Virtual Reality (2026) 30:56
https://doi.org/10.1007/s10055-026-01314-5

ORIGINAL ARTICLE

Virtual return to work scenarios as emotional exposure tools: evidence from a non-clinical sample

Stéphanie Delroisse[1] · Moïra Mikolajczak[1] · Aurélie Wagener[2]

Received: 9 October 2024 / Accepted: 7 January 2026

Abstract
Return to work (RTW) after sick leave is often associated with anxiety in workers. Based on cognitive and behavioural therapy (CBT), Work-focused cognitive behavioural therapy (W-CBT) includes gradual RTW (i.e., partial work resumption) to overcome anxiety and facilitate RTW. In particular, learning to cope with RTW-related difficulties while enhancing self-efficacy is essential when resuming work. Using virtual reality (VR) to simulate RTW situations is promising, as it offers greater control and security than real-life situations. This study investigates the potential of virtual work environments simulating RTW to elicit relevant emotional reactions, enhance the sense of presence, and maintain low levels of cybersickness, in view of their use as exposure tools in a non-clinical population. Seventy workers were first immersed in a "quiet desk" (i.e., control environment) and then in work environments. They completed self-assessments of emotional comfort, negative emotions (i.e., anxiety, discouragement, anger, and guilt), state somatic and cognitive anxiety, sense of presence, and cybersickness. Results revealed that the work environments elicited anxiety and reduced emotional comfort, while demonstrating good immersive properties, as reflected by high levels of presence and low levels of cybersickness. The present study provides evidence supporting the use of virtual work environments as exposure tools in W-CBT.

Keywords Return to work · Virtual reality · Work-focused cognitive behavioural therapy · Emotional exposure

1 Introduction

Long-term sick leave can be due to several causes including mental disorders such as adjustment disorders (including stress-related disorders), depression and anxiety (Brämberg et al. 2024). At some point, these workers will consider returning to work which could be quite challenging. For workers on long-term absence, return to work (RTW) could be associated with anxiety and stress (for reviews, see Figueredo et al. 2020; Gragnano et al. 2018). RTW is defined as a multidimensional process of a returning worker in the workforce after a sick leave, shaped by psychosocial factors – such as RTW expectations and job strain – and broader systemic influences, including healthcare and workplace structures (Gragnano et al. 2021; Schultz et al. 2016). RTW can be facilitated by the development of key psychological factors such as self-efficacy (Cancelliere et al. 2016; Etuknwa et al. 2019; Gragnano et al. 2021; Volker et al. 2015). RTW self-efficacy is the individual's belief in his or her ability to cope with the job demands and the obstacles he or she is likely to encounter during the RTW process. The more workers show high self-efficacy, the greater the likelihood of resuming to work (Gragnano et al. 2018; Saint-Arnaud et al. 2003; Selander et al. 2015; Volker et al. 2015) whereas poor self-efficacy during recovery for some individuals prevents effective RTW (Bostjanvic and Karacin 2014; Saint-Arnaud et al. 2003).

To improve RTW, cognitive and behavioral therapy (CBT) has shown evidence of effectiveness as a workplace intervention for common mental health disorders including stress and burnout (for a review, see Joyce et al. 2016). Recently, based on their systematic review, Slater et al. (2023) have proposed a distinction between traditional CBT and Work Focused Cognitive Behavioural Therapy (W-CBT). Traditional CBT aims at detecting dysfunctional

✉ Stéphanie Delroisse
stephanie.delroisse@uclouvain.be

[1] Institute for Research in Psychological Sciences, Université catholique de Louvain, Louvain-la-Neuve, Belgium

[2] Department of Psychology, Research Unit for a life-Course perspective on Health and Education, University of Liège, Liège, Belgium

Published online: 07 February 2026

patterns of thinking and behaving that contribute to psychological distress and change them into more realistic thinking habits and adaptive coping strategies (Hoffmann et al. 2012). In CBT, techniques such as in vivo exposure are frequently employed to facilitate cognitive and behavioral changes, fostering resilience and promoting psychological well-being (Knowles and Tolin 2022; Pinto et al. 2024). Exposure is defined as a procedure that gradually confronts the person with a stimulus that generates an undesirable emotional or behavioral response (Marshall 1985). Gradual exposure allows the individual to confront his/her fear in a controlled manner, providing opportunities for corrective learning experiences and the acquisition of new, less anxiety-provoking associations (Craske et al. 2008). Concerning W-CBT, specific components are *"work related goal setting*, *work related psychoeducation*, *work-related behavioural activation with a gradual return to work plan*, *work related problem solving*, *work-related cognitive therapy and homework*" (Slater et al. 2023, p. 21). In W-CBT, particular emphasis is placed on gradual workplace exposure as facilitating RTW. W-CBT has shown positive effects on RTW (for reviews, see Brämberg et al. 2024; Slater et al. 2023).

The fear of returning to work pushes some individuals to leave their jobs to avoid relapse, whereas a gradual and supported RTW is reassuring and associated with less anxiety (Saint-Arnaud et al. 2006). Indeed, returning to part-time work as an intermediate level of exposure before returning to full-time work is already challenging for the worker after a long-term absence. Typically, work factors such as high demands, job strain, low control, little support from colleagues or employer can be part of the re-entry experience and jeopardize the RTW process (de Vries et al. 2014, 2018; Pélissier et al. 2014; Saint-Arnaud et al. 2006; Villotti et al. 2024). In their meta-synthesis of qualitative research, Andersen et al. (2012, p. 97) have highlighted for some workers the difficulty "*to protect themselves from exceeding their work capacity after resuming work as it was hard for them to set limits in demanding situations at work even though they considered this an important coping strategy for RTW*". Then, learning to cope with RTW difficulties while enhancing self-efficacy is essential when returning to work, even on a part-time basis. In this perspective, using virtual reality to expose individuals to RTW situations is promising since one of the advantages of virtual reality compared to real-life situations, that is it greater control and security over the exposure situations.

Virtual reality (VR) is a computer technology that represents an immersive artificial environment which requires devices such as special headsets to immerse users in three-dimensional virtual worlds (Emmelkamp and Meyerbröker 2021). In psychology, virtual reality exposure therapy (VRET) uses immersive virtual environments to simulate anxiety-provoking scenarios. By replicating real-world situations, VR enables therapists to create tailored and customizable exposure scenarios that closely resemble the specific triggers of anxiety (Ma et al. 2021; Parsons and Rizzo 2008). VR has been shown to be effective in the treatment of cognitive, psychological, motor and functional impairments for psychiatric disorders (for a meta-review of meta-analyses, see Dellazizzo et al. 2020) in a wide range of clinical conditions including emotion regulation (for reviews, see Colombo et al. 2021; Montana et al. 2020), anxiety (for a meta-analysis, see Carl et al. 2019 and for a systematic review of reviews, see Cieslik et al., 2020) and depressive disorders (for a meta-analysis, see Fodor et al. 2018). For anxiety and related disorders, meta-analyses have shown large effect sizes for VRET compared to control or waiting list and no significant difference between VRET and in vivo exposure (Carl et al. 2019; Powers and Emmelkamp 2008).

VRET offers the possibility of creating simulated environments that promote the cognitive, emotional, and sensorimotor processing of stimuli that are not easily controlled in the physical world (Rizzo and Koening 2017). Compared to in vivo exposure, VR exposure shows multiple advantages. First, it allows the therapist to have more control over the environment (Bouchard and Paquette 2023; Côté and Bouchard 2008; Ma & al. 2021; Maples-Keller et al. 2017): while some unpredicted events can happen in real-life situations (e.g., a broken-down subway during exposure to public transports), therapists can control these events in VR through a better graduation of patients' exposures by selecting low stress events (e.g., a slowing subway) to very stressful events (e.g., lights out in the subway). Second, it allows repeated exposure as often as the patient needs, at their own pace (Côté and Bouchard 2008; Ma et al. 2021). Third, VR reduces out-of-office travel costs for exposure situations (e.g., transportation costs) and it offers security and confidentiality to be practiced in the therapy office (Bouchard and Paquette 2023té & Bouchard, 2008; Maples-Keller et al. 2017). Fourth, being immersed in a virtual environment favors experiencing a situation with one's own eyes which overcomes the problem of visualization and mental imagery skills that can arise in traditional settings (Colombo et al. 2021). Fifth, an additional advantage of VRET concerns the acquired skills transferable to the individual's everyday life (Fox et al. 2009) and the generalization of the treatment effects measured with behavioral real-life activities (for a meta-analysis, see Morina et al. 2015). Finally, with the use of VR to treat their disorders, participants report satisfaction, and some patients even consider VR as more acceptable (Garcia-Palacios et al. 2007; Maples-Keller et al. 2017) and more attractive (Guillén et al. 2018) than traditional treatments. Some patients report that it is easier to confront their fears for the first time in VR than in real situations and

they consider VR as less aversive (for a review, see Botella et al. 2015).

