

The Hidden Psychological Costs of Virtual Work: Examining the Psychosocial Adverse Effects of Metaverse in the Workplace

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ABSTRACT

The rapid evolution of virtual and augmented reality technologies has significantly impacted workplace environments across various sectors. The interconnected and immersive environments that these technologies can provide to the users has often been referred to by the name of Metaverse. This paper provides an overview, based on current scientific literature, of the potential psychological impacts of Metaverse technologies in occupational settings, drawing on current research to highlight areas of concern such as cognitive overload, social isolation, distorted reality perception, and increased anxiety and depression risks. The study advocates for the development of guidelines and best practices to ensure a safe, rational, and ethical use of these technologies in occupational settings. By doing so, it provides insights for users, developers, policymakers, and industry stakeholders, aiming to foster responsible development and integration of these technologies into professional environments.

CCS CONCEPTS

• **Virtual reality;** • **Human and societal aspects of security and privacy;** • **Social and professional topics;** • **Risk management;**

KEYWORDS

Metaverse, Psychology, Risks, Virtual reality, Augmented Reality

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1 INTRODUCTION

Digital worlds will likely become more ubiquitous and integrated in the society of the future [1], including in the future workplaces [2]. Extended reality technologies (referred also as xReality – XR [3], see also media-generated reality [4]), including technologies like Virtual Reality (VR) and Augmented Reality (AR), is nowadays implemented into a broad array of applications that include training, visualization of 3-dimensional data, spatial planning, and for facilitating remote work [5]. This swift transition is propelled by rapid developments in essential technologies such as mobile internet,

artificial intelligence, an increase in hardware and software capabilities, and small screens capable of high-resolution [6, 7]. These innovations have profoundly altered how people can engage with and understand the digital worlds [3, 8]. The need to investigate the possible adverse effects on people using XR technologies is important for ensuring the safety and health of users in professional settings [9, 10]. As XR technologies become more entrenched in daily workplace operations, they raise important questions and challenges for Occupational Safety and Health (OSH) standards [11]. These technologies not only present opportunities to enhance training and operational efficiency but also introduce risks that must be carefully managed. Policymakers, industry leaders, and OSH professionals are thus called upon to adopt a cautious and at the same time flexible approach to ensure that advancements in these fields – that are generally beneficial for the workplaces in the context of OSH [12–14] – that do not compromise some aspects of workers’ safety and well-being. Despite the rapid incorporation of XR technologies into professional environments, there remains a significant gap in research. This gap particularly concerns the long-term effects of the use of XR systems, as well as the potential psychological risks in occupational settings. Early studies have often tackled physical issues like simulation sickness/cybersickness and ergonomic concerns associated with VR equipment [9, 15]. However, until recently [16], potential psychological issues have not been extensively assessed, especially in the context of workplace usage of these technologies. This could be attributed to the fact that psychological conditions in the context of digital media have been most often studied in the context of young people exposure to videogames [17, 18], and less commonly in the wider context of adults using XR technologies for work purposes.

1.1 The Metaverse

According to recent forecasts, by the year 2026, the 25% of people will be spending one hour at least, each day, in the Metaverse, engaging in activities ranging from work and education to leisure, thereby moving some aspects of their daily lives from the physical world to virtual environments [19]. The Metaverse, as a concept, was originally envisioned in the novel “Snow Crash” in 1992, and the notion of Metaverse was related to technological innovations providing the users with immersive experiences [20]. Such theorization put the foundational ideas for the possibility of computer-generated alternate digital realities, despite initial attempts to develop XR systems was constrained by the technical limitations and non-interactive nature of the early technologies [21, 22]. In its contemporary form, the Metaverse could be seen as representing the future of XR technologies, where the virtual world are able to enrich user experiences by providing more sophisticated interconnectivity and intelligent, AI-driven, and adaptive virtual



