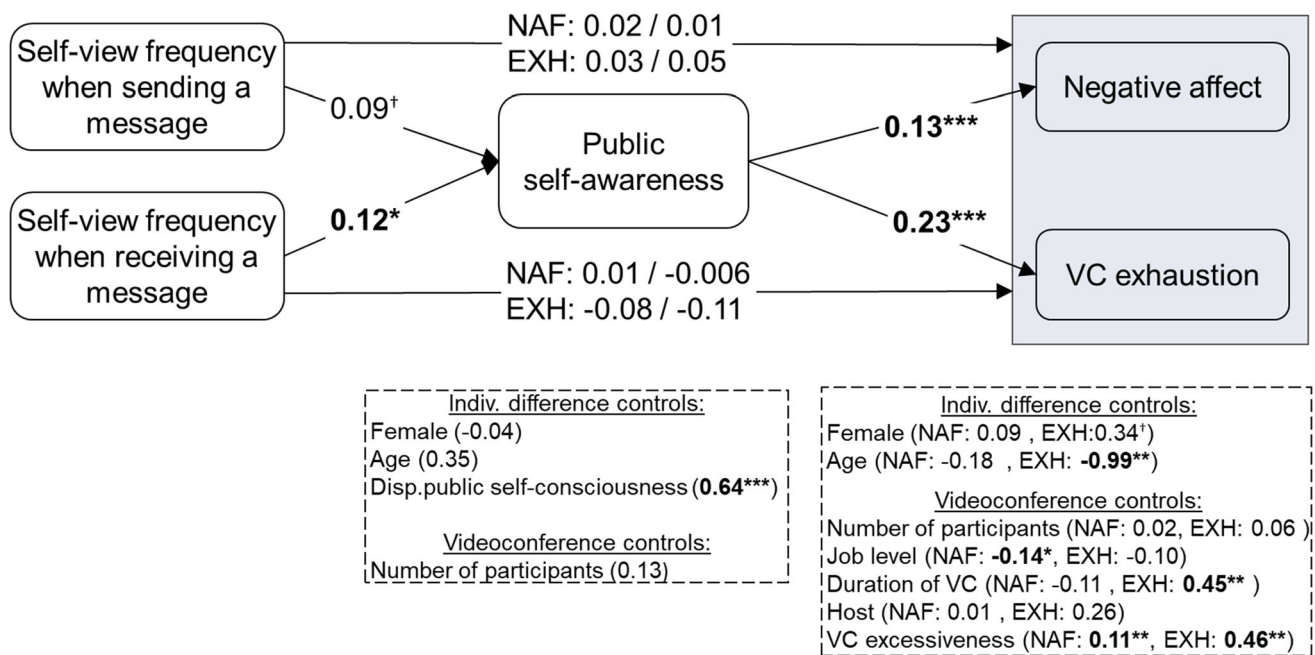


Fig. 3 Study 2 regression results

time. Such a replication strategy reduces the probability that the observed relationships are spurious and increases the researcher's confidence in the conclusion (Benlian et al. 2020). Moreover, in our case, time is critical: the relationships observed in study 1, conducted when intense VC use was new to most employees, could disappear when remote work becomes a new normal.

Our results confirm that self-view frequency is positively related to public self-awareness. The latter, in turn, consistently increases negative affect and (in study 2) VC fatigue. Importantly, addressing RQ2, both self-view frequency when receiving and sending a message increase public self-awareness. However, the adverse effects are most likely to reach out when self-view is performed in a message-receiving role, e.g., listening to others. The mediating function of public self-awareness was confirmed only for the “self-view when receiving a message – negative affect / VC exhaustion” path but not for self-view in a message sender role. Next, addressing RQ1, the statistical validations speak for the self-view frequency when receiving a message heightens negative affect and exhaustion indirectly through the raised public self-awareness state. The effect size of self-view frequency on public self-awareness is smaller in study 2, decreasing from nearly medium in study 1 to small in study 2. Given that we asked users to assess their last VC (single event) and that multiple VCs occur daily (series of repeated events), the cumulative effect might have substantial implications.