VR exposure also has certain limitations for both therapists and patients. Among clinicians, one fear involves the potential impact on the therapeutic alliance due to the lack of eye contact during VR exposure. However, research has not shown any deterioration in the alliance or negative effects (e.g., increased anxiety) following VR treatments (see Emmelkamp and Meyerbröker 2021 for review). Another concern is that patients might drop out of VR therapy because they perceive it as unrealistic or disconnected from real-life situations. Yet, dropout rates appear similar between VR exposure and in vivo exposure (see Benbow and Anderson 2019 for meta-analysis). An important limitation for clinicians is the economic cost of VR tools: although many VR programs exist for treating various mental disorders, their acquisition can be expensive for independent practitioners. Additionally, implementing VR in a clinical setting requires specific training and technical skills for installing and using the equipment (e.g., computer, headset), which takes time and effort – even though VR applications are becoming increasingly user-friendly (Bell et al. 2024; Côté and Bouchard 2008). For patients, VR may cause symptoms like nausea, dizziness, or headaches – known as *cybersickness* – which typically subside shortly after the VR session (Côté and Bouchard 2008; Lavoie et al. 2021). Improvements in both software and hardware have reduced these symptoms over time (Bell et al. 2024). However, intense emotional reactions during VR exposure can persist after the session and may lead to rumination (Lavoie et al. 2021). Therefore, therapists need to pay attention to patients' emotional experiences during VR and discuss any potential lingering effects (Bell et al. 2024).

In short, W-CBT is an effective psychological approach to support RTW, addressing the cognitive and emotional barriers that may hinder reintegration. Consistent with graded activity CBT principles, gradual work resumption enables individuals to develop and strengthen coping skills in response to work-related stressors within the actual work setting, and VRET can be an effective complement to in vivo exposure to occupational situations in preparation for RTW. The aim of the present study is to validate virtual work environments as a tool for return-to-work exposure. To create an efficient new virtual environment, it is essential to consider its immersive properties, that is to limit cybersickness and induce a sense of presence (Della Libera et al. 2023). Cybersickness can be assimilated to motion sickness. Indeed, immersed users in VR may experience abdominal symptoms and oculomotor problems (Simón-Vicente et al. 2024). The sense of presence allows users to become more deeply immersed and engaged in the virtual environment. Research by Slater (2009) emphasizes that a heightened sense of presence – where users feel as if they are truly in the virtual space – leads to more convincing and impactful experiences. Additionally, Biocca et al. (2003) argued that the perceived realism and interaction within VR environments are crucial for achieving this deep sense of presence, ultimately making the technology more effective for various applications, from training simulations to therapeutic interventions. Overall, four dimensions—often referred to as "illusions"—of the sense of presence have been identified (Biocca et al. 2003; Felnhofer et al. 2019; Slater 2009): (1) place illusion, which is the sensation of actually being in the environment; (2) plausibility illusion, or the perception that the scenario is genuinely occurring; (3) copresence illusion, which refers to the feeling of sharing the space with other characters even though they are not seen; and (4) social presence illusion, the sense of a psychological connection between oneself and the other characters. Beside the technological characteristics of the virtual environments to increase users' sense of presence, elicit emotions is another key factor (for a review, see Diemer et al. 2015). Actually, since VR techniques use similar principles to gradual in vivo exposure and since virtual learnings must be transferred in real life, efficient virtual environments have to induce distress in patients (Dellazizzo et al. 2020).

We have created four work virtual environments: a neutral environment represented by a "quiet desk" used as a familiarization immersion and three work environments (i.e., an open space, a meeting room and working from home) that typically simulate RTW situations such as interactions with supervisor and colleagues, answering questions about sick leave, negotiating accommodations, responding to criticism, setting one's own limits. The aim of the present study was to examine whether a set of three virtual environments could effectively be used as tools for return-to-work (RTW) exposure. More specifically, we investigated their ability to elicit relevant emotional responses, foster a strong sense of presence, and minimize cybersickness. These characteristics are essential for ensuring the environments are suitable for therapeutic use. Emotional induction was assessed along five dimensions (emotional comfort, anxiety, discouragement, anger, guilt), with a particular focus on comparing each environment to a neutral control condition. This evaluation in a non-clinical sample represents a necessary step before these environments can be ethically and effectively used in clinical interventions targeting RTW-related difficulties. First, we hypothesized that these virtual work environments should elicit more negative emotions such as anxiety, anger, discouragement and guilt in workers, compared with a control environment (i.e., familiarization immersion environment). Second, the environments were assessed for their immersive properties to ensure that they allow a strong sense of presence and do not

elicit cybersickness. Our conceptualization of presence was guided by four key "illusions" particularly relevant to the return-to-work (RTW) context. Place illusion was critical to recreate the feeling of being physically back at work, allowing participants to meaningfully re-engage with familiar stimuli. Plausibility illusion ensured that scenarios involving managers and colleagues were perceived as credible, as their usefulness for training or exposure relies on users perceiving them as realistic and relevant to their own professional experiences. Finally, copresence *and* social presence addressed the relational dimension of RTW, where reconnecting with others is often central to successful reintegration. To ensure that observed effects were attributable to the manipulated virtual environments, rather than individual predispositions or prior stress levels, we included immersive tendencies and work-related stress as covariates in our analyses.

Table 1 Descriptive statistics

	N (%)	Mean (SD)	Min-Max
Age		38.90 (11.24)	23–64
Gender (M/F)	35/34		
Professional status			
Employees/ public officials	64 (92.8%)		
Self-employed	3 (4.3%)		
Manual workers	1 (1.4%)		
Unemployed	1 (1.4%)		
Activity sectors			
Public administration	12 (17.4%)		
Banking/Finance/Insurance	25 (36.2%)		
Commerce/Distribution	6 (8.7%)		
Communication/Multimedia	1 (1.4%)		
Construction/ Real estate	1 (1.4%)		
Law/Justice	2 (2.9%)		
Education/Training	1 (1.4%)		
Consultancy	1 (1.4%)		
Industry	2 (2.9%)		
IT/Telecommunications	2 (2.9%)		
Fashion/Textiles	1 (1.4%)		
Human Resources	4 (5.8%)		
Business services	1 (1.4%)		
Social services	1 (1.4%)		
Health care	7 (10.1%)		
Transport/Logistics	2 (2.9%)		
Virtual experience (Yes/No)	36/33		
MSP-9		29.42 (8.53)	15–52
ITQ		57.12 (11.31)	29–82
Focus		21.20 (4.09)	10–31
Involvement		15.80 (3.99)	10–26
Emotion		13.16 (4.29)	4–22
Game		6.96 (3.95)	3–20

2 Method

2.1 Participants

Seventy participants took part in the study (Table 1) and one female participant withdrew from the study, asking to stop the experiment during the open-space environment, as "it brings back too many memories", leaving a total of 69 participants. A minimum of 59 participants was required based on a priori power analysis performed using G*Power 3.1. (Faul et al. 2009) with alpha threshold of 0.05, power of 0.95 and the intermediate effects size of 0.25 for repeated measures with immersive tendencies and work stress as covariables.

Participants were recruited through social networks (including Facebook groups, LinkedIn pages, etc.) and via word of mouth between April and June 2024. The study was presented to the participants as the validation of virtual work environments as training tools for professional situations likely to be experienced by people on sick leave when they return to work. To be included in the study, participants were French speaking, as the VR scenarios were in French. Being on sick leave was an exclusion criterion. Also, having eye disease, brain injury or recent concussion with loss of consciousness, photosensitive epilepsy, severe migraines, heart disease, vestibular problems, balance disorders, as well as severe motion sickness (i.e. people reporting constant nausea and/or vomiting in at least two transport situations) were exclusion criteria.

2.2 Immersive environments

2.2.1 Technical information

The VR stimuli were developed based on two main sources. First, they were informed by events reported by patients on sick leave, drawn from the first author's clinical experience. Second, they were shaped by factors identified in the scientific literature as facilitating or hindering return to work. For example, importance of social support from supervisors including expressions of empathy and understanding has been highlighted in various studies (see Corbière et al. 2020 for a scoping review; Kärkkäinen et al. 2018; Lysaght and Larmour-Trode 2008). In practical terms, in one of the scenarios, this was reflected by a supervisor avatar expressing his support participants by saying: *"I imagine you're feeling stressed today, but know that it's completely normal, and I'm here to support you as you return to work."*

The virtual characters were animated without motion capture using Unreal Engine 5 combined with a customized avatar control system built on existing Unreal Engine animation frameworks. This system allowed real-time,

action-based control of avatars, enabling the generation of body animations, behaviors, and speech without manual keyframing. Avatar behaviors – such as walking, gesturing, or reacting—were driven by scripted automation and animation blueprints within Unreal, which are triggered contextually to reduce repetitive animation work while maintaining coherent and fluid motion. Facial expressions and lip synchronization were handled via automated systems: the avatars used Unreal's facial rigging combined with a proprietary control layer to dynamically map speech and emotional cues. While key expressions were fine-tuned when needed, the majority of both body and facial animation was managed through automation, allowing consistent avatar behavior across different characters and scenarios. The experiment was conducted by two final-year Master's students in psychology trained by the first author, following a rigorous protocol. It was carried out using the standalone Meta Quest 2 headset, connected to a laptop. This setup allowed the experimenter to see on the laptop screen exactly what the participant was viewing through the VR headset. During the experiment, participants were seated on a chair facing a table on which the laptop was placed the laptop. The experimenter stood next to the participant for the entire session, selecting each VR environment in the following fixed order: a "quiet office", an open-space office, a meeting room, and a living room (each environment is described in detail in the next sections). Throughout the VR experience, participants remained seated—either at a desk (in the neutral and open-space environments) or at a large table (in the meeting room and home settings). Their virtual hands mirrored the movement of the controllers, and if they looked down, they could also see a virtual representation of their torso, arms, legs, and feet. Except for the quiet office—where there was no avatar interaction—participants were instructed to respond as spontaneously as possible to the questions posed by the avatars. Each time a question was asked, the scene automatically paused to allow for the participant's response. Once the response was given, the experimenter clicked the "continue" icon to proceed to the next step in the scenario.

2.2.2 Familiarization immersion in the control environment

The "quiet desk" was used to familiarize the participant. This environment represents a calm, professional space in which participants were seated at a desk, looking up at a starry sky. In this environment, participants were asked to pop bubbles with their hands to familiarize themselves with their virtual body (see Fig. 1).