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environments [20, 23]. Such interpretation of the Metaverse emphasizes a service-oriented architecture, promoting deeper social interactions and extensive user-generated content. Nevertheless, defining the Metaverse comprehensively remains a challenge, and has been often described as an unclear concept and a buzzword [4, 24]. More generally, the concept of Metaverse is broadly seen in the scientific literature as a terminology describing XR technologies, particularly when these technologies empathize aspects such as connectivity, avatars, blockchain [25], and digital twins [26]. Its applications have expanded to specialized work environments such as industrial settings, and recently Metaverse applications aimed at workplaces and industry have been recently referred as “industrial Metaverse” [27, 28]. As XR technologies are an integral part of the Metaverse, risks of working in the metaverse include psychological risks and criticalities that have been identified in the use of XR technologies, as suggested in previous literature [16]. Please note that the term XR and the term Metaverse will be used synonymously in the present article to refer to these technologies able to deliver immersive experiences to the users, that either replace or interact with the physical environment.

1.2 The present study

This study aims to identify the potential psychosocial risks, adverse effects, and challenges that arise from implementing these immersive technologies in such settings. The aim of this study is to provide essential insights to users, developers, policymakers, and industry stakeholders regarding the potential hazards linked to the Metaverse. Furthermore, this research aims to advocate for establishing comprehensive guidelines, policies, and best practices that ensure the future safe implementation of these technologies in the workplace. Finally, the study seeks to forward the responsible development of the Metaverse, enhancing their benefits while attempting at minimizing the associated risks.

2 METHOD

This article attempts to provide a narrative overview of select key studies from digital media literature, evaluating the potential psychological risks of the Metaverse with a focus on workplace implications. The article also aims to suggest opportunities for future research endeavors and best practice. The literature search targeted publications from 2016 to April 2024 that had to do with the context of risks and ill effects in relation to XR technologies in the workplaces. All material referenced were written in English. Please note that the findings presented in this article are part of a larger literature review study aimed to comprehensively evaluate current risks of the OSH consequences of the implementation of Metaverse technologies in the context of workplaces. In the present article, only the findings related to psychological issues are presented. The search was conducted using Scopus, Web of Science, ACM Digital Library, IEEE Xplore, and Google Scholar, to include both technology-driven repositories as well as more general ones.

3 RESULTS

The scientific literature has, in general, not prioritized examining the psychological risks associated with Metaverse technologies, despite in recent years the topic has gained more attention from

the scientific community [29, 30]. This oversight extends to the broader implications and specific psychological challenges posed by such technological integrations. Remarkably, there remains a significant gap in the research concerning the long-term effects of employing Metaverse technologies in workplace settings. This lack of comprehensive study should be filled, given the rapid adoption, and increasing reliance on XR technologies in various professional sectors. Here are presented some of the potential psychological effects of Metaverse technologies, and how these may affect OSH.

Cognitive overload: Implementing Metaverse technologies as an innovative tool in information and communication technologies changes user interactions and interfaces significantly, necessitating adaptation in task management techniques. Such adaptation may increase the users’ mental effort, as adapting conventional tasks to VR often demands more from an individual’s working memory. Research on VR’s impact on mental workload in specific professional tasks is not yet comprehensive, but existing studies provide varied findings. A study [31] compared mental workloads between VR and traditional PC environments using a VR system simulating office-like tasks. The study found similar levels of mental exertion in both conditions. Conversely, another study [32] found that virtual environments could lead to higher mental fatigue than actual office settings. A recent systematic review [9] showed that the current direct evidence of the effects of VR on mental workload is somehow inconclusive. Additionally, the role of user expertise in both VR and specific tasks seems to be critical, affecting both the performance and the mental effort required [9]. If the interaction methods and interfaces are inadequate or poorly designed, they could cause mental overload and reduce performance efficiency [9]. Moreover, in high-pressure situations where tasks demand maximum efficiency, users might avoid using VR if it increases mental strain. Mental overload and fatigue are psychological experiences that may directly affect the users’ mental health in the workplace, as cognitive overload in the workplace may be connected to burnout [33].

Social isolation: It has been suggested that VR promotes social isolation in specific contexts that are not related to the work environment [34], as well as in vulnerable groups as children and adolescents [35]. Despite ongoing discussions about the connection between different types of computer technology and social isolation over recent decades [36], conclusive evidence remains elusive. The long-term implications of isolation experienced in virtual reality have not been thoroughly examined in professional settings. Given the potential mental health effects, further research is needed, particularly in workplace environments where individuals engage with VR technology extensively.

