Improving Emotional And Psychological Well-Being

The Opportunity for Emotionally Responsive Virtual Reality Experiences in Training and Therapy

By emteq labs

Contents

Executive Summary

Virtual Reality (VR) is showing great promise in the areas of training and therapy, yet there is still untapped opportunity in clinical, professional, educational and vocational settings.

VR has the potential to go further, to deliver more powerful, longer-lasting benefits to more participants and patients across a broader section of use cases and conditions. This paper explores some of those opportunities.

VR technologies have already demonstrated that multi-sensory immersive experiences can facilitate deep perceptual and emotional connections between the user and the virtual environment, and that this can deliver outstanding results in both training and therapy environments.

Compared with traditional training approaches, including on-line and in-person sessions, training providers see that VR delivers significant improvements to participants' experiences and the learning outcomes. VR is proving to deliver impressive advancements in key learning metrics such as reductions in learning time, increased information recall and greater confidence in applying the learnings to the real world.

In therapeutic settings, VR is enabling powerful and innovative treatments for some of the most prevalent and important mental health issues our societies face today. Additionally, immersive technologies are helping practitioners overcome one of the biggest barriers to treatment, by enabling patients to undergo therapy remotely, in their own homes.

Whilst Virtual Reality is making truly ground-breaking progress in these scenarios, there is an important missing element – emotional feedback.

The power of VR to create emotional and empathetic connections for the user provides tremendous opportunity for the treatment of mental health conditions and in meeting the surging demand for rapid, effective learning and development programmes.

Through VR and immersive technologies powerful positive experiences can be created that excite, stimulate, guide, cure, and educate more effectively than traditional tried-and-tested approaches.

Emotional feedback is poised to play an important role within immersive and virtual experiences. The ability to understand an individual's specific emotional reaction to any given VR experience can help guide the amount of stimulation, exposure or challenge that they are presented with, in real-time, making the experience more engaging, memorable and transferable.

This paper investigates the current trends in global mental health, with specific emphasis on the impact of COVID-19 in both organisations and therapeutic settings. It looks at the mental health, training and remote working challenges corporations, business, institutions and therapists face today, highlighting how Virtual Reality is being used in these settings, and how the addition of an emotional feedback element could create even more opportunity for Virtual Reality in training and therapy situations.

Section 4 highlights a number of organisations that are using immersive experiences to help individuals conquer and manage their mental health conditions, as well as those providing training solutions for development of resilience, situational preparedness and new soft-skills.

Key takeaways:

- Prior experiences may influence an individual's response (priming effects)

- During the early months of the COVID-19 pandemic, the USA saw an increase in reported severe mental health issues of more than 700%.

- Adding emotional feedback to help provide remote, graded mental health therapy could save UK health organisations more than £163m/year.

- VR training can half training costs and improve learner outcomes by more than 40%.

- Appropriate levels of emotional engagement in VR training are especially important in self-taught, distance learning.

- Emotionally aware immersive experiences will enable progressive therapies and powerful training programmes that can help individuals and organisations in a time when person to person interaction is increasingly reliant upon digital technologies.

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The Mental Health Pandemic

Mental Health disorders affect one in every four people today – the largest cause of disability worldwide. In the UK alone, the economic costs exceed £94 billion per year, with mental health being the leading cause of health insurance claims, far exceeding back pain.

Worldwide, over 970 million people suffer from one or more mental health disorders, and many millions more suffer from sub-optimal behavioural patterns and choices driven by their emotional states, leading to ill health from over-eating, lack of exercise, smoking, alcohol abuse and more.

The role of digital technologies and social media in increasing rates of mental health disorders has been a topic of research and discovery for the last decade.[1] Whilst a direct causal relationship remains allusive and mostly anecdotal, there is evidence[2,3], that digital technologies can play both a contributory and amplificatory role in predisposed individuals through increases in physical and communication behaviours that are known to have negative impacts on mental health and well-being.

As our societies have migrated towards the always-on lifestyles, exposure to digital technologies is only increasing, contributing to rising numbers of cases and increasing severity. With the rapid shift to more pervasive digital lives that the COVID-19 pandemic initiated, this will become more pronounced.