2.2.3 Exposure environments

Virtual exposure scenarios were developed in three work environments simulate common workplace interactions during return-to-work situations: the open space (OS), the meeting room (MR) and a living room as the working from home apartment (WFH). For some scenarios, two or three versions of the dialogue with the avatar were designed to reflect increasing levels of distress, in line with principles of graded exposure therapy. One version is called "Facilitating interaction" in which the avatar (a colleague or the manager) adopts a supportive and empathetic stance, expressing genuine concern and positive regard for the returning employee. This version aims to provide a psychologically safe exposure to social interaction at work. We labelled the next version "Pressuring interaction" in which the avatar expresses a seemingly polite attitude but emphasizes pragmatic concerns (e.g., staff shortages, workload). This interaction may be perceived as subtly pressuring or emotionally distant, introducing moderate social stress. Finally, the last version is a "Threatening interaction" in which the avatar displays overtly negative behaviors, such as blaming the

Fig. 1 Screenshot from the quiet desk

person for his/her absence, expressing resentment. This version represents a confrontational interaction.

In the OS (see Fig. 2), participants were initially alone, and they were asked to read work-related e-mails from the manager, colleagues, clients and the company (e.g., invitations to meetings, tasks to do) in both Pressuring version and Threatening version (see Table 2). Then, they were joined by colleagues, four of whom interacted with them: colleague 1 who just said hello, colleague 2 suggested a coffee later because she is too busy, colleague 3 discussed about the workload and the worker's absence in three different ways (see Table 2) and colleague 4 asked for participants health status.

In the MR (see Fig. 3), participants sat at a large table, initially alone, reading posters on the wall (e.g., customers first, work hard). They were then joined by the manager, with whom they discussed various points regarding return to work: (1) how they felt on the first day in welcome back discussion (see Table 2 for the different versions); (2) the causes of sick leave and what helped recovery; (3) tasks adjustments (see Table 2 for the different versions); (4) autonomy in task management (see Table 2 for the different versions); (5) the participant's expectations of the manager regarding his/her attitude during his/her absence, the tasks he/she wants to do when he/she resumes work, what he/she can do to avoid a relapse, what he can contribute to his/her career development; and (5) feedback after one week days' work (see Table 2 for the different versions). After this one-on-one meeting, they were joined by colleagues, to whom the manager explained the distribution of tasks. During the team meeting, colleagues adopt three different reactions: one colleague shows supportive reaction, another asks for more information before taking a position, and the last one shows his dissatisfaction.

Finally, in the WFH environment, participants sat at a dining table overlooking the apartment, with a tablet and phone in front of them. They received a series of calls from one colleague, a RH employee, the manager concerning their upcoming RTW (see Fig. 4). Then they read a summary of a previous meeting, while being interrupted by various calls from the private area (e.g., a friend, a deliverer, a neighbor) and they took part in two online meetings, one with the team to present himself/ herself and one with the manager to discuss the work from home arrangement (see Table 2 for the different versions).

2.3 Measures

Socio-demographic and work-related information. Participants were asked to provide the following information: age, gender, socio-professional status (e.g., employee), vocational sector (e.g., sales, education, health), occupation and having experience of virtual reality before (yes-no).

Immersive tendencies were measured by *The Immersive Tendencies Questionnaire* (ITQ; Witmer and Singer 1998) which assesses one's tendency to shut out external distractions to focus on different tasks in daily life. The French version (Robillard et al. 2002) contains 18 items where participants rate their level of agreement on a 7-point scale ranging from 1 "never" to 7 "often". Four dimensions are derived: focus (i.e., the tendency to maintain focus on current activities), involvement (i.e., the tendency to become involved in activities), emotion (i.e., the ease of feeling intense emotions evoked by the activity), and game (i.e., the tendency to play video games). Responses to the 18 items were added to obtain a measure of total immersive tendencies.

State of stress at work was assessed by the short version (MSP-9) of Mesure de Stress Psychologique (Lemyre and Tessier 2003). The scale is composed of symptom-descriptors covering affective (e.g., "I feel preoccupied, tormented or anxious"), cognitive (e.g., "I don't know where I'm at,

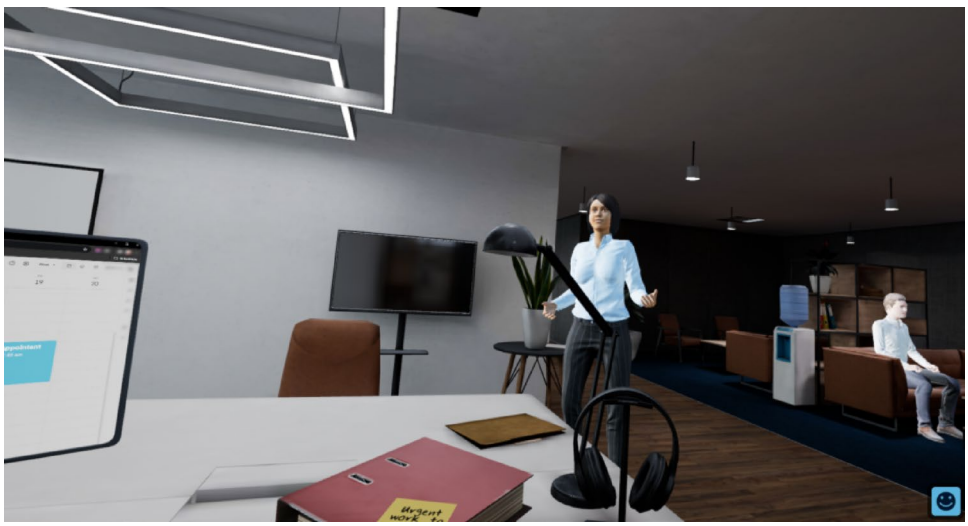

Fig. 2 Screenshot from the open space

Table 2 Dialogue description for facilitating, pressuring and threatening versions

Open space - alone	Pressuring version: A customer who wants to know whether he can continue to deal with the replacement colleagues or the participant and asks to postpone the meeting scheduled for the following day
	Threatening version: A customer expressing dissatisfaction with working with colleagues during the participant's absence and asking to see him/her in a meeting the following day.
Open space - colleagues	*Facilitating version*: The colleague 3 expresses warmth, care, and emotional support, emphasizing that the person was missed and that their wellbeing matters *Pressuring version*: The colleague 3 acknowledges the person's return mainly in terms of workload, highlighting practical challenges during their absence while encouraging reintegration *Threatening version*: The colleague 3 conveys frustration and pressure, implying resentment over the absence and expecting the person to compensate now that they're back
MR - alone with the manager	*Welcome back message – Facilitation version*: the manager expresses his support and confidence in the participant *Welcome back message – Pressuring version*: the manager expresses his satisfaction with the return to relieve the workload on the team *Welcome back message – Threatening version*: the manager expresses his reproaches for the absence
	Tasks adjustments – Facilitating version: The manager emphasizes a supportive and gradual return-to-work process, proposing a collaborative discussion to adjust tasks and avoid overload, with flexibility over time *Tasks adjustments – Pressuring version*: The manager acknowledges the return but expects a quick recovery, delegating the task distribution to colleagues and stressing the need for the employee to resume full responsibilities soon
	Autonomy in task management – Facilitating version: The manager promotes autonomy and self-paced work while offering ongoing support, encouraging open communication and self-care to ensure a smooth and sustainable return *Autonomy in task management – Pressuring version*: The manager allows some autonomy but emphasizes frequent check-ins and urgency, reflecting a focus on efficiency and performance during a high workload period
	Feedback – Facilitating version: The manager offers supportive feedback, acknowledging the employee's efforts while gently pointing out difficulties and encouraging help-seeking, all within a trusting and caring tone *Feedback – Pressuring version*: The manager provides more critical feedback, emphasizing the need to quickly adapt, manage stress, and increase productivity to keep up with team demands under pressure
WFH	*Working from home arrangement – Facilitating version*: The manager promotes flexibility and trust, encouraging the employee to self-manage their schedule and reach out when needed, with a focus on outcomes rather than control *Working from home arrangement – Pressuring version*: The manager emphasizes structure, constant availability, and accountability during remote work, with regular check-ins and a clear expectation of high productivity

Fig. 3 Screenshot from the meeting room

Fig. 4 Screenshot from the living room (WFH)

I'm not thinking clearly, I lack attention and concentration"), behavioral (e.g., "I feel overwhelmed; I feel I'm running out of time".) and physical (e.g., "I have physical pain: backache, headache, neck pain, bellyaches") domains, all loading on a single underlying factor. We adapted the MSP-9 to work area by asking respondents to indicate the extent to which each statement applied to them in their work over the past month on a Likert scale ranging from 1 "not at all" to 8 "extremely". Responses to the 9 items were added to obtain a measure of work-related stress.

Cybersickness was assessed using the French version of the Simulator Sickness Questionnaire (SSQ; (Bouchard et al. 2011; Kennedy et al. 1993). The SSQ consists of 16 items and starts with the following question "During your virtual reality experience, did you experience any of the following symptoms?". Symptoms are grouped in two subscales that assess nausea (e.g., increased salivation) and oculomotor symptoms (e.g., eye fatigue). Participants replied on a 4-point Likert scale ranging from 0 = "not at all" to 3 = "severely". Scores range from 0 to 24 for each subscale, with higher scores indicating higher levels of cybersickness. SSQ was administrated twice: before the control environment as a baseline and after the immersion in work environments.

