

Understanding videoconference fatigue: a systematic review of dimensions, antecedents and theories

Understanding
videoconference
fatigue

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Received 19 July 2021
Revised 28 January 2022
8 April 2022
14 May 2022
Accepted 14 May 2022

Abstract

Purpose – While videoconferencing has allowed for meetings to continue in a virtual space without the need for face-to-face interaction, there have been increasing reports of individuals affected by a phenomenon colloquially known as videoconference fatigue (VF). This paper presents a systematic review of existing literature to understand the empirical manifestations of the phenomenon, the causes behind it and potential theoretical explanations behind its effects.

Design/methodology/approach – A comprehensive search on four academic databases was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and produced 34,574 results, with 14 articles meeting the eligibility criteria.

Findings – Analyses showed that VF can be classified into four dimensions: physical, emotional, cognitive and social. Antecedents of VF can be organized into psychological, social, technical, chronemic and productivity factors. Potential theoretical explanations applied in existing studies were described and elaborated upon. The authors also highlight the importance of addressing social concerns as a key priority in alleviating VF.

Originality/value – To our knowledge, this is the first comprehensive systematic review of existing research on VF. The contribution of this paper is twofold: First, the authors described VF in a systematic and rigorous manner and provide theoretical insights, as much of the current discourse around VF tends to be based on anecdotal evidence and reports. Second, the authors explore potential theoretical explanations surrounding the phenomena, to address the lack of understanding behind the processes by which VF affects individuals.

Keywords Anxiety, Burnout, Communication technologies, Media effects, Computer-mediated communication, Systematic review, Wellbeing, Exhaustion, Videoconferencing, Computer communications software, Videoconference fatigue, Zoom fatigue

Paper type Research paper

In-person communication resembles videoconferencing as much as a real blueberry muffin resembles a packaged blueberry muffin that contains artificial flavors, textures and preservatives. You eat too many, and you're not going to feel very good.

– Sheryl Brahmam, Missouri State University

Introduction

Defined as a technological platform used to transmit voice, pictures and data to produce a face-to-face-like form of interaction (Lowden and Hostetter, 2012), videoconferencing soared in



This project was supported by the Ministry of Education Singapore through an Academic Research Fund Tier 1 Grant (RG34/21). The authors thank Pearl Z. Sim for assisting with an early draft of the manuscript.

popularity as people across the world adapted to the social and work-related changes which came about due to the Covid-19 pandemic. Videoconferencing apps – such as Zoom, Skype and Google Hangouts – were downloaded over 62 million times within one week in March 2020, with weekly average downloads almost double that observed in 2019 (Perez, 2020). One particular app, Zoom, saw its daily user numbers rise from 10 million in December 2019 to more than 300 million in April 2020 (Evans, 2020). The uptake of videoconferencing solutions cut across sectors. Businesses transitioned rapidly, with employees spending several hours daily on videoconferencing apps (Brynjolfsson *et al.*, 2020). Students and teachers also had to utilize videoconferencing applications, with online lessons replacing many in-person classes (Kandri, 2020). While videoconferencing tools have allowed organizations to continue operating in a virtual space, there have been reports of individuals affected by a phenomenon we term *videoconference fatigue* (VF). Anecdotally, VF might arise from extensive use of videoconferencing, and it manifests in exhaustion, burnout, anxiety and reality blurring, which could hamper mental well-being and productivity (Jiang, 2020; Pathak, 2020; Murphy, 2020).

Despite its importance, there are no systematic reviews – to our knowledge – which have investigated the empirical manifestations of the phenomenon, the possible causes behind it and the potential theoretical explanations behind its effects. Based on our preliminary literature review, two specific research opportunities stand out in motivating us to perform this exercise. First, individual studies of VF rarely considered the varied dimensions in which VF may manifest – beyond the physical and into cognitive and emotional facets. This could be due to researchers relying on their preferred disciplinary and theoretical approaches, which may not provide a comprehensive understanding of the phenomena. Second, because of these varied theoretical approaches, offering a review that provides a holistic and multi-theoretical perspective of VF will help enrich researchers' understanding of processes by which VF impacts individuals negatively. Hence, we hope to provide an overarching view of the landscape of empirical research studying the phenomena, which may shed more light on the phenomena from multiple points of view and yield pathways for future research on this particularly pertinent issue. Overall, we aim to answer the following research questions in this paper:

- RQ1. What dimensions of videoconference fatigue have been examined?
- RQ2. What antecedents of videoconference fatigue have been examined thus far?
- RQ3. What are the theoretical perspectives used to understand videoconference fatigue thus far?

Preliminary literature review

Videoconferencing

As a mode of communication, videoconferencing has been defined as a “manifestation of computer-mediated communication phenomena” and has been studied extensively through its media richness and social presence (Ferran and Watts, 2008, p. 1,566). It comprises video and audio elements that transmit in real-time, making it an effective mode of communication in terms of media richness (Denstadli *et al.*, 2012). Over decades, technological advancements such as high-speed Internet connections and enhanced computer processing power have resulted in huge leaps in video and audio quality. Recently, there has also been a proliferation of free or low-cost videoconferencing tools, such as Zoom, Cisco WebEx and Skype, making it available to millions of users (Henry and Shellenbarger, 2020).

One of videoconferencing's key advantages is its synchronous nature, as it enables real-time interaction among participants from remote environments without the obstacles of geographical boundaries (Wang, 2004). This reduces environmental impact and lessens stress and fatigue from travel (Bates, 2005). Videoconferencing has also evolved from

two-way interactions to multi-way communication between people (Wainfan and Davis, 2004) making it a dynamic tool for group-based communication. For example, applications like Zoom can hold 100 members during the video meetings, while Microsoft Teams can hold up to 300 members in one video conference (Tan, 2020). Another advantage of videoconferencing is its exchange of information in terms of documents and presentation sharing, making it an attractive and cost-effective mode of visual communication (Panteli and Dawson, 2001).

Outcomes of excessive videoconferencing

Some researchers have found positive outcomes that arise through the appropriate use of videoconferencing, such as greater openness in communication, increased opinion diversity and fostering a more positive work environment (e.g. Rousmaniere *et al.*, 2014). Despite this, the prolonged amount of time individuals spend on videoconferencing during the pandemic has sparked concerns about its potential negative consequences (Pathak, 2020). Anecdotally, it had been claimed that videoconferencing resulted in exhaustion and burnout. For example, individuals have reported feeling extremely tired after videoconferencing, and suggested that they needed more time than usual to recover before taking on another task (Murphy, 2020). Others have reported greater stress and anxiety from the constant need to be online and visible in videoconferences (Jiang, 2020). While these experiences have been documented, they have been classified under different terms – such as “zoom” (named after the videoconferencing app) or teleconference fatigue. For heuristic purposes, we classify these experiences under the term *videoconference fatigue* (VF).