Distorted reality perception: Few studies have explored how extended use of XR technologies can affect how reality is perceived. Some research has shown that temporary distortions perception can be induced in healthy individuals [16]. Others have proposed that VR excessive use may also be linked to losing touch with reality and a distorted sense of time [37, 38]. This type of side effects derived from the use of Metaverse technologies can affect users in the workplaces, and may contribute in increasing existing OSH risks. It is unclear whether the ability of these technologies to distort reality may affect workers’ long-term psychological well-being.

Anxiety and depression: Although XR technologies have been employed to treat anxiety [39], certain aspects of VR use that may induce anxiety are particularly troubling. Recent studies have underscored the potential mental health challenges linked to using XR technologies in the workplace [16]. In a recent study directly studying the use of head mounted displays (HMDs) in work environment [40], participants worked for 40 hours in a virtual reality (VR) environment and another 40 hours in a traditional office setting. The findings revealed that working in VR resulted in heightened levels of frustration and anxiety. Depression has been reported in case of extensive use of digital media [41, 42]. Some researchers [43] have highlighted potential negative impacts of Metaverse technologies on mental conditions such as depression, anxiety, addiction, self-harm, suicidality, and anorexia, particularly among vulnerable groups like children. However, comprehensive studies on these negative effects in the work settings are still insufficient to draw definitive conclusions.

Addiction: Metaverse technologies may provide recurring rewarding experiences that can lead to addiction-like behaviors [30]. This phenomenon is recognized in the context of gaming disorders [44]. Defined by ongoing or repetitive gaming behavior, gaming disorder is characterized by a loss of control over gaming, prioritizing gaming over other activities and interests, and continuing to game despite negative consequences. A meta-analysis work [45] estimates the global prevalence of gaming disorders to be between 2% and 3%, primarily involving internet-based gaming. In the context of the Metaverse, the use of immersive technologies extends the range of daily activities that can be digitized, potentially leading to increased engagement in virtual worlds and more significant disruptions to everyday functioning, as discussed [30]. Research indicates that compulsive use of VR technology affects between 2% and 20% of its users, highlighting the potentially addictive characteristics of these immersive technologies [45]. Additionally, other studies have emphasized the risk of addiction associated with the Metaverse [46]. As the Metaverse is combined into workplace environments, it remains unclear whether addiction phenomena, typically associated with gaming, might also affect users of Metaverse technologies in professional settings, or if the extensive use of these digital technologies in the workplace can translate to unhealthy usage of these technologies in the private sphere. This matter is particularly relevant as these technologies may be used extensively over long periods in the workplace. However, These concerns have yet to be directly tested in experimental settings within workplaces, and evidence from other fields highlights the need for future OSH evaluations to consider the potential adverse effects arising from prolonged use of XR technologies in work environments.

Acute Stress: Incorporating Metaverse technologies into workplace environments introduces a range of stress-related challenges. The metaverse is recognized as an expansive and intricate source of information that has the potential to overwhelm its users [47], and users that are not used to handle the overflow of information from the digital space may experience negative cognitive effect [48]. It has been found that carrying VR meetings may increase stress more than traditional non-immersive meetings [49, 50]. Furthermore, audience feedback in VR has been found to influence stress levels [51]. Therefore, it appears that VR may intensify stress during meetings that involve presentations. However, evidence that XR

technologies actually provoking acute stress in the workplaces is currently limited [9].

Techno-stress: The phenomenon of techno-stress is not exclusive for the Metaverse technologies, and it has been previously assessed as in the case of the introduction of other technologies in the work environment [52, 53]. This stress arises from the challenges users face while engaging with technological tools [54]. This type of stress is generally linked to challenges in using new technologies [55]. This form of stress, particularly techno-complexity, stems from the perceived complexity of ICTs that can make employees feel under-skilled, leading to symptoms like irritability and exhaustion [54, 56]. According to previous research [55], there are five main contributors to techno-stress, with a significant focus on techno-complexity. This term describes the complexity inherent in an ICT that may overwhelm employees, making them feel their computing abilities are insufficient. Symptoms of this stress include decreased focus, irritability, memory issues, and fatigue. Considering the novelty of Metaverse technologies for many employees, it is plausible to assume that it may contribute to techno-complexity related stress, requiring an adaptation to this new technology [56]. While XR may replace some existing technologies, it could also contribute to techno-overload, as it involves managing multiple, simultaneous information streams that increase work pace and volume [57]. Given the novel and demanding nature of VR, it is expected to impose significant psychological and physiological burdens on users [57, 58]. Despite its implications, VR is often overlooked in discussions about techno-stress [9, 59]. A future transition to virtual offices might contribute to worsen techno-stress [60], potentially undermining worker well-being [61].