Anxiety was measured by the State-Trait Inventory for Cognitive and Somatic Anxiety (STICTA) (Ree et al. 2008). The STICTA distinguishes state (when completing the scale) and trait anxiety (anxiety in general) and divides anxiety into subscales: cognitive anxiety (e.g., concentration difficulties, worries) and somatic anxiety (e.g., palpitations, tense muscles). The state anxiety subscale was selected to compare anxiety before and after the immersions with 10 items measuring cognitive anxiety and 11 items measuring somatic components. Items were rated on a 4-point Likert scale from 1 "Not at all" to 4 "Very much so" with higher scores indicating higher levels of anxiety. STICTA-state was administrated twice: before the control environment as a baseline and after every immersion. Cognitive anxiety items and somatic anxiety items were added separately, leading to 4 scores: cognitive and somatic anxiety before the experiment, and cognitive and somatic anxiety after the experiment.

Level of negative emotions was assessed by the Subjective Unit of Disturbance Scale (SUDS) for emotional comfort (SUDS-comfort), anxiety (SUDS-Anx), discouragement (SUDS-D), anger (SUDS-Ang) and guilt (SUDS-G). For all SUDS, participants answered with anchor points at 0–1 "Not at all", 2–3 "A little"; 4–6 "Moderately"; 7–8 "A lot", and 9–10 "Totally".

Presence was assessed using the Four Presence Dimensions which consist of 16-item questionnaire in French (Simon and Wagener, in preparation). The four dimensions include "place illusion" (i.e., the sense of being in the place); "plausibility illusion" (i.e., the feeling that the scenario is actually taking place); "copresence illusion" (i.e., the sense of sharing the environment with other characters); and "social presence illusion" (i.e., the feeling that a psychological link exists between oneself and the other characters). Participants replied on a 7-point scale ranging from 1 "totally disagree" to 7 "totally agree". Scores of each dimension range from 4 to 28 with higher scores indicating higher sense of presence.

2.4 Procedure

Before taking part in the study, participants were informed about the research project and the exclusion criteria for VR through verbal information (see Fig. 2). Participants who met the inclusion criteria were invited to participate in the study. Before conducting data collection, participants were provided a consent form, which contained all information about the study. The data collection started after the

participant clicked on the box "*I agree to participate in this study and give permission to use my data for scientific research purposes*".

The experiment was conducted in two phases. First, participants responded via LimeSurvey to the required informed consent for participation, sociodemographic information, the ITQ and MSP-9. Then, participants went to an isolated room to undergo the virtual reality (VR) experience. Before the actual exposure, they completed the STICSA) and the SSQ. The VR experience lasted approximately 50 min, during which participants were exposed to four virtual environments: the control environment (5 min), the OS (15 min), the MR (20 min), and WFH (10 min). After each immersion in an environment, the participant removed the headset and took a break before returning to the next environment and filled out questionnaires.

During the VR experience, SUDS-comfort was administrated 14 times during immersions: 1 time in the control environment, 4 times in the OS, 6 times in the MR and 3 times in the WFH. SUDS-Anx, SUDS-D, SUDS-Ang, and SUDS-G were measured 6 times during the experience: after the control environment, after the OS emails, after the OS with colleagues, after the MR with the manager, after the MR with the whole team, and after WFH. After the VR experience, participants again completed the STICSA, the SSQ, and the presence questionnaire. Figure 5 outlines the procedure and the timing of the various measurements.

The study was approved by the local ethics committee and was conducted following the ethical standard as described in the Declaration of Helsinki (1964).

2.5 Statistical analyses

Analyses were carried out using IBM SPSS Statistics (version 27). The statistical significance threshold considered was 0.05. To begin, to assess emotional comfort by environment (i.e., control environment, OS, MR and WFH), we calculated the mean of the SUDS taken 14 times during the exposure (see above) for our statistical analyses leading to four SUDS-comfort. Then, preliminary analyses were conducted to assess if the assumptions of parametric analyses for the dependent variables (i.e., SUDS-comfort, SUDS-Anx, SUDS-D, SUDS-Ang and SUDS-G) were met. First, the Mauchly's test of sphericity was conducted: results confirmed that the assumption of sphericity was not violated for SUDS-Anx, SUDS-D, SUDS-Ang as the test yielded a non-significant result ($p > .05$), while SUDS-comfort and SUDS-G were violated ($p < .05$). The distribution of standardized residuals was examined with Q-Q plots and confirmed that the residuals followed a normal distribution for all variables, except for the measures taken in the control environment as baseline, which did not show a normal distribution since the majority of participants indicated zero for their level of anxiety, discouragement, anger and guilt, and nine or ten for their level of emotional comfort. These results were expected, given that the participants have not yet been confronted with actual working environments. They have therefore not undergone any transformation.

To analyze our results, we first performed descriptive analyses before the experiment of the various dimensions to assess the psychological profile of our participants. Then, we conducted a repeated measures ANOVAs to compare levels of emotional comfort, anxiety, discouragement, anger and guilt in each environment (i.e., control environment as baseline, OS, MR and WFH) controlling for work-related stress (MSP-9) before exposure and immersive tendencies (ITQ) as covariates. Alpha was set at 0.05.

3 Results

3.1 Immersive tendencies and work stress

Table 1 shows means for all assessed variables before the experiment. In our sample, the total score for immersive tendencies (ranging from 18 to 126) was moderate, and the work stress was low to moderate (ranging from 9 to 52).

3.2 Immersive properties with cybersickness and sense of presence

Regarding the measure of the feeling of presence, 4 items were transcribed with errors in the questionnaire and had to be deleted from the variables. This error was identified during the course of the study, affected 27 participants and was immediately corrected in the questionnaires for subsequent participants. As a result, the feeling of presence was calculated on 12 items (3 items per dimension) for 27 participants and on 16 items (4 items per dimension) for 42 participants. To assess the impact of this error, a Pearson correlation between the scores obtained with 12 items and those with 16 items for each dimension was performed. Place illusion-12 items strongly correlated with place illusion-16 items ($r = .94$, $p < .000$), plausibility-illusion-12 items strongly correlated with plausibility illusion-16 items ($r = .94$, $p < .000$), copresence-12 items strongly correlated with copresence-16 items ($r = .98$, $p < .000$) and social presence-12 items strongly correlated with social presence-16 items ($r = .96$, $p < .000$). Therefore, we replaced the missing items by the mean of the items, as recommended by Rubin et al. (2007).

Table 3. Descriptive statistics for immersive properties (i.e., presence and cybersickness).

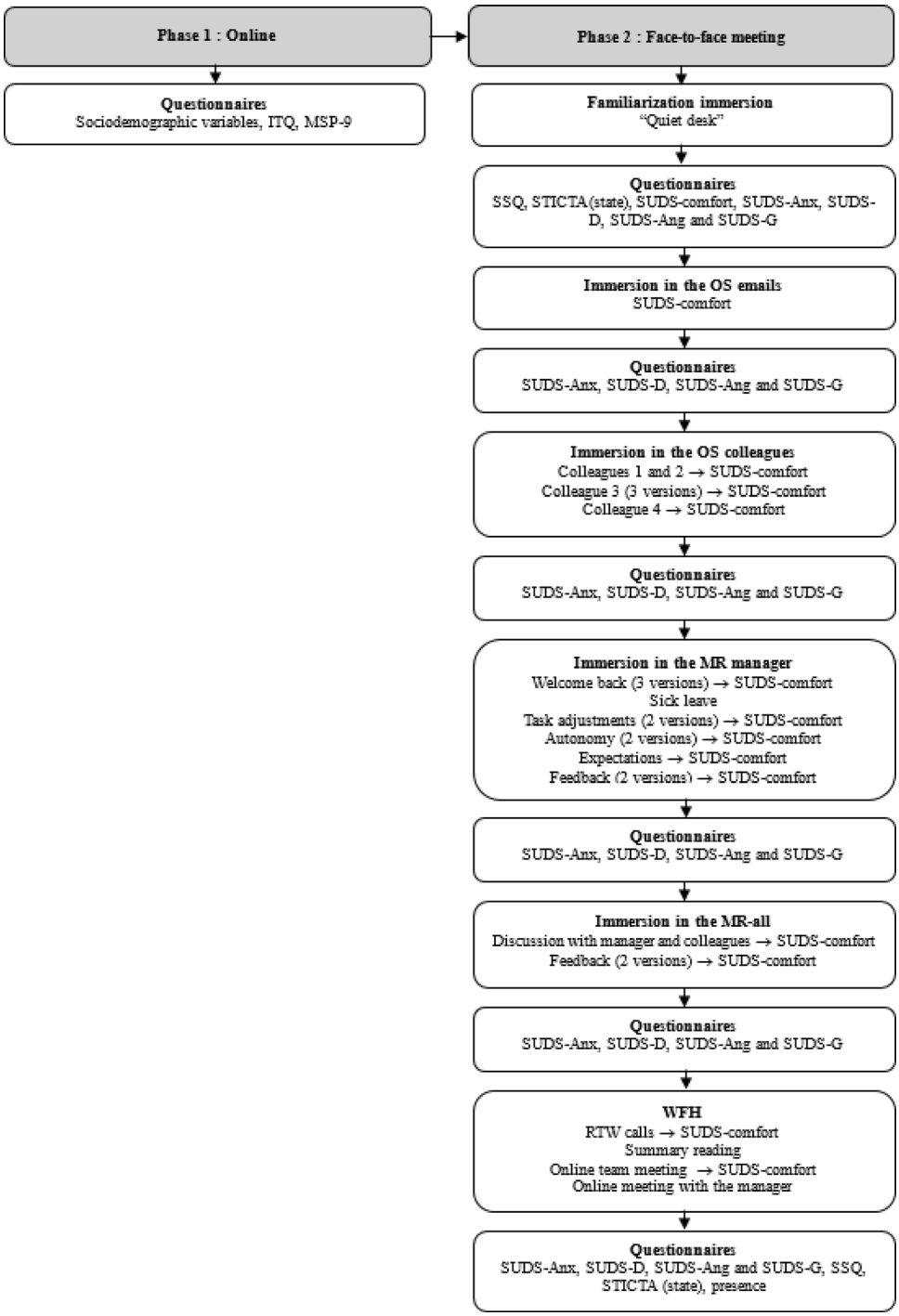

Fig. 5 Flowchart illustration of study design as it was conducted

3.3 Evolution of variables during immersion

First, when controlling for immersive tendencies and work stress, the results showed that emotional comfort differed significantly between environments ($F(68,3)=3.46$, $p=.02$, $\eta^2=0.14$), being higher in the control environment ($X=9.04$; $SD=0.95$) than in the OS ($X=5.28$; $SD=1.50$), the MR ($X=5.05$; $SD=1.43$) and WFH ($X=5.18$; $SD=1.72$). Post hoc comparisons with Bonferroni adjustment revealed a significant difference between the control environment and the OS, the MR-manager and the WFH (see Table 4), and that the environments other than the control on do not differ significantly from one another.