When left unchecked, the effects of VF may be detrimental to health, productivity and learning outcomes. Exhaustion can lead to a decline in work and school performance, impaired decision-making, slower reflexes and various negative health outcomes (Law, 2007). Stress and anxiety also result in poorer sleep and rest, increase moodiness and irritability, negatively impact memory and concentration, and can lead to depression and suicidal thoughts (Putwain, 2007).

Potential causal mechanisms of videoconference fatigue

In face-to-face conversations, the brain subconsciously processes nonverbal cues from a communicator’s entire body (Archer and Akert, 1977). This can include body posture, hand gestures and gait. However, as videoconferencing often focuses solely on the communicator’s face, some scholars argue that the user loses the ability to glean information through nonverbal cues in the rest of the body (Walther and Tidwell, 1995). This is cognitively demanding as the user must pay intense attention to the communicator’s words while trying to process available visual cues. In videoconference meetings, participants see not only the communicator but also sometimes a multitude of faces staring at them. The participant is forced to pay attention and form eye contact with many faces at the same time. As such, an individual’s brain must work harder to focus on these multiple visual cues. Such cue overload could lead to exhaustion, a manifestation of VF (Bailenson, 2021).

Videoconferencing may also exert substantial pressure on users to be visible. Employees are sometimes advised – other times required – to always leave their webcams on during videoconference meetings. This perpetual surveillance can lead to individuals exerting constant effort in impression management – checking one’s appearance, smiling to look pleasant, and looking attentive and in full concentration (Murphy, 2020). While these actions may be willingly enacted, they can also contribute to VF, as performance under surveillance involves the exertion of significant cognitive effort.

In traditional meetings, individuals can sometimes observe and adhere to implicit social norms, such as being quiet and not introducing unnecessary distractions. During

videoconferences, participants might be unaware of the status of the mute button and cause unneeded distractions by answering phone calls or speaking to someone in the same physical room as them. Network latency issues, or lag, can also reduce the quality of audio-visual content, disrupting the flow of the lesson. Distractions can also occur as a result of multitasking (May and Elder, 2018). People are increasingly confident in their abilities to engage in a few tasks at any one time (Salvucci and Taatgen, 2011). They could be rushing a report, making a phone call and writing an urgent email, all in the middle of a videoconference meeting. This, together with the need to split attention across different participants, can result in individuals being needlessly distracted and suffering from VF at the end of the day.

Research opportunities

Based on our preliminary literature review, we encountered two research opportunities. First, existing definitions of VF across individual studies have yet to fully consider its broad and varied manifestations. For example, Bennett *et al.* (2021) defined VF as “the degree to which people feel exhausted, tired, or worn out attributed to engaging in a videoconference” (p. 331). However, the experience of VF goes beyond physical tiredness and may comprise motivational, emotional and other elements, as described by researchers (Fauville *et al.*, 2021; Shockley *et al.*, 2021; Vandenberg and Magnuson, 2021). Even so, these factors might not be sufficient in painting a full picture of how VF can manifest. Some research suggests that excessive use of virtual communication from remote working can lead to work–family conflict and stress, due to the difficulties of managing work–life balance (Golden *et al.*, 2006; Pennington *et al.*, 2022). These findings suggest a social dimension of VF, which has yet to be defined sufficiently in past studies on VF. One reason for this discrepancy in the way VF has been conceptualized could be that researchers examining VF have adopted different disciplinary and theoretical lenses in understanding the phenomena. To address this, we use a problematization approach (Chatterjee and Davison, 2021) to develop a more rounded definition of VF that will holistically consider different disciplinary and theoretical lenses.

Second, there is a lack of theoretical understanding behind the processes by which VF affects individuals negatively. Psychosocial factors behind adverse impacts of technology use such as social media platforms have received much attention in recent times (e.g. Kaur *et al.*, 2021; Cho, 2022), but the theoretical constituents and antecedents of VF have received considerably less attention. To understand the phenomena and its impact, there is a critical need to describe VF and its antecedents in a systematic and rigorous manner, based on sound empirical studies. It is important to explore this phenomenon and its mechanisms as videoconferencing becomes a dominant mode of communication post-pandemic, with some reports suggesting that 75% of business meetings will be held virtually by 2024 (Standaert *et al.*, 2021). In education, some have similarly suggested that virtual learning in some form will remain and evolve over time (Li and Lalani, 2020). To better understand VF, its antecedents and explore the possible theoretical explanations surrounding the phenomena, we synthesized literature surrounding the use and effects of videoconferencing.

Method

A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines (Moher *et al.*, 2009). This method provides a guided approach that enables researchers to conduct systematic reviews and present findings with both methodical evaluation of article quality and transparency in presentation (Moher *et al.*, 2009). We outline this methodology in the following section, by

describing the eligibility criteria for inclusion, search strategy and the approach to data analysis.

The unit of analysis for our review was a study, defined as a piece of research that “produces one or more reports on a sample that does not overlap with other samples” (Littell *et al.*, 2008, p. 67). This reduces the potential bias that might be introduced with studies that produce multiple reports. To be included in our review, articles had to (1) involve participants who were healthy individuals; (2) be published (a) in English, (b) in the last 20 years to ensure relevance and (c) in peer-reviewed journals; (3) rely on original empirical data; and (4) focus on two-way screen-based communication between two or more individuals. Studies that focused on general media use such as watching television or using social media sites were excluded from our review since they do not involve synchronous screen-based communication between individuals.

A two-step search strategy was utilized to search for articles related to videoconferencing and fatigue. First, we searched several academic databases to preliminarily identify relevant articles. From this initial search, we generated a list of search terms that might encompass different forms of screen-based communication and definitions of fatigue, pairing them in different search combinations. The keywords were *media*, *digital*, *teleconferenc**, *videoconferenc**, *zoom*, *video*, *virtual conferenc**, *computer*, *phone*, with *fatigue*, *tired*, *overuse*, *exhaustion*, *burnout* and *anxiety*. Keyword searches were performed in four academic databases: *Web of Science*, *ERIC*, *PubMed* and *PsycINFO*. One round of search was conducted in Fall 2020. To account for more recent publications, we conducted two more rounds of searches on *Google Scholar* in Spring and Fall 2021. This was followed by a forward and backward citation search of shortlisted studies, to identify potentially relevant articles that might have been missed in the search.