6.1 Theoretical Contributions

This study adds to theory development in the following ways.

First, focusing on the peculiarities of VCs, our conceptual and empirical efforts point to public self-awareness as a new ICT-rooted stressor not considered by technostress scholars before (Tarafdar et al. 2007, Maier et al. 2015). While it is possible to map exhaustion and negative affect after a VC to the transactional process of technostress, the self-view feature seems to go beyond established technology stress-evoking characteristics, namely usability, dynamic and intrusive features (Ayyagari et al. 2011). Because technology provides digital mirrors and other self-awareness stimuli not only in VCs, e.g., in the form of selfies, which are increasingly popular on social media, we see the potential to further theorize about a new cluster of features and the corresponding novel stressor.

Second, we contribute to research on VC fatigue (for summary, see Tables 1 and 2) by focusing on the self-view feature, earlier mentioned in the conceptualizations of Bailenson (2021), Riedl (2021), and Aagaard (2022). Even after controlling for alternative explanations such as attitude to VCs (Oducado et al. 2022), duration (Fauville et al. 2023), the number of participants (Nesher Shoshan and Wehrt 2022), being a host, job level and demographic characteristics (Fauville et al. 2023; Schockley et al. 2021), the effects of self-view frequency are significant for negative affect and exhaustion after a VC. Notably, we advocate that self-view does not equate to camera use,

Table 8 Summary of study 1 and study 2

Criterion	Study 1	Study 2
Sample used for analysis	176 European employees	253 European employees
Data collection time	October 2020	December 2021
Negative affect operationalization	Open-ended responses to “What did you feel after this meeting? Which emotions have you experienced” coded as count (number of words) and binary variable (presence/absence)	5-item scale, see Appendix A Thompson (2007)
VC exhaustion operationalization	Derived from open-ended responses as a subset of negative affect expressions; after that, coded as a binary variable (presence/absence)	3-item scale, see Appendix A Maier et al. (2015)
H1. Higher self-view frequency is associated with higher public self-awareness	Yes	Yes
H2. The association between self-view frequency and public self-awareness differs for the message recipient vs. sender role	No. Though the magnitude is higher in absolute values for a message recipient, the difference is statistically insignificant	No. Though the magnitude is higher in absolute values for a message recipient, the difference is statistically insignificant
H3. Higher public self-awareness is associated with higher negative affect (H3a) and VC exhaustion (H3b)	Yes	Yes
H4a. Public self-awareness mediates the effect of self-view frequency on negative affect	Yes	Only for the link “self-view frequency when receiving a message – negative affect.”
H4b. Public self-awareness mediates the effect of self-view frequency on VC exhaustion	No	Only for the link “self-view frequency when receiving a message – VC exhaustion.”
Controls for public self-awareness	Female (n.s.), age (n.s.), number of participants (n.s.), disp.public self-consciousness (+)	Female (n.s.), age (n.s.), number of participants (n.s.), disp.public self-consciousness (+)
Controls for negative affect	Female (n.s.), age (n.s.), job level (n.s.), host (n.s.), number of participants (n.s.), duration of VC (+), VC excessiveness (+)	Female (n.s.), age (n.s.), job level (-), host (n.s.), number of participants (n.s.), duration of VC (n.s.), VC excessiveness (+)
Controls for VC exhaustion	Female (n.s.), age (n.s.), job level (n.s.), number of participants (n.s.), host (n.s.), duration of VC (+), VC excessiveness (+)	Female (n.s.), age (-), job level (n.s.), host (n.s.), number of participants (n.s.), duration of VC (+), VC excessiveness (+)
Differences in self-view frequency across VC layouts	Insignificant	Insignificant
Differences in absolute self-view frequency across communication roles	Self-view frequency when sending is slightly higher than when receiving a message	Insignificant

(+) significant positive association, (-) significant negative association, (n.s.) non-significant

which was found to boost fatigue and gave rise to recommendations for more audio-only meetings (Schockley et al. 2021; Ngien and Hogan 2022). Thus, we supplement and clarify the scholarly works on Zoom fatigue, which were conducted under the premise that self-view and camera use are inseparable.