Secondly, concerning each negative emotion (i.e., anxiety, discouragement, anger and guilt), means are presented in table 5. The results show that, when controlling for immersive tendencies and work stress, anxiety differed significantly between the environments ($F(68,5)=2.64$, $p=.03$,

Table 3 Shows scores of presence and cybersickness. Results indicated overall low scores before and after the whole process of immersion, even if nausea increased significantly with exposure ($t(68)$ = -4.71, $p<.001$) as well as oculomotor symptoms ($t(68)$ = -7.61, $p<.001$). Presence showed high scores for all four dimensions

		Pre-immersion Mean (SD)	Post-immersion Mean (SD)
Presence	Place Illusion		19.83 (3.91)
	Plausibility illusion		18.11 (4.52)
	Copresence illusion		18.05 (4.30)
	Social presence illusion		16.95 (4.15)
SSQ	Nausea	0.55 (1.30)	2.46 (3.38)
	Oculomotor	1.75 (2.14)	5.15 (4.13)

Table 4 Bonferroni-Adjusted post hoc comparisons between control and other environments

Outcome	Comparison	Mean Difference	95% CI	*p*-value
Emotional comfort	Control vs. OS	3.76	[3.27, 4.25]	<0.001
	Control vs. MR	3.96	[3.47, 4.52]	<0.001
	Control vs. WFH	3.86	[3.29, 4.43]	<0.001
Anxiety	Control vs. OS-emails	– 4.12	[– 4.99, – 3.25]	<0.001
	Control vs. OS-colleagues	– 4.90	[– 5.75, – 4.05]	<0.001
	Control vs. MR-manager	– 4.89	[– 5.81, – 3.96]	<0.001
	Control vs. MR-all	– 4.64	[– 5.52, – 3.76]	<0.001
	Control vs. WFH	– 4.57	[– 5.46, – 3.68]	<0.001
Anger	Control vs. OS-emails	– 2.26	[– 3.12, – 1.41]	<0.001
	Control vs. OS-colleagues	– 3.04	[– 3.96, – 2.12]	<0.001
	Control vs. MR-manager	– 3.73	[– 4.74, – 2.71]	<0.001
	Control vs. MR-all	– 3.62	[– 4.58, – 2.66]	<0.001
	Control vs. WFH	– 3.30	[– 4.20, – 3.41]	<0.001
	OS-emails vs. MR-manager	– 1.46	[– 2.46, – 0.47]	<0.001
	OS-emails vs. MR-all	– 1.36	[– 2.42, – 0.30]	<0.01
	OS-emails vs. WFH	– 1.04	[– 1.96, – 0.13]	=0.01

p-values are Bonferroni-adjusted. All significant comparisons involve the control environment, except for anger, where OS-emails also differed from MR-manager, MR-all, and WFH. See Table 1 for means in each condition. OS = Open Space; MR = Meeting Room; WFH = Work From Home

$\eta^2 = 0.18$). post hoc comparisons with bonferroni adjustment revealed a significant difference between the control environment and OS-emails, OS-colleagues, MR-manager and WFH (see Table 4). Notably, no significant differences were observed among the other environments. Discouragement did not significantly differ between environments after controlling for immersive tendencies and work stress, $F(5, 68) = 2.16$, $p = .07$, $\eta^2 = 0.15$. As the omnibus test was not statistically significant, no post hoc comparisons were conducted. Anger, when controlling for immersive tendencies and work stress, did not differ significantly between the environments ($F(68,5) = 1.46$, $p = .22$, $\eta^2 = 0.11$). However, we found an effect of the work stress as a covariate on the environments, $F(68,5) = 3.91$, $p = .004$, $\eta^2 = 0.24$. In an exploratory way, we then created two groups based on the median of work stress (28) and we conducted the same analyses, considering work stress as a between-subjects variable with the group of unstressed workers ($n = 34$) and the group of stressed workers ($n = 35$). While controlling for immersive tendencies, results revealed a significant main effect for group ($F(69,1) = 12.13$, $p < .001$) and no significant main effect for the environments ($F(69,5) = 0.55$, $p = .74$. The interaction environments*group was significant ($F(68,5) = 3.38$, $p = .01$, $\eta^2 = 0.21$). As the Fig. 6 shows, the stressed participants felt more anger in all environments than less stressed participants, excepted for the control environment in which both groups felt very low level of anger. Table 4 depicts significant differences between environments using post hoc comparisons with bonferroni adjustment. Guilt, when controlling for immersive tendencies and work stress, did not differ significantly between the environments ($F(68,5) = 0.09$, $p = .99$, $\eta^2 = 0.007$.

Finally, concerning the somatic and cognitive components of anxiety (STICTA), assessed at pre- and post-immersion, the analyses showed that somatic symptoms significantly increased ($t(68) = -4.76$; $p < .001$) between pre ($X = 12.35$; $SD = 2.44$) and post-experiment ($X = 14.75$; $SD = 4.55$), as well as cognitive symptoms ($t(68) = -2.43$; $p = .01$) between pre ($X = 13.25$; $SD = 4.38$) and post-experiment ($X = 14.41$; $SD = 5.96$).

4 Discussion

RTW after sick leave is a real challenge for workers leading some of them to experience anxiety and/or other negative emotions. Indeed, as shown by Pélissier et al. (2014), returning to a previous job was impeded by fear as well as tedious work, being older, prolonged sick leave. Actually, among the 402 workers on sick leave in their study, they highlighted that the idea of returning to work generated fear in one third, indifference in another third and enthusiasm

Table 5 Mean and standard deviation for negative emotions in control environment, OS, MR and WFH

	Control Env.	OS emails	OS colleagues	MR manager	MR-all	WFH
SUDS-Anx	0.35 (1)	4.46 (2.52)	5.25 (2.27)	5.23 (2.29)	4.99 (2.23)	4.91 (2.58)
SUDS-D	0.22 (0.86)	4.39 (2.75)	4.93 (2.53)	5.03 (2.49)	4.62 (2.38)	4.52 (2.85)
SUDS-Ang	0.06 (0.38)	2.32 (2.46)	3.10 (2.71)	3.78 (2.79)	3.68 (2.89)	3.36 (2.82)
SUDS-G	0.12 (0.58)	2.16 (2.70)	2.91 (2.98)	2.78 (2.94)	3.14 (3.04)	2.13 (2.59)

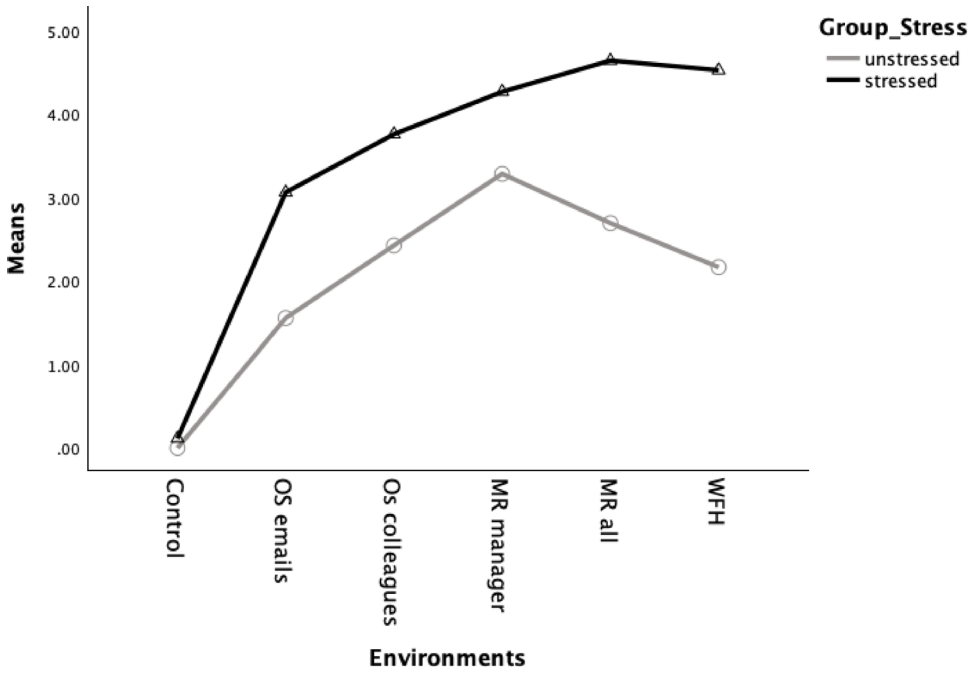

Fig. 6 Means of anger for stressed and unstressed groups. Lines with triangles represent the stressed group and lines with circles represent the unstressed group

in the remaining third. Beside anxiety, some workers felt guilty about missing work because of a mental health problem (Saint-Arnaud et al. 2003), or anger about the work environment (Bosjancic and Koracin 2014). Consequently, preparing for resuming work and learning to regulate negative emotions are essential for increasing RTW self-efficacy, namely self-confidence in coping with the difficulties associated with RTW. In the literature, partial resumption is seen as a gradual exposure to returning to work and has been shown to be effective (Blonk et al. 2006; Huijs et al. 2012; Slater et al. 2023). A promising alternative to partial resumption is virtual reality exposure to work situations characterizing resumption, which aims to trigger emotions such as those felt in reality by workers (e.g., anxiety, discouragement, anger and guilt) in order to regulate them. Therefore, the purpose of this study was to validate virtual work environments as virtual reality exposure tools, that is to demonstrate their immersive properties and their capacity to induce negative emotions. Indeed, triggering negative emotions is needed to learn to tolerate and regulate emotional experience during exposure and to avoid avoidance (Bouchard and Paquette 2023).