To identify the relevant studies, four researchers first screened the title and abstract of all the articles retrieved using the keyword searches and shortlisted relevant papers using the inclusion and exclusion criteria described above. Next, we retrieved the full article of each shortlisted study, before reading through them to ascertain their eligibility to be included in the review. After the final sample has been identified, key information from the articles was extracted for analysis: (1) source, (2) sample size, (3) sample description, (4) method, (5) key findings, (6) dimension/s of VF, (7) antecedent/s of VF and (8) relevant theories. A total of 14 studies met our eligibility criteria and were used in our analysis. [Figure 1](#) provides a summary of the entire process and the number of articles filtered out at each stage of the process.

Analytical approach

To address the research questions, we (a) extracted how each study conceptualized and operationalized fatigue resulting from two-way screen-based communication to identify different empirical manifestations of the phenomena, (b) identified the antecedents to these different operationalizations of fatigue as described by each study and (c) identified the theoretical explanations which the researchers have grounded the findings on. A summary of all the studies included in this review and their key characteristics is presented in [Table 1](#).

Findings

Dimensions of videoconference fatigue

Based on our review, we identified four dimensions of VF – physical, emotional, cognitive and social. First, some studies have noted that the use of virtual communication tools could result in some form of *physical* exhaustion. This has been operationalized as excessive tiredness after videoconferencing use (Bennett *et al.*, 2021; Shahrivini *et al.*, 2021; Fauville *et al.*, 2021;

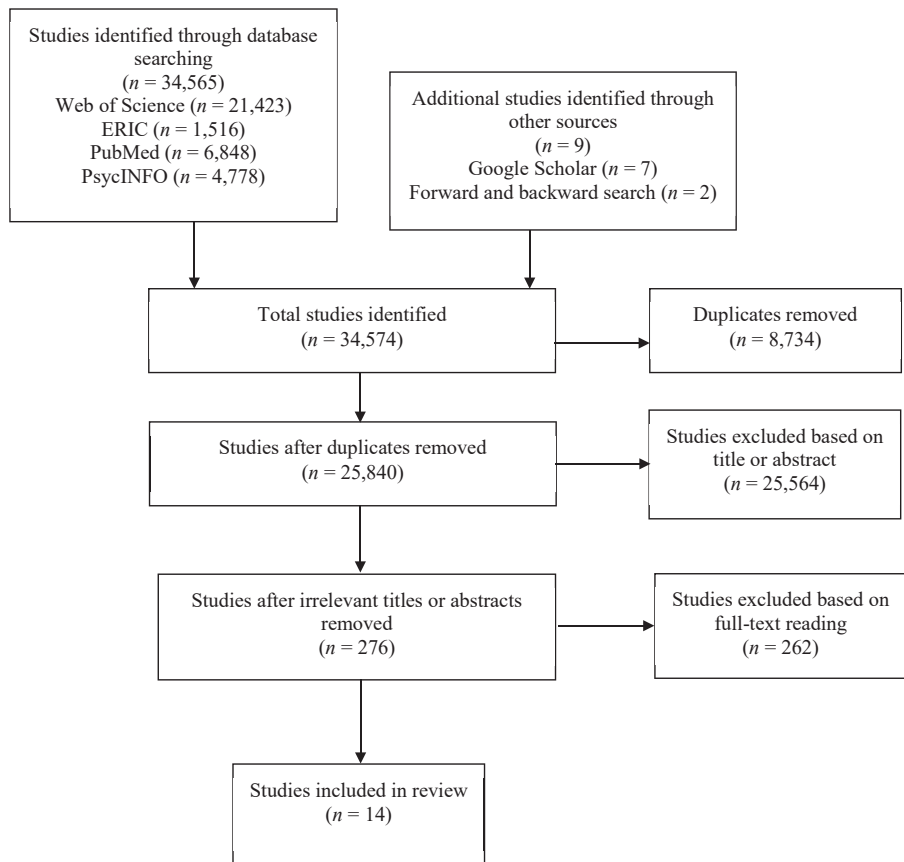


Figure 1.
PRISMA flowchart of
study identification
and inclusion

Kuhn, 2021; Nesher Shoshan and Wehrt, 2021; Shklarski *et al.*, 2021). This physical dimension also encompasses self-reported perceptions of being sapped of all energy, with users reporting that using videoconferencing tools is “energy-draining” and has a negative impact on the body (Amponsah *et al.*, 2022, p. 7). Another manifestation of physical VF is eyestrain, with prolonged hours of looking at videoconference screens resulting in users experiencing vision blurriness, eye irritation and visual discomfort (Fauville *et al.*, 2021; Amponsah *et al.*, 2022; Shklarski *et al.*, 2021).

Second, our analysis revealed that researchers have also examined what could be construed as *emotional* exhaustion which may arise from screen-based communication (Amponsah *et al.*, 2022). This includes feelings of irritability, moodiness and emotional overextension (Fauville *et al.*, 2021), as well as feelings of nervousness and anxiety (Shahrvini *et al.*, 2021; Vandenberg and Magnuson, 2021; Wegge, 2006). During videoconferencing, participants may be overwhelmed with the speed and frequency of conversations between speakers and participants, resulting in some level of anxiety.

In addition, some studies examined stress as a potential form of discomfort which may arise from videoconferencing (Vandenberg and Magnuson, 2021; Pennington *et al.*, 2022; Shklarski *et al.*, 2021). Individuals under stress feel that the situational demands are taxing and perceive that they cannot cope with them (Lazarus, 1993). This might manifest in feelings

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|-------------------------------|-------------|--------------------------|--|--|---|--|------------------------------|
| Amponsah <i>et al.</i> (2022) | 8 | University faculty | Interviews | <ul style="list-style-type: none"> Participants viewed videoconferencing as physically and emotionally draining Connectivity issues and disruptions by conversation partners resulting in lower productivity are key concerns | Physical: Eyestrain Emotional: Emotional exhaustion Cognitive: Inability to focus | Psychological: Information overload; increased need to focus and pay attention Technical: Poor sound and video quality Chronemic: Length of meetings Productivity: Loud background noise influence concentration; meetings turn to online chatrooms; people discussing things that were not on agenda; asking partners to repeat themselves Social: Pressure to be constantly available Technical: Connection issues Chronemic: Length of meetings; time of day of meetings Productivity: Distractions from communication partners | Jobs demands-resources model |
| Bennett <i>et al.</i> (2021) | 55 | Remote working employees | Qualitative open-ended responses and quantitative hourly assessments | <ul style="list-style-type: none"> Visual demands, technical problems and distractions can lead to fatigue due to effort required to sustain attention Tiredness experienced greater especially later in the day Fatigue higher if group belongingness is low | Physical: Exhaustion | Social: Pressure to be constantly available Technical: Connection issues Chronemic: Length of meetings; time of day of meetings Productivity: Distractions from communication partners | Attention restoration theory |

(continued)

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Table 1.
Key characteristic of included studies

Table 1.