Third, by exploring whether correlations of self-attention vary across communication roles, we contribute to the self-awareness research stream within social psychology, answering the call by Silvia and O’Brien (2004) to look for contextual factors as potential moderators of adaptive and maladaptive effects of self-awareness. We observe the differences across communication roles in the total effect of self-view on outcomes (negative affect and VC

exhaustion), not concerning the intermediate state (public self-awareness).

Forth, we contribute to research on individual differences in ICT use. As expected, people predisposed to public self-consciousness report higher preoccupation with how others see them in a VC. This result corroborates the recent evidence from Kuhn (2022) and, in a broader sense, adds to the existing body of literature on personality factors in the perception of technology-related stress (Maier et al. 2019). Contrary to one of the first and most cited works on Zoom fatigue (Fauville et al. 2023), which suggests the vulnerability of women (also, Oducado et al. 2022; Schockley et al. 2021), our two studies exhibit insignificant gender effects. A reason could be that we control for

dispositional public self-consciousness, while previous works do not. In study 2 only, age was inversely related to VC exhaustion, in line with (Fauville et al. 2023); and the negative affect was found to be inversely proportional to the job level. This finding is synonymous with Schockley et al. (2021), who found that non-tenure colleagues are prone to higher VC fatigue. Although previous works verified the audience as a self-awareness trigger (Carver and Scheier 1978), our study exhibits that in the presence of a digital mirror, the effect of the number of attendees is marginal. One possible explanation may have been given by clinical psychologist Ellen Hendriksen with her statement: “Each of us – we are each our own worst critic” (The Guardian 2018). In a VC, the own reflection already feels like having an audience, while the number of actual observers becomes less important.

6.2 Practical Contributions

Because the current tendency shows that remote work and studies are here to stay (Woolf 2022), our investigation is relevant for practitioners and highlights the potential to improve VCs practices. For online meeting organizers (managers in the work domain and lecturers in the educational domain), our findings confirm the criticality of VC duration as a predictor of exhaustion, hence calling for precise planning and the necessity of breaks. We do not promote camera-off online meetings, contrary to (Schockley et al. 2021; Ngien and Hogan 2022), but rather call for the promotion of education and mindful use of technology features in the first place. Given the possibility of hiding self-view in most VC tools, users may consider this option first, keeping their video streamed to other attendees. Once a video call in a team has been agreed upon, the colleagues appreciate mutuality and non-verbal cues, especially in a small circle, as interviews (Nesher Shoshan and Wehrt 2022; Luebstorff et al. 2023) and LinkedIn posts show (Karl et al. 2022). For ordinary VC participants, our findings suggest that focusing on the self-view may not be beneficial, especially at events when they mainly perceive and listen to others, like a lecture or a webinar. For presenters, self-observation may be less harmful regarding final outcomes like negative affect and VC exhaustion but is likely to increase public self-awareness.

6.3 Limitations and Future Research Outlook

Our investigation has several limitations, which we hope will serve as an impetus for follow-up studies. First, we collected and analyzed the self-reported data. We used a marker variable to assess common method bias (CMB), and it does not appear to influence the estimations in any

significant way (Appendix G). However, future experimental studies might deliver more convincing causal evidence. Second, individual characteristics beyond public self-consciousness, as well as cultural differences, are worth examination. Third, we do not discuss coping strategies to mitigate public self-awareness induced by self-observation in a VC. Neither do we include other factors of exhaustion, e.g., multitasking (Riedl 2021) or reduced mobility (Bailenson 2021), that have been theorized yet remain to be empirically verified.

Supplementary Information The online version contains supplementary material available at <https://doi.org/10.1007/s12599-024-00874-7>.

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