Overall, we confirmed our hypotheses about the triggering of negative emotions, especially anxiety in work environments compared to control environments. First, our results showed that the environments generate an adequate sense of presence and few cybersickness symptoms, indicating good immersive proprieties necessary for exposure (Della Libera et al. 2023). The sense of presence is a crucial factor to consider during clinical immersions in VR, as it allows virtual stimuli to elicit the emotional reactions expected or needed in psychotherapy (Riva et al. 2014). A minimum level of presence may be required to trigger anxiety in users exposed to anxiety-inducing stimuli. Although cybersickness increased between pre-immersion and post-immersion, these may be more related to the anxiety experienced (e.g., difficulty concentrating, sweating, salivation) by participants than to weak technological qualities (Bouchard et al. 2021). Indeed, as our results showed, somatic anxiety and cognitive anxiety increased significantly between pre-immersion and post-immersion. Secondly, regarding the activation of negative emotions, the results indicated a decrease in emotional comfort and an increase in anxiety in work environments compared to the control environment, controlling for immersion propensity and work stress. This demonstrated that the virtual work environments are an effective exposure tool for anxiety related to RTW. Concerning discouragement, although the omnibus test did not reach

conventional statistical significance ($p = .07$), the effect size was moderate ($\eta^2 = 0.15$), suggesting a potentially meaningful difference between environments. For exploratory purposes and to inform future research, Bonferroni-adjusted post hoc comparisons were examined. These revealed significant differences between the control environment and OS-emails, OS-colleagues, MR-manager, and WFH. These findings, while interpreted with caution, suggest that discouragement may indeed vary across work environments, and warrant further investigation with larger samples. With regard to anger, while Bonferroni post-hoc analyses showed that they were higher in work environments than the control environment, the results showed no significant differences when work stress and immersion propensity were added as control variables. However, we found that workers stressed at work felt more anger than workers with little or no work stress in the work environment compared to the control one. The relationship between anger, negative affect and job strain has already been shown among workers (Steptoe et al. 2000) as well as neural substrates similarities between anxiety and anger (see Richard et al. 2023 for a systematic review). Concerning guilt, although the means were lower in the control environment than in the work environments, they did not differ significantly when controlling for immersive tendencies and work stress. However, if the activation of guilt was low in our general population sample, taking into account the history of the patients' backgrounds, we assume that guilt would be higher in a clinical population that is on sick leave, as evidenced by previous studies (Nielsen et al. 2013; Saint-Arnaud et al. 2003; Salminen et al. 2015). Consequently, the means should be much higher and differ significantly in a clinical population in professional environments, compared to the control environment.

The induction of emotions other than anxiety in virtual work environments seems important. Indeed, while VR has shown its effectiveness in anxiety exposure (for a meta-analysis, see Carl et al. 2019), other emotions need to be regulated for psychological well-being. Emotion regulation is associated with positive wellbeing outcomes (e.g., life satisfaction, positives affect) (for a review, see Montana et al. 2020) whereas deficit in emotion regulation is common to emotional disorder including anxiety disorders, unipolar depression, and related disorders (Barlow et al. 2011). In their unified protocol for transdiagnostic treatment of emotional disorders, Barlow et al. (2011) have proposed five core treatment modules aimed to regulate emotions including emotion awareness and emotion-focused exposure. This type of exposure aims to expose patients to specific situations that provoke intense emotions, such as sadness, shame or anger. By confronting these emotionally charged situations, patients learn to tolerate and regulate their emotions rather than avoid them. In fact, VR allows the creation of controlled settings in which individuals can train emotional regulation, through situational strategies (i.e., strategies generating an emotion by selecting or modifying an emotion-eliciting situation) as exposure and behavioral activation; through attentional strategies (i.e., focusing attention on specific aspects of the situation to change emotion) such as mindfulness and relaxation; through cognitive strategies (i.e., modifying interpretation and meaning of a stimulus to modify its emotional impact) such as cognitive reappraisal; and through and response modulation strategies (changing emotion once it has been triggered) such as stress inoculation and impulse control (for a review, see Colombo et al. 2021). Taken together, these results allow us to assert that the virtual work environments can be used as emotions exposure tools (i.e., situational strategies), but also as cognitive reappraisal tools (i.e., cognitive strategies) in which the individual can rethink the interpretations he or she makes of interactions with avatars to modify emotional impact. Finally, environments can be used in stress inoculation training (i.e., response modulation strategies) which is a type of training designed to prepare individuals for stressful events by exposing them to stressful situation and helping them reduce the potential for negative cognitive, psychological, and behavioral reactions (see Serina et al., 2014 for a systematic review).

Regarding clinical perspectives, first, the triggering of various emotions (i.e., anxiety, discouragement, anger, and guilt) in healthy workers within virtual work environments suggests that these environments are a valuable tool for emotional exposure. In a future study, it will be necessary to test this VR tool with a clinical population, specifically workers on sick leave, and to assess its effectiveness in reducing negative emotions and increasing RTW self-efficacy, a good predictor of actual RTW. Self-efficacy refers to an individual's belief in their ability to successfully navigate the process of returning to work, from the first day of sick leave through to work resumption and beyond, including overcoming potential obstacles during the RTW process. More specifically, a mixed design with repeated measures should be employed. The between-subjects variable will compare the exposure to virtual reality (VR) simulations of professional environments (open space, meeting room, and working from home) with a control group. The within-subjects variables should focus on the evolution of negative emotions, RTW self-efficacy, work ability, and RTW expectations before and after the VR exposure. Work ability reflects an individual's assessment of his/her capability to meet work demands in relation to their health status. RTW expectations are the perceived duration and difficulties of the work resumption process (Gragnano et al. 2021). High levels of self-efficacy, work ability, and positive RTW expectations are associated with a greater likelihood of successfully

returning to work (Gragnano et al. 2018; Selander et al. 2015; Volker et al. 2015). To avoid relapse after resuming work, better prepare individuals to obstacles associated with RTW (Corbière et al. 2017) is made possible with our tool. In particular, our environments seem promising to address obstacles of relations with colleagues (i.e., interactions with colleagues in the open space and the meeting room), relations with the superior (i.e., interactions with the superior in the meeting room and in the working from home environment) and the working-life balance obstacles (i.e., working from home environment).

In addition, from a transdiagnostic perspective (Dalgleish et al. 2020), because our tool can address various processes common to different mental disorders (e.g., emotional regulation, avoidance), we believe that it can be used for other disorders, such as social anxiety and stress management. For example, introducing yourself at a meeting or answering questions of a colleague in the presence of other colleagues in the room are exposure situations in the context of social anxiety. Dealing with a stream of e-mails or phone interruptions while performing another task are exposure situations in the context of stress management.

This study has several limitations. First, the measurement of the sense of presence involved an item error for 27 of the 69 participants for whom it was measured by three items instead of four for each dimension. This error was alleviated by replacing the missing items by the mean of the items (Rubin et al. 2007). Secondly, the duration of the experiment may have increased participants' fatigability, which in turn may have had an impact on SITCA-assessed somatic and cognitive anxiety. Short breaks were provided between each environment (control, open space, meeting room and working from home), but these may not have been sufficient to prevent participants from becoming fatigued as the experiment progressed. Finally, when the consent to take part in the experiment was presented, the participants were informed of the aim of the study, that is to validate virtual work environments as a treatment tool for RTW. It is possible that the participants' awareness of the experiment's goal exacerbated social desirability bias, prompting them to provide responses that were aligned with perceived expectations.

Acknowledgements We would like to express our sincere gratitude to Juliana Acuna and Cyril Thiry, Master's students in psychology at UCLouvain, for their valuable contribution to data collection in this study. Their dedication and meticulous work in administering the measures and overseeing the participants greatly facilitated the smooth execution of the experiment. Their support was essential to the success of this project, and we are deeply appreciative of their efforts.

Author contributions S.D., M.M. and A.W developed the experimental design together. S.D. and M.M. carried out statistical analyses after data collection. S.D. wrote the main manuscript text and reviewed and corrected it.

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on a reasonable request.

Declarations

Competing interests The first author holds shares in Melimpus, a company that markets virtual environments. This conflict of interest is managed and supervised through an agreement with the Catholic University of Louvain and the University of Liège in Belgium, and complies with their conflict of interest management policies. The second and third authors have no conflicts of interest to declare.