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|---|-----------------------------|--|------------------------|--|---|---|-------------------|
| Fauville <i>et al.</i> (2021) | 2,724 | University students | Cross-sectional survey | <ul style="list-style-type: none"> Greater frequency and longer durations of meetings predicted videoconference fatigue People who experienced greater fatigue after a videoconference meeting had a more negative attitude toward it Led to development of Zoom Exhaustion and Fatigue (ZEF) Scale | Physical: Exhaustion Emotional: Irritable and moody Cognitive: Motivational Social: Isolation; want to be left alone | Psychological: Cognitive load; hyper gaze; mirror anxiety; perception of being physically trapped Chronemic: length of meetings; length of breaks between meetings | N.A. |
| Hinds (1999) | Study 1: 71 | Undergraduate students | Lab experiment | <ul style="list-style-type: none"> Interacting over videoconference systems requires higher cognitive load and results in poorer task performance | Cognitive: Heightened cognitive load | Technical: Connection and latency issues | N.A. |
| Kuhn (2021) | Study 1: 86 Study 2: 347 | Study 1: Remote working employees Study 2: University business students | Cross-sectional survey | <ul style="list-style-type: none"> Frequency of self-view predicted aversion to videoconference meetings Relationship was contingent on degree of public self-consciousness | Physical: Exhaustion | Psychological: Mirror anxiety – Public self-awareness and self-focus | N.A. |

(continued)

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|---------------------------------|----------------------------|-----------------------------|--|---|-------------------------|---|-----------------------|
| Nesher Shoshan and Wehrt (2021) | Study 1: 81 Study 2: 53 | Working adults | Study 1: Longitudinal survey Study 2: Cross-sectional survey | <ul style="list-style-type: none"> • Videoconference meetings significantly more exhausting than meetings through other forms of media • Respondents indicate loss in social cues and work effectiveness, technical problems, and expectations from others being key concerns | Physical: Exhaustion | Psychological: Mirror anxiety – Public self-awareness and self-focus Social: Communicating with silent crowd; expectation by others to turn on camera Technical: Computer issues – hanging and freezing Productivity: Disruption in work processes | Media richness theory |
| Pennington et al. (2022) | 540 | Remote working adults | Cross-sectional survey | <ul style="list-style-type: none"> • Increased use of videoconference tools related to VF • Women and mothers with multiple children experienced greater VF | Emotional: Stress | Social: Vulnerable social positions – Women; mothers of multiple children | N.A. |
| Ratan et al. (2022) | 613 | Adult videoconference users | Cross-sectional survey | <ul style="list-style-type: none"> • Videoconference fatigue higher among females and Asians • Gender and race differences mediated by facial dissatisfaction | ZEF Scale | Psychological: Mirror anxiety – facial dissatisfaction Social: Vulnerable social positions – Women; Asians | N.A. |

(continued)

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Table 1.

Table 1.

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|--------------------------------|-------------|---------------------------------|---------------------------------------|---|--|---|-------------------|
| Shahrvini <i>et al.</i> (2021) | 104 | University students | Cross-sectional survey | <ul style="list-style-type: none"> Digital fatigue was intensely experienced in synchronous small group sessions, which led to disengagement, exhaustion, and an inability to focus, hampering participation Students had a loss of motivation because they could not engage in in-person training, impacting learning Mental health declined as students experienced isolation, disconnectedness, and anxiety | Physical: Exhaustion Emotional: Anxiety Cognitive: disengagement; inability to focus | Social: Disruption of routines from stay home orders | N.A. |
| Shklerski <i>et al.</i> (2021) | 92 | Remote working psychotherapists | Interviews and cross-sectional survey | <ul style="list-style-type: none"> VF is a significant challenge, manifesting through eye strain and energy depletion in meeting work demands Key factors of mirror home environment and anxiety, unproductive technological issues exacerbate feelings of VF | Physical: Exhaustion, Eyestrain Emotional: Stress | Psychological: Cognitive load; mirror anxiety Social: Unconductive home environment and latency issues Technical: Connection and productivity: Distracted communication partners | N.A. |

(continued)

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|--------------------------------|-------------|---|------------------------|---|--|--|--------------------------|
| Shockley <i>et al.</i> (2021) | 103 | Remote employees | Field experiment | <ul style="list-style-type: none"> • Camera use is significantly related to VF • Relationship is moderated by gender and organizational tenure | Cognitive: Disengagement Social: Less likely to speak and express ideas | Psychological: Mirror anxiety – switching on camera Social: Vulnerable – social position – women, newer employees | Self-presentation theory |
| Vandenberg and Magnuson (2021) | 108 | University nursing students and faculty | Cross-sectional survey | <ul style="list-style-type: none"> • Students felt disconnected from peers and instructor as a result of videoconferencing use • Both faculty and students experience technological (e.g. poor Internet connectivity) and psychological issues (e.g. stress and anxiety) • Competing demands between work and family, and uncondusive home environment were cited as psychosocial concerns | Emotional: Stress; anxiety Social: Disconnectedness | Technical: Poor Internet connectivity Social: Competing demands between work and family; uncondusive home environment | N.A. |

(continued)

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Table 1.

Table 1.

| Source | Sample size | Sample description | Method | Key findings | Dimension(s) of VF | Antecedent(s) of VF | Relevant theories |
|-------------------------------------|----------------------------|---------------------|----------------|---|------------------------------------|---|--|
| Wegge (2006) | Study 1: 88 Study 2: 60 | University students | Lab experiment | <ul style="list-style-type: none"> Individuals experienced greater test anxiety if their own picture is presented large and in the center of their display screen Presenting own picture intensifies negative affectivity (dislike, anger, and shame), further amplified if technical (audio or visual interruption) or organizational (consultant referring to a book for an answer) problems occurred during the conversation | Emotional: Anxiety | Psychological: Cognitive load Technical: Connection and latency issues Productivity: Distractions from communication partners | Theory of objective self-awareness |
| Wegge et al. (2007) | 96 | Call center agents | Lab experiment | <ul style="list-style-type: none"> Communicating with an unfriendly partner increased more intense emotions and strain (negative mood, tiredness, and emotional dissonance), as well as more errors Adding time pressure leads to higher strain and less talking | Emotional: Emotional dissonance | N.A. | Social presence theory, Theory of objective self-awareness |

of being overloaded and perceiving a lack of control over one's circumstances, which reflect an *emotional* dimension of fatigue.