Surveillance: The ability of XR technologies to provide a high level of immersion as well as stimulate sense of presence in the users [62], together with the complex capability of providing a digital networks within the Metaverse, raise significant ethical and legal challenges, including concerns about user privacy, data security, content moderation, and the possibility of information misuse [63, 64]. The collection of personal data by the XR devices, as biometric information, videos, photos, and audio, opens possibilities for the employee to be continuously monitored while using the equipment. Digital footprints [65], once captured, are susceptible to misuse, such as identity theft or unauthorized surveillance Research has consistently highlighted public unease concerning the potential for non-consensual recording while using XR [66]. Additionally, the threat to privacy is not confined to direct users alone but also extends to bystanders who could inadvertently be subjected to non-consensual recording and therefore breaches of privacy [67]. These privacy and security issues carry further implications for psychological well-being of the users in the workplaces, as well as potential colleagues that are exposed directly to the recording of personal data. This may induce anxiety and stress in the workplace, as monitoring practice in the workplaces are known stressors [68]. Such psychological impact may also lead to increased feelings of vulnerability and loss of control, further complicating the users' experience in these digital realms.

Cyberbullying: The evolution towards more realistic virtual environments creates the possibility for the users to interact in ways that are not possible in traditional digital media. Cyberbullying,

as identified by previous research as a pivotal risk in the metaverse [69], and bullying has been reported in users of metaverse technologies [70]. This type of bullying can manifest in several ways, from simulating physical attacks through digital avatars to different forms of harassment, all of which can have profound psychological effects on the victims [71]. The reported incidence of avatar harassment and virtual crimes [72] presents concerns for the safety of the users. Furthermore, research shows that people may adjust their behaviors in the virtual worlds according to their avatar's appearance [16, 73]. The phenomenon has been found to be more prominent in immersive media compared to 2D [74]. This could intensify instances of cyberbullying in virtual reality, making certain avatars more susceptible to bullying and fostering discrimination in the workplace.

Other: There are numerous additional ill effects potentially related to the utilization of XR technologies. These are, compared to psychological negative consequences, more widely discussed in the literature, and are for example: cybersickness, visual fatigue, and muscular issues [9, 75], as well as other criticalities of the metaverse regarding ethical [76], and legal [63] challenges, may indirectly affect users' psychological health and increase stress. In an OSH perspective, these additional hazards may generally worsen the quality of the workplaces.

4 DISCUSSION

The present article showed that the scientific literature has been exploring potential psychological ill effects of the use of Metaverse technologies, with some recent systematic efforts to individuate them [29, 77]. The direct impact of these risks on the use of Metaverse technologies in occupational settings, has only recently started to be comprehensively discussed [16]. In the integration of Metaverse technologies into workplace settings, a significant concern arises from the cognitive overload that these technologies may impose on users. This overload, primarily due to the necessity to adapt traditional tasks to XR environments, can significantly burden an individual's working memory and mental effort. The published research, however, shows heterogeneous findings. Furthermore, the potential negative impact of cognitive load may be task-specific, and it may be highly related to individual user factors, and cognitive ergonomic factors of the specific Metaverse technology analyzed [9, 10]. Therefore, it is important to design VR interfaces that are intuitive and user-friendly, and to provide adequate training to enhance user expertise in navigating these environments efficiently.