References

Andersen MF, Nielsen KM, Brinkmann S (2012) Meta-synthesis of qualitative research on return to work among employees with common mental disorders. Scand J Work Environ Health 38(2):93–104. https://doi.org/10.5271/sjweh.3257

Barlow DH, Ellard KK, Fairholme CP, Farchione TJ, Boisseau CL, Allen LB, Ehrenreich-May J (2011) The unified protocol for transdiagnostic treatment of emotional disorders: client workbook. Oxford University Press, New York, NY

Bell IH, Pot-Kolder R, Rizzo A, Rus-Calafell M, Cardi V, Cella M, Ward T, Riches S, Reinoso M, Thompson A, Alvarez-Jimenez M, Valmaggia L (2024) Advances in the use of virtual reality to treat mental health conditions. Nat Rev Psychol 3(8):552–567. https://doi.org/10.1038/s44159-024-00334-9

Benbow AA, Anderson PL (2019) A meta-analytic examination of attrition in virtual reality exposure therapy for anxiety disorders. J Anxiety Disord 61:18–26. https://doi.org/10.1016/j.janxdis.2018.06.006

Biocca F, Harms C, Burgoon JK (2003) Toward a more robust theory and measure of social presence: review and suggested criteria. Presence Teleoper Virtual Environ 12:456–480. https://doi.org/10.1162/10547460332276270

Blonk RWB, Brenninkmeijer V, Lagerveld SE, Houtman ILD (2006) Return to work: a comparison of two cognitive behavioural interventions in cases of work-related psychological complaints among the self-employed. Work Stress 20(2):129–144. https://doi.org/10.1080/02678370600856615

Boštjančič E, Koračin N (2014) Returning to work after suffering from burnout syndrome: perceived changes in personality, views, values, and behaviors connected with work. Psihologija 47(1):131–147. https://doi.org/10.2298/PSI1401131B

Botella C, Serrano B, Baños RM, Garcia-Palacios A (2015) Virtual reality exposure-based therapy for the treatment of post-traumatic

stress disorder: a review of its efficacy, the adequacy of the treatment protocol, and its acceptability. Neuropsychiatr Dis Treat 11:2533–2545. https://doi.org/10.2147/NDT.S89542

Botella C, Fernández-Álvarez J, Guillén V, García-Palacios A, Baños R (2017) Recent progress in virtual reality exposure therapy for phobias: a systematic review. Curr Psychiatry Rep 19(7):42. https://doi.org/10.1007/s11920-017-0788-4

Bouchard S, Paquette A (2023) Un survol des stratégies de régulations de l'anxiété à l'aide de La réalité virtuelle: du traitement par exposition à l'adaptation culturelle des stratégies favorisant La résilience. Sci Et Comportement 33(1):57–71

Bouchard S, Robillard G, Renaud P, Bernier F (2011) Exploring new dimensions in the assessment of virtual reality induced side effects. J Comput Inform Technol 1:20–32

Bouchard S, Berthiaume M, Robillard G, Forget H, Daudelin-Peltier C, Renaud P, Blais C, Fiset D (2021) Arguing in favor of revising the *Simulator sickness questionnaire* factor structure when assessing side effects induced by immersions in virtual reality. Front Psychiatry 12:739742. https://doi.org/10.3389/fpsyt.2021.739742

Brämberg E, Åhsberg E, Fahlström G, Furberg E, Gornitzki C, Ringborg A, Thoursie PS (2024) Effects of work-directed interventions on return-to-work in people on sick-leave for to common mental disorders-a systematic review. Int Arch Occup Environ Health 97(6):597–619. https://doi.org/10.1007/s00420-024-02068-w

Cancelliere C, Donovan J, Stochkendahl MJ, Biscardi M, Ammendolia C, Myburgh C, Cassidy JD (2016) Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews. Chiropr Man Ther 24(1):32. https://doi.org/10.1186/s12998-016-0113-z

Carl E, Stein AT, Levihn-Coon A, Pogue JR, Rothbaum B, Emmelkamp P, Asmundson GJG, Carlbring P, Powers MB (2019) Virtual reality exposure therapy for anxiety and related disorders: a meta-analysis of randomized controlled trials. J Anxiety Disord 61:27–36. https://doi.org/10.1016/j.janxdis.2018.08.003

Cieślik B, Mazurek J, Rutkowski S, Kiper P, Turolla A, Szczepańska-Gieracha J (2020) Virtual reality in psychiatric disorders: a systematic review of reviews. Complement Ther Med 52:102480. https://doi.org/10.1016/j.ctim.2020.102480

Colombo D, Díaz-García A, Fernandez-Álvarez J, Botella C (2021) Virtual reality for the enhancement of emotion regulation. Clin Psychol Psychother 28(3):519–537. https://doi.org/10.1002/cpp.2618

Corbière M, Mazaniello-Chézol M, Bastien MF, Wathieu E, Bouchard R, Panaccio A, Guay S, Lecomte T (2020) Stakeholders' role and actions in the Return-to-Work process of workers on Sick-Leave due to common mental disorders: a scoping review. J Occup Rehabil 30(3):381–419. https://doi.org/10.1007/s10926-019-09861-2

Côté S, Bouchard S (2008) Virtual reality exposure for phobias: a critical review. J CyberTherapy Rehabil 1(1):75–92

Craske MG, Kircanski K, Zelikowsky M, Mystkowski J, Chowdhury N, Baker A (2008) Optimizing inhibitory learning during exposure therapy. Behav Res Ther 46(1):5–27. https://doi.org/10.1016/j.brat.2007.10.003

de Vries G, Hees HL, Koeter MW, Lagerveld SE, Schene AH (2014) Perceived impeding factors for return-to-work after long-term sickness absence due to major depressive disorder: a concept mapping approach. PLoS ONE 9(1):e85038. https://doi.org/10.1371/journal.pone.0085038

de Vries H, Fishta A, Weikert B, Rodriguez Sanchez A, Wegewitz U (2018) Determinants of sickness absence and return to work among employees with common mental disorders: a scoping review. J Occup Rehabil 28(3):393–417. https://doi.org/10.1007/s10926-017-9730-1

Della Libera C, Simon J, Larøi F, Quertemont E, Wagener A (2023) Using 360-degree immersive videos to assess multiple transdiagnostic symptoms: a study focusing on fear of negative evaluation, paranoid thoughts, negative automatic thoughts, and craving. Virtual Reality, 1–16. https://doi.org/10.1007/s10055-023-00779-y

Dellazizzo L, Potvin S, Luigi M, Dumais A (2020) Evidence on virtual reality-based therapies for psychiatric disorders: meta-review of meta-analyses. J Med Internet Res 22(8):e20889. https://doi.org/10.2196/20889

Diemer J, Alpers GW, Peperkorn HM, Shiban Y, Mühlberger A (2015) The impact of perception and presence on emotional reactions: a review of research in virtual reality. Front Psychol 6:26. https://doi.org/10.3389/fpsyg.2015.00026

Emmelkamp PMG, Meyerbröker K (2021) Virtual reality therapy in mental health. Ann Rev Clin Psychol 17:495–519. https://doi.org/10.1146/annurev-clinpsy-081219-115923

Etuknwa A, Daniels K, Eib C (2019) Sustainable return to work: a systematic review focusing on personal and social factors. J Occup Rehabil 29(4):679–700. https://doi.org/10.1007/s10926-019-09832-7

Faul F, Erdfelder E, Buchner A, Lang AG (2009) Statistical power analyses using G* power 3.1: tests for correlation and regression analyses. Behav Resh Methods 41:1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Felnhofer A, Hlavacs H, Beutl L, Kryspin-Exner I, Kothgassner OD (2019) Physical presence, social presence, and anxiety in participants with social anxiety disorder during virtual cue exposure. Cyberpsychol Behav Soc Netw 22:46–50. https://doi.org/10.1089/cyber.2018.0221

Figueredo JM, García-Ael C, Gragnano A, Topa G (2020) Well-being at work after return to work (RTW): a systematic review. Int J Environ Res Public Health 17(20):7490. https://doi.org/10.3390/ijerph17207490

Fodor LA, Coteț CD, Cuijpers P, Szamoskozi S, David D, Cristea IA (2018) The effectiveness of virtual reality based interventions for symptoms of anxiety and depression: a meta-analysis. Sci Rep 8:10323. https://doi.org/10.1038/s41598-018-28113-6

Fox J, Arena D, Bailenson JN (2009) Virtual reality: a survival guide for the social scientist. J Media Psychol Theor Methods Appl 21(3):95–113. https://doi.org/10.1027/1864-1105.21.3.95

Garcia-Palacios A, Botella C, Hoffman H, Fabregat S (2007) Comparing acceptance and refusal rates of virtual reality exposure vs. in vivo exposure by patients with specific phobias. Cyberpsychol Behav Impact Internet Multimed Virtual Real Behav Soc 10(5):722–724. https://doi.org/10.1089/cpb.2007.9962

Gragnano A, Negrini A, Miglioretti M, Corbière M (2018) Common psychosocial factors predicting return to work after common mental disorders, cardiovascular diseases, and cancers: a review of reviews supporting a cross-disease approach. J Occup Rehabil 28(2):215–231. https://doi.org/10.1007/s10926-017-9714-1

Gragnano A, Villotti P, Larivière C, Negrini A, Corbière M (2021) A systematic search and review of questionnaires measuring individual psychosocial factors predicting return to work after musculoskeletal and common mental disorders. J Occup Rehabil 31(3):491–511. https://doi.org/10.1007/s10926-020-09935-6