Third, we identified a cognitive dimension to videoconference fatigue, which consists of three factors – motivational fatigue, disengagement and difficulties focusing. Motivational fatigue refers to a reduced inclination to engage in activities after videoconferencing (Fauville *et al.*, 2021). Disengagement results in individuals feeling disinterested and disconnected (Shahrivini *et al.*, 2021; Shockley *et al.*, 2021). When cognitive processing abilities are overwhelmed, videoconference participants may also suffer from an inability to focus (Shahrivini *et al.*, 2021; Amponsah *et al.*, 2022). Findings from Hinds (1999) suggest that heightened cognitive load because of audiovisual information overload may lead to individuals being more error-prone in work tasks.

Finally, the studies pointed toward a *social* dimension to VF. Such social fatigue is manifested in individuals wanting to be alone and isolated from others after virtual communication sessions (Fauville *et al.*, 2021). Higher levels of videoconference use also led to users being less likely to speak up during videoconference meetings or express their ideas in virtual discussions (Shockley *et al.*, 2021). Users also report feeling more distant and disconnected from other people. This manifested through the concept of depersonalization, where people develop excessively detached behavior towards others (Vandenberg and Magnuson, 2021). Based on our review, VF appears to manifest in ways that were beyond a general feeling of tiredness or feeling burned out. Indeed, VF seems to be a complex and multi-faceted sense of discomfort and weariness that can manifest physically, emotionally, cognitively and socially.

Antecedents of videoconference fatigue

Having explored the different dimensions in which VF has been conceptualized and studied, we then examined what the antecedents to these different dimensions could be. Based on the shortlisted studies, we found five factors that could result in one or more forms of VF – psychological, social, technical, chronemic and productivity. First, we identified some *psychological* factors which could result in one or more forms of VF. These include information overload, as individuals can be exhausted from processing the overwhelming amount of information that could be conveyed through virtual communication tools (Amponsah *et al.*, 2022). This then results in users needing to put in more cognitive effort to focus and pay attention to the conversation. This overload can be a result of an imbalance between the demands of processing visual and verbal information concerning the cognitive capacity of the individual. Overload could also present itself as visual demands that videoconference participants face, as they must pay greater attention to nonverbal cues (Shklarski *et al.*, 2021; Neshor Shoshan and Wehrt, 2021). Analogous to this is the increased cognitive load from *both* producing nonverbal cues in videoconferencing and interpreting the nonverbal cues of communication partners, as both processes require intentional effort and attention (Fauville *et al.*, 2021).

Psychological overload can also exist in the form of *hyper gaze*, in which participants obtain the direct eye-gaze of numerous communication partners (Fauville *et al.*, 2021). Videoconferencing software tends to represent participants using a grid of their faces looking at each participant. As compared to in-person meetings such as classrooms, where students are facing the front of the class and looking only at the instructor without other students looking at them (Bailenson, 2021), this overload of visual information can overwhelm participants and lead to VF.

Fauville *et al.* (2021) also noted the effect of seeing one's face constantly during videoconferencing, which they term *mirror anxiety*. This increases self-focused attention which can lead to negative effects like fatigue. Mirror anxiety has been studied in several

studies. Videoconference users in [Shklarski et al.'s \(2021\)](#) study acknowledge the negative effects of self-view during videoconferencing, with one individual commenting “It’s more exhausting because your face is also on the screen” (p. 60). Videoconference users who leave their cameras on during meetings reported higher levels of fatigue compared to those who kept theirs off ([Shockley et al., 2021](#)). A key variable to consider is an individual’s facial appearance dissatisfaction. As illustrated in [Ratan et al. \(2022\)](#), facial dissatisfaction facilitated higher feelings of VF, as stronger self-objectification could lead to greater negative self-focused attention or mirror anxiety.

Related to this is the size of the individual’s face in videoconferencing tools, with a larger face size prompting greater self-focus and anxiety ([Wegge, 2006](#)). Using videoconferencing software can also lead to a higher sense of public self-awareness and self-focus ([Nesher Shoshan and Wehrt, 2021](#)). [Kuhn \(2021\)](#) found the frequency that users view themselves in videoconference meetings predicted an aversion to using videoconferencing tools. This relationship was contingent on users’ degree of public self-consciousness. Individuals may also feel trapped as they have to constantly stay in the camera’s field of view ([Fauville et al., 2021](#)). For the camera to capture their faces, videoconference participants must ensure they are facing the device all the time and restrain themselves from looking elsewhere or shifting to another location.

Second, our analysis found that *social* factors could contribute to different facets of VF. This revolves around the social norms and expectations that communication partners are expected to follow in a videoconference. One aspect is the social pressure to be constantly available. For example, it was noted that some videoconference participants are expected to be in front of their computers all the time even during stay-home orders ([Bennett et al., 2021](#)). There are also expectations from others to stay in line with videoconferencing norms ([Nesher Shoshan and Wehrt, 2021](#)). This includes leaving the camera on all the time during meetings or to respond promptly to requests for videoconference meetings. On the other hand, users also express challenges in communicating virtually with totally silent others – where all other users turn their cameras off and are muted, with such experiences noted as being “very exhausting”, “super frustrating” and the silent crowd being “very hard to read” ([Nesher Shoshan and Wehrt, 2021](#), p. 15). This is in contrast to in-person communication, where even a silent crowd can exhibit responsiveness through non-verbal cues such as head nodding, which can carry semantic meaning ([McClave, 2000](#)).

Participants in videoconferences may also feel obliged to over-express positive emotions (e.g. smiling, looking their best) as they want to leave the best impression among the attendees, even though they may not feel that way. Such emotional dissonance refers to the incongruence between how an individual is feeling and their facial expression ([Wegge et al., 2007](#)). Previous research has highlighted how effortful self-presentation may be cognitively demanding ([Vohs et al., 2005](#)), which can lead to VF.