An increased tendency to social isolation has been sometimes connected to the use of new technologies such as social media and has been suggested to be important in the case of VR usage [34, 35]. However, there are no findings regarding the possibility of these technologies in work settings. The distortion of reality that XR technologies can induce in the users can lead to perceptual anomalies where users may experience a distorted sense of time and reality [37, 38]. Such distortions, while temporary, could have long-lasting psychological implications on an individual's ability to discern between virtual and actual realities, potentially increasing OSH risks. These temporary perceptual changes require more

research to understand the long-term effects of these distortions on psychological well-being and workplace safety.

The use of HMDs for extended periods has highlighted these effects, suggesting that the immersive nature of such technologies can significantly heighten emotional responses compared to traditional office settings. Moreover, the addictive potential of these immersive experiences cannot be overlooked. The characteristics of Metaverse environments that offer rewarding experiences may foster addiction-like behaviors [30], akin to those observed in gaming. The potential future extended use of such technologies in the workplace, where they might be employed continuously over long periods, raises concerns about the potential to prime the users to a habitual and possible compulsive use of these technologies, that may expand also outside the work settings.

Incorporating Metaverse technologies into workplace environments presents a spectrum of psychological stressors that need careful management to maintain employee well-being. The complexity and immersive nature of these technologies, as they deliver vast amounts of information, can overwhelm users, potentially leading to acute stress [9]. Some studies have argued that VR meetings can heighten stress more than traditional settings [49, 50], emphasizing the need for organizational strategies to moderate the unique pressures introduced by virtual environments. Techno-stress also emerges as a significant concern, where the introduction of new, complex technologies can make employees feel under-skilled and overwhelmed [54]. This form of stress is particularly pertinent as Metaverse technologies integrate multiple streams of information that require users to multitask extensively, which can exacerbate stress levels and reduce job performance [57]. Thus, providing adequate training and resources to help employees adapt to these new tools is crucial, to avoid that the introduced stressors may increase susceptibility to existing OSH risks.

The level of user surveillance permitted with Metaverse technologies also has important implications in the sphere of psychological health. The continuous collection and potential misuse of detailed biometric and behavioral data can increase feelings of vulnerability and anxiety among employees [63, 66]. Ensuring robust data protection measures and transparent communication about data use are essential to mitigate these concerns. Additionally, the realism facilitated by Metaverse technologies can lead users to experience cyberbullying, as virtual interactions might embolden harmful behaviors. This is partly due to the anonymity and various embodiment options that avatars provide, which may encourage negative interactions that may not occur in face-to-face settings [69].

The presented results suggest that addressing the psychological impacts of integrating Metaverse technologies in organizational settings is crucial for the future of the workplaces, where the use of Metaverse technologies will likely increase in the future. Despite growing concerns about the psychological health of workers due to the integration of Metaverse technologies, the current empirical evidence on potential negative psychological effects remains limited. Consequently, there is a need for more empirical research in this area to better understand these impacts.

To mitigate these potential psychological negative effects deriving from the use of Metaverse technologies at work, may be

important to introduce comprehensive training sessions that gradually familiarize employees with VR technologies, especially in the earlier stages of adoption. This approach can help minimize cognitive overload and reduce anxiety associated with adapting to new technological environments. Additionally, ensuring that VR interfaces and tasks are ergonomically designed is crucial to reduce both physical and mental strain. Implementing mandatory breaks from virtual experiences can also prevent prolonged exposure, which may otherwise lead to cognitive fatigue and stress.

Developing clear guidelines for VR use in the workplace is furthermore relevant. These should include limits on daily exposure to prevent gaming-like addiction phenomena and discourage behaviors that lead to cyberbullying or social isolation. Employers should strengthen privacy measures to protect user data and prevent unauthorized surveillance. A clear communication of privacy rights and transparent policies regarding collection and retention of personal data could reduce negative feelings related to privacy breaches as well as enhancing trust in the technology.

It is pivotal to listen to employee input in the process of integrating Metaverse technologies in the workplaces. By involving workers in the decision-making process, organizations can increase the acceptability and trust of the technology and potentially reduce negative psychological effects. This inclusive approach also ensures that the integration of new technologies aligns with the practical needs of the employees.

Finally, conducting recurring assessments of the psychological impact of VR technologies on employees and utilizing feedback to refine practices may mitigate potential arising psychological issues. This will ensure the psychological well-being of the workforce as they navigate this advanced technological landscape.

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