Guillén V, Baños RM, Botella C (2018) Users' opinion about a virtual reality system as an adjunct to psychological treatment for stress-related disorders: a quantitative and qualitative Mixed-Methods study. Front Psychol 9:1038. https://doi.org/10.3389/fpsyg.2018.01038

Hofmann SG, Asnaani A, Vonk IJ, Sawyer AT, Fang A (2012) The efficacy of cognitive behavioral therapy: a review of Meta-analyses. Cogn Therapy Res 36(5):427–440. https://doi.org/10.1007/s10608-012-9476-1

Huijs J, Koppes LL, Taris TW, Blonk RW (2012) Differences in predictors of return to work among long-term sick-listed employees

with different self-reported reasons for sick leave. J Occup Rehabil 22(3):301–311. https://doi.org/10.1007/s10926-011-9351-z

Joyce S, Modini M, Christensen H, Mykletun A, Bryant R, Mitchell PB, Harvey SB (2016) Workplace interventions for common mental disorders: a systematic meta-review. Psychol Med 46(4):683–697. https://doi.org/10.1017/S0033291715002408

Kärkkäinen R, Kinni RL, Saaranen T, Räsänen K (2018) Supervisors managing sickness absence and supporting return to work of employees with burnout: a membership categorization analysis. Cogent Psychol. https://doi.org/10.1080/23311908.2018.1551472

Knowles KA, Tolin DF (2022) Mechanisms of action in exposure therapy. Curr Psychiatry Rep 24(12):861–869. https://doi.org/10.1007/s11920-022-01391-8

Lavoie R, Main K, King C, King D (2021) Virtual experience, real consequences: the potential negative emotional consequences of virtual reality gameplay. Virtual Reality 25:69–81. https://doi.org/10.1007/s10055-020-00440-y

Lemyre L, Tessier R (2003) La mesure de stress psychologique en recherche de première Ligne. Can Family Physician Le Médecin De Famille Canadien 49:1166–1168

Lysaght RM, Larmour-Trode S (2008) An exploration of social support as a factor in the return-to-work process. Work (Reading Mass) 30(3):255–266

Ma L, Mor S, Anderson PL, Baños RM, Botella C, Bouchard S, Cárdenas-López G, Donker T, Fernández-Álvarez J, Lindner P, Mühlberger A, Powers MB, Quero S, Rothbaum B, Wiederhold BK, Carlbring P (2021) Integrating virtual realities and psychotherapy: SWOT analysis on VR and MR based treatments of anxiety and stress-related disorders. Cogn Behav Ther 50(6):509–526. https://doi.org/10.1080/16506073.2021.1939410

Maples-Keller JL, Bunnell BE, Kim SJ, Rothbaum BO (2017) The use of virtual reality technology in the treatment of anxiety and other psychiatric disorders. Harv Rev Psychiatry 25(3):103–113

Marshall WL (1985) The effects of variable exposure in flooding therapy. Behav Ther 16(2):117–135. https://doi.org/10.1016/S0005-7894(85)80040-X

Montana JI, Matamala-Gomez M, Maisto M, Mavrodiev PA, Cavalera CM, Diana B, Mantovani F, Realdon O (2020) The benefits of emotion regulation interventions in virtual reality for the improvement of wellbeing in adults and older adults: a systematic review. J Clin Med 9(2):500. https://doi.org/10.3390/jcm9020500

Morina N, Ijntema H, Meyerbröker K, Emmelkamp PM (2015) Can virtual reality exposure therapy gains be generalized to real-life? A meta-analysis of studies applying behavioral assessments. Behav Res Ther 74:18–24. https://doi.org/10.1016/j.brat.2015.08.010

Nielsen MB, Rugulies R, Hjortkjaer C, Bültmann U, Christensen U (2013) Healing a vulnerable self: exploring return to work for women with mental health problems. Qual Health Res 23(3):302–312. https://doi.org/10.1177/1049732312468252

Parsons TD, Rizzo AA (2008) Affective outcomes of virtual reality exposure therapy for anxiety and specific phobias: a meta-analysis. J Behav Ther Exp Psychiatry 39(3):250–261. https://doi.org/10.1016/j.jbtep.2007.07.007

Pinto TM, Veiga VM, Macedo EC (2024) Effectiveness of cognitive-behavioral therapy on resilience of adults: a systematic review and meta-analysis. J Behav Cogn Therapy 34(2). https://doi.org/10.1016/j.jbct.2024.100495

Powers MB, Emmelkamp PM (2008) Virtual reality exposure therapy for anxiety disorders: a meta-analysis. J Anxiety Disord 22(3):561–569. https://doi.org/10.1016/j.janxdis.2007.04.006

Ree MJ, French D, MacLeod C, Locke V (2008) Distinguishing cognitive and somatic dimensions of state and trait anxiety: development and validation of the state-trait inventory for cognitive and somatic anxiety (STICSA). Behav Cogn Psychother 36:313–332. https://doi.org/10.1017/S1352465808004232

Richard Y, Tazi N, Frydecka D, Hamid M, Moustafa AA (2022) A systematic review of neural, cognitive, and clinical studies of anger and aggression. Curr Psychol 42:17174–17186. https://doi.org/10.1007/s12144-022-03143-6

Riva G, Mantovani F, Bouchard S (2014) Presence. In: Wiederhold BK, Bouchard S (eds) Advances in virtual reality and anxiety disorders. Springer, Berlin, pp 9–33

Rizzo AS, Koenig ST (2017) Is clinical virtual reality ready for primetime? Neuropsychology 31(8):877–899. https://doi.org/10.1037/neu0000405

Robillard G, Bouchard S, Renaud P, Cournoyer LG (2002) Validation canadienne- française de Deux mesures importantes En réalité virtuelle: l'immersive tendencies questionnaire et Le presence questionnaire. Poster presented at the 25e congrès annuel de La Société. Québécoise pour la Recherche en Psychologie (SQRP), Trois-Rivières

Rubin LH, Witkiewitz K, Andre JS, Reilly S (2007) Methods for handling missing data in the behavioral neurosciences: don't throw the baby rat out with the bath water. J Undergrad Neurosci Educ 5(2):A71

Saint-Arnaud L, Saint-Jean M, Rhéaume J (2003) De La désinsertion à La réinsertion professionnelle à La suite d'un arrêt de travail pour Un problème de santé mentale. Santé Mentale Au Québec 28(1):193–211. https://doi.org/10.7202/006988ar

Saint-Arnaud L, Saint-Jean M, Damasse J (2006) Towards an enhanced Understanding of factors involved in the Return-to-Work process of employees absent due to mental health problems. Can J Community Mental Health 25(2):303–315. https://doi.org/10.7870/cjcmh-2006-0027

Salminen S, Mäkikangas A, Hätinen M, Kinnunen U, Pekkonen M (2015) My Well-Being in my own hands: experiences of beneficial recovery during burnout rehabilitation. J Occup Rehabil 25(4):733–741. https://doi.org/10.1007/s10926-015-9581-6

Schultz IZ, Chlebak CM, Stewart AM (2016) Impairment, Disability, and return to work. In: Schultz I, Gatchel R (eds) Handbook of return to Work. Handbooks in Health, Work, and disability, vol 1. Springer, Boston. https://doi.org/10.1007/978-1-4899-7627-7_1

Selander J, Tjulin Å, Müssener U, Ekberg K (2015) Contact with the workplace during long-term sickness absence and worker expectations of return to work. Int J Disabil Manag 10:e3. https://doi.org/10.1017/idm.2015.3

Serino S, Triberti S, Villani D et al (2014) Toward a validation of cyber-interventions for stress disorders based on stress inoculation training: a systematic review. Virtual Reality 18:73–87. https://doi.org/10.1007/s10055-013-0237-6

Simón-Vicente L, Rodríguez-Cano S, Delgado-Benito V, Ausín-Villaverde V, Cubo Delgado E (2024) Cybersickness. A systematic literature review of adverse effects related to virtual reality. Neurologia 39(8):701–709. https://doi.org/10.1016/j.nrleng.2022.04.007

Slater M (2009) Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments. Philos Trans R Soc Lond B Biol Sci 364:3549–3557. https://doi.org/10.1098/rstb.2009.0138

Slater D, Venning A, Matthews L, Iles R, Redpath P (2023) Defining work-focused cognitive behavioural therapy (W-CBT) and whether it is effective at facilitating return to work for people experiencing mental health conditions: a systematic review and narrative synthesis. Health Psychol Open 10(2):20551029231217840. https://doi.org/10.1177/20551029231217840

Steptoe A, Cropley M, Griffith J, Kirschbaum C (2000) Job strain and anger expression predict early morning elevations in salivary cortisol. Psychosom Med 62(2):286–292. https://doi.org/10.1097/00006842-200003000-00022

van der Klink JJ, Blonk RW, Schene AH, van Dijk FJ (2001) The benefits of interventions for work-related stress. Am J Public Health 91(2):270–276. https://doi.org/10.2105/ajph.91.2.270

Villotti P, Kordsmeyer AC, Roy JS, Corbière M, Negrini A, Larivière C (2024) Systematic review and tools appraisal of prognostic factors of return to work in workers on sick leave due to musculoskeletal and common mental disorders. PLoS ONE 19(7):e0307284. https://doi.org/10.1371/journal.pone.0307284

Volker D, Zijlstra-Vlasveld MC, Brouwers EP, van Lomwel AG, van der Feltz-Cornelis CM (2015) Return-to-Work Self-Efficacy and actual return to work among Long-Term Sick-Listed employees. J Occup Rehabil 25(2):423–431. https://doi.org/10.1007/s10926-014-9552-3