Studies have found that people in vulnerable social positions are more prone to VF. Women report higher levels of VF as compared to their male counterparts ([Pennington et al., 2022](#); [Ratan et al., 2022](#); [Shockley et al., 2021](#)). Specifically, mothers with multiple children experienced greater stress and fatigue while working remotely ([Pennington et al., 2022](#)). Newer employees reported higher levels of VF as compared to employees with longer organizational tenure ([Shockley et al., 2021](#)). [Ratan et al. \(2022\)](#) noted that VF was 11% higher among Asians than White users, and 14.9% higher in females than males, and attributed these findings to the social group differences and conformity pressure these individuals are under.

Working from home as a result of stay-home orders can also cause individuals to face competing demands from work and family ([Vandenberg and Magnuson, 2021](#)). Employees may suffer from fatigue as a result of anxiety and pressure stemming from managing both

work and household demands at the same time. Availability and response pressure by both employers and family on individuals working from home may hence cause additional stressors due to the disruption of normal routines where employees were able to separate between traditional and non-traditional working hours (Shahrvini *et al.*, 2021).

Further exacerbating the stress of transiting to home-based videoconferencing are unconducive home environments, where there are significantly higher distractions as compared to institutional settings (Vandenberg and Magnuson, 2021). Some users reported concerns regarding lack of privacy, as they could be living in crowded and small homes without access to individual headphones or having intrusive household members. Both factors could be key drivers of stress when it comes to private and confidential virtual discussions (Shklarski *et al.*, 2021).

Third, *technical* issues relating to problems such as connection or latency issues with the Internet provider may result in anxiety, frustration and ultimately fatigue for videoconference users (Bennett *et al.*, 2021; Wegge, 2006; Hinds, 1999; Vandenberg and Magnuson, 2021; Shklarski *et al.*, 2021). This can manifest through dropped connections or lag, which can result in delayed responses from communication partners, poor audio quality and choppy video (Amponsah *et al.*, 2022). Other technical factors can include using old devices that may not be technologically adequate for videoconferencing. This can result in problems such as devices not working or crashing in the middle of a meeting, leading to frustration and anxiety (Nesher Shoshan and Wehrt, 2021).

Fourth, studies pointed towards *chronemic factors* as a potential antecedent to different forms of fatigue. For example, the length of videoconference meetings may be a key factor. The longer these meetings are, the higher the levels of sustained attention a videoconference user is expected to maintain (Bennett *et al.*, 2021; Amponsah *et al.*, 2022). Similarly, some studies have pointed out the frequency of videoconference meetings as an important consideration (Bennett *et al.*, 2021; Fauville *et al.*, 2021). Other time-based factors include the length of breaks in between videoconferences, where shorter durations result in higher levels of VF (Fauville *et al.*, 2021), and the time of day in which videoconference meetings are held (Bennett *et al.*, 2021). In particular, videoconference meetings held in the earlier parts of the day may lead to early energy drains which contribute to exhaustion for the rest of the day (Bennett *et al.*, 2021).

Finally, *productivity* factors are concerned with workflow changes as a result of increased dependency on videoconferencing. Users may experience disruptions from their communication partners which will slow down work productivity and efficiency (Wegge, 2006; Bennett *et al.*, 2021). These can include partners having difficulty operating videoconferencing software, experiencing technical issues, engaging in distractions such as family needs or not being in front of the webcam (Amponsah *et al.*, 2022; Shklarski *et al.*, 2021). Some users experience scenarios where meetings turn into online chat rooms, with partners spending excessive time discussing casual topics that were not on the meeting agenda (Nesher Shoshan and Wehrt, 2021). Loud background noises in some communication partners' environments can also negatively impact meeting flow and productivity, as users find themselves having to ask the other party to repeat themselves (Amponsah *et al.*, 2022). Constant interruptions of work processes and videoconference meetings may eventually result in frustration and fatigue.

Theoretical explanations

In addition to identifying these antecedents, we have also identified various theories utilized by existing research. Firstly, researchers employing a social psychological approach have utilized self-presentation theory, social presence theory and the theory of objective self-awareness to examine VF (Shockley *et al.*, 2021; Wegge, 2006; Wegge *et al.*, 2007).

Self-presentation theory posits that individuals have an inherent desire to be viewed by others in a positive light, and in order to leave a good impression, strive to present positive information about themselves (Goffman, 1959; Schneider, 1981). As self-presentation acts as a form of self-regulation that calls for active monitoring and management of behavior and speech during social interactions, it is cognitively demanding (Baumeister, 1982). Shockley *et al.* (2021) suggest that in videoconference meetings, individuals who have their cameras on perceive themselves as being watched by others. This leads to a heightened need for self-presentation to leave a more positive impression on others. This notion of being watched creates increased cognitive load which ultimately results in fatigue.

Social presence theory proposes that different forms of communication media vary in their ability to transmit social cues (Short *et al.*, 1976). Videoconferences allow for high social presence due to their ability to convey social information through non-verbal signals and facial expressions, and hence should heighten the emotions expressed and received by communication partners (Wegge *et al.*, 2007). This can potentially lead to stronger levels of fatigue in videoconferencing meetings.

According to the theory of objective self-awareness (Wicklund, 1979), seeing one's image prompts stronger levels of self-awareness which can make individuals more critical of themselves and result in higher negative emotions. This approach has been used to explore both the effects of seeing one's video and image in videoconferences, and the influence of the size of the video, with a larger video size prompting more negative affect and reaction (Wegge, 2006; Wegge *et al.*, 2007).

Media richness theory (Daft and Lengel, 1984) has been adopted as the theoretical lens in two studies to understand the phenomena of VF (Hinds, 1999; Nesher Shoshan and Wehrt, 2021). The original theory suggests that richer media, as a result of encompassing more cues, produces better communication outcomes since it facilitates greater shared meaning and reduces ambiguity (Daft *et al.*, 1987). This suggests that videoconferencing is a richer form of medium as compared to other media, such as text chat or emails, but less rich than face-to-face communication. By that logic, videoconferencing should be less exhausting than media that has fewer cues. However, based on more recent developments in media richness theory (Ishii *et al.*, 2019), Nesher Shoshan and Wehrt (2021) propose that media perception and subsequent effects of videoconferencing are not based on objective cues, but on subjective interpretation of the symbolic meanings represented by videoconferencing. In their study, users who find videoconferencing more exhausting make reference to symbolic meanings of what was lost during the pandemic, often making comparisons to the "good old times" of face-to-face meetings (p. 16).

One study employed the perspective of the job demands-resources model (Demerouti *et al.*, 2001) to understand the effects of videoconferencing on university instructors' experience of VF (Amponsah *et al.*, 2022). According to the job demands-resources model, an employee's working conditions can be understood as a combination of both job demands and resources, with the latter acting to reduce the impact of the former on the individual (Demerouti *et al.*, 2001). Though videoconferencing as a communication tool may provide benefits in terms of work productivity and flexibility, it places additional demands on employees such as the social pressure to be constantly available, increased cognitive load and the need to master technological challenges (Amponsah *et al.*, 2022). This may potentially lead to fatigue and burnout. A breakdown of the dimensions and antecedents of VF, together with the relevant theories are presented in Table 2.

Discussion

Despite the concerns about the effects of prolonged videoconferencing, there has been no comprehensive review of the literature examining the phenomena of VF. This systematic

| | | |
|----------------------|-----------------------|--|
| Dimensions of VF | Physical | <ul style="list-style-type: none"> Physical exhaustion Bennett et al. (2021), Fauville et al. (2021), Kuhn (2021), Nesher Shoshan and Wehrt (2021), Shahrivini et al. (2021), Shklarski et al. (2021) Eyestrain Amponsah et al. (2022), Shklarski et al. (2021) |
| | Emotional | <ul style="list-style-type: none"> Emotional exhaustion Amponsah et al. (2022) Irritable and moody Fauville et al. (2021) Anxiety Shahrivini et al. (2021), Vandenberg and Magnuson (2021), Wegge (2006) Stress Pennington et al. (2021), Shklarski et al. (2021), Vandenberg and Magnuson (2021) |
| Antecedents of VF | Cognitive | <ul style="list-style-type: none"> Motivational Fauville et al. (2021) Disengagement Shahrivini et al. (2021), Shockley et al. (2021) Inability to focus Amponsah et al. (2022), Hinds (1999), Shahrivini et al. (2021) |
| | Social | <ul style="list-style-type: none"> Less likely to speak and express ideas Shockley et al. (2021) Isolation; want to be alone Fauville et al. (2021) Disconnectedness Vandenberg and Magnuson (2021) Information overload Amponsah et al. (2022) Increased need to focus and pay attention Amponsah et al. (2022) Cognitive load from producing and interpreting visual cues Fauville et al. (2021), Nesher Shoshan and Wehrt (2021), Shahrivini et al. (2021), Wegge (2006) |
| Social factors | Psychological factors | <ul style="list-style-type: none"> Hyper gaze Fauville et al. (2021) Mirror anxiety Fauville et al. (2021), Shklarski et al. (2021) <ul style="list-style-type: none"> Facial dissatisfaction Ratan et al. (2022) Presence of webcam Shockley et al. (2021) Public self-awareness and self-focus Kuhn (2021), Nesher Shoshan and Wehrt (2021) |
| | Technical factors | <ul style="list-style-type: none"> Perception of being physically trapped Fauville et al. (2021) Vulnerable social positions – women Pennington et al. (2022), Ratan et al. (2022), Asians Ratan et al. (2022), mothers of multiple children Pennington et al. (2022), newer employees Shockley et al. (2021) Social pressure to be constantly available Bennett et al. (2021) Disruption of normal routines from stay home orders Shahrivini et al. (2021) Silent crowd Nesher Shoshan and Wehrt (2021) Expectation by others to turn on camera Nesher Shoshan and Wehrt (2021) Competing demands between work and family Vandenberg and Magnuson (2021) Unconducive home environment Vandenberg and Magnuson (2021) <ul style="list-style-type: none"> Lack of privacy Shklarski et al. (2021) |
| Productivity factors | Chronemic factors | <ul style="list-style-type: none"> Connection and latency issues Bennett et al. (2021), Hinds (1999), Shklarski et al. (2021), Vandenberg and Magnuson (2021), Wegge (2006) Poor sound and video quality Amponsah et al. (2022) Computer issues: Hanging and freezing Nesher Shoshan and Wehrt (2021) |
| | Productivity factors | <ul style="list-style-type: none"> Length of meetings Amponsah et al. (2022), Bennett et al. (2021), Fauville et al. (2021) Frequency of meetings Fauville et al. (2021) Length of breaks between meetings Fauville et al. (2021) Time of day when meetings occur Bennett et al. (2021) Distractions from communication partners Bennett et al. (2021), Shklarski et al. (2021), Wegge (2006) Loud background noise influence concentration Amponsah et al. (2022) Disruption in work processes and meetings Amponsah et al. (2022), Nesher Shoshan and Wehrt (2021) |
| Theories | | <ul style="list-style-type: none"> Self-presentation theory Baumeister (1982), Goffman (1959) – Explored by Shockley et al. (2021) Social presence theory Short et al. (1976) – Explored by Wegge et al. (2007) Theory of objective self-awareness Wicklund (1979) – Explored by Wegge (2006) and Wegge et al. (2007) Media richness theory Daft and Lengel (1984)– Explored by Hinds (1999) and Nesher Shoshan and Wehrt (2021) Job demands-resources model Demerouti et al. (2001) – Explored by Amponsah et al. (2022) |

Table 2.
Summary of
dimensions,
antecedents and
theories

review provides a holistic account of how previous researchers have conceptualized VF, the drivers of VF, as well as the theoretical approaches used to examine it. Specifically, we synthesized existing research to clarify the concept of VF and its dimensions, identified potential antecedents and summarized the existing theoretical approaches used to explain its effects. We believe our findings provide useful theoretical and conceptual foundations for future researchers interested in examining the phenomena, along with implications for videoconferencing software designers and users.

Four dimensions of VF

First, we found that researchers have generally considered four dimensions of VF – physical, emotional, cognitive and social. Physical manifestations of VF include excessive tiredness and exhaustion. In addition, during our process of performing the systematic review, studies also noted physical exhaustion which may result from activities *related* to videoconferencing. These include eye, neck, shoulder and wrist pain from excessive screen and keyboard use (Mocci *et al.*, 2001; Seppala, 2001; Murata *et al.*, 2003; Cheng *et al.*, 2019). Although not included in the systematic review, these studies suggest that computer use may compound physical fatigue arising from videoconferencing. Mood-related *emotional* manifestations of VF were also noted. In emotional VF, this may manifest in feelings of stress, moodiness and irritability. Parallel to emotional manifestation of VF is a cognitive facet of VF, where motivational levels, engagement and focus are reduced after videoconferencing. In addition to physical, emotional and cognitive manifestations, our analyses also revealed a social dimension to VF. Feelings of disconnectedness and depersonalization are *social* manifestations of videoconference fatigue, a result of individuals being disillusioned with the constant need to be in contact with other people. Social VF may result in shunning behavior.

While some working definitions of VF largely center on physical and emotional tiredness (e.g. Bennett *et al.*, 2021), our review showed that a holistic understanding of VF must consider the multi-faceted ways in which VF manifests. While current research has tended to focus on the physical and emotional dimensions of VF, cognitive and social dimensions of VF should also be considered to capture its diverse manifestation. Existing evidence also suggests VF to be non-pathological in nature, as it has an identifiable cause and tends to be shorter-term (Jason *et al.*, 2010). As a result, we propose to define VF as a *non-pathological tiredness arising from videoconferencing which manifests in physical, emotional, cognitive and social ways*.

Multiple theoretical perspectives explaining antecedents to VF

Beyond this, our systematic review also attempted to identify key antecedents to VF and their associated theoretical explanations. These included psychological factors, social factors, technical problems, chronemic factors and productivity-related issues. We found that these were explained through a range of theoretical perspectives such as self-presentation theory, social presence theory, the theory of objective self-awareness, media richness theory and the job demands-resources model.

One key implication from our review is that VF arises from a complex amalgamation of factors, from its specific media affordances, individual user perceptions and technical ability, and the social and organizational context in which it occurs. For example, psychological antecedents such as hyper gaze and mirror anxiety are individual psychological phenomena that occur due to specific affordances found in certain videoconferencing applications. On the other hand, normative pressures, communication with silent crowds and competing work vs home demands are associated with the social and organizational context in which videoconferencing is being undertaken. Our findings noted that a range of theoretical perspectives – from social psychological, media affordance and organizational

approaches – were adopted by different scholars to examine VF. As in the oft-cited parable of the blind men and the elephant, scholars using specific theoretical perspectives may fail to consider a holistic picture of how VF arises. In contrast, by adopting a complementary approach that considers multiple conceptual lenses used in examining VF (e.g. Cairney, 2013), our systematic review helps bridge the individual theoretical “blind spots” to reveal a more holistic understanding of how VF occurs.

Practical implications

Our review has also shed light on some issues that employers, human resource managers, educators and healthcare professionals should take note of. As videoconferences continue to become an integral aspect of work life, the exhaustion which accompanies them is of increasing concern (Mayer, 2020). Employers, managers and healthcare professionals ought to take note of the different ways in which VF can manifest. Specifically, beyond physical exhaustion, there is a need to keep a lookout for emotional, psychological and social manifestations of fatigue. For example, if an employee displays increasing disconnection (social), stress (emotional) and disengagement (psychological), it might be useful to examine if these symptoms could be due to excessive use of videoconferencing in work-related contexts.

Similarly, there are several strategies in which interested stakeholders can tackle VF among workers and students to ensure it does not negatively impact productivity and wellbeing. First, users can exercise various user interface choices to protect themselves from VF. This could include enabling “speaker view” on their videoconference platform of choice to ensure only the person speaking is displayed on screen to reduce hyper gaze, multiple visual cues and public self-awareness. Users can also disable “self-view” to reduce mirror anxiety and the tendency for users to constantly check on themselves. Videoconferencing software developers can also set these as default settings in their software. Second, managers need to pay attention to the perceived norms surrounding videoconferences. Adept managers ought to utilize various strategies to reduce the pressure for employees to be constantly available and to address normative response pressure through verbal assurances. Third, companies and schools should find ways to increase the technical competencies and self-efficacy of workers and students in using videoconferencing software, and be ready to provide them with technical training, resources and equipment to reduce technical issues which may exacerbate VF. Fourth, the frequency and duration of meetings, even those which are face-to-face, are positively related to employee fatigue and perceived workload (Luong and Rogelberg, 2005). The simplest way to reduce VF is to not hold unnecessary virtual meetings, reduce the length and intensity of virtual conversations, and incorporate sufficient breaks within a session. Finally, efforts should be made to increase awareness of individuals’ tendency to overestimate their abilities to multitask. Developers of videoconferencing software can also build in behavioral nudges to discourage multitasking to mitigate information overload and VF.

Future research directions

Our review points toward two main areas in which future research directions can take. First, our finding that VF may manifest across different domains of human experience – such as physical, emotional, cognitive and social – may open new lines of research for the study of the phenomena. For example, future research can further empirically assess VF through the development and validation of instruments measuring these different facets of VF. Future research can also explore the relative severity of the VF dimensions identified and how they might affect certain populations differently. For example, do people with certain traits experience social or VF more than others, and are lower- and mid-level employees more

susceptible to VF than those in top-level management? With regard to user experience, developers and researchers can also examine what specific features and experience within videoconferencing contribute to VF in different ways and across different contexts – such as using it for meetings versus lectures. This can help point out ways to better design the interface of videoconferencing applications for different purposes. Finally, it is also possible to explore if these dimensions of fatigue extend to other novel forms of synchronous digital communication platforms which aim to foster high levels of social presence, including but not limited to, virtual and augmented reality.

Second, our review offered a stock take of the theoretical perspectives utilized to explain how different aspects of VF come about. For example, some work on VF emphasized nonverbal mechanisms and processes as potential causes of VF (e.g. Bailenson, 2021; Fauville *et al.*, 2021). While the media effects perspective (limited capacity model, media synchronicity theory) and some aspects of social psychology (theory of objective self-awareness, self-awareness attention theory) are relevant to nonverbal mechanisms, stress and overload theories from an organizational perspective are also important in understanding how VF occurs. These perspectives are not mutually exclusive and may operate in a complementary manner to cause VF. Future research should consider exploring, conceptually synthesizing and testing the concepts from the theories identified in this review, to build toward a more holistic model to understand VF. This may help contribute to a dedicated and comprehensive theoretical approach on which future researchers can rely on to explain the phenomena of VF, as well as potentially related forms of fatigue that may arise from future communication platforms tapping on virtual and augmented reality.

Conclusion

In conclusion, we identified four ways in which VF manifests: physical, emotional, cognitive and social, contributing to a comprehensive and empirically grounded definition of the phenomena. We also explored the different theoretical approaches used to examine the potential causes of VF, providing a holistic account of the varied ways in which VF arises. While the study of VF is nascent, the findings from our systematic review provide substantive theoretical and empirical grounding for future research on the phenomena. From this, we hope that this review sparks future work which considers the different ways in which VF manifests and occurs, and that the search for solutions to this pressing issue is not limited by disciplinary lenses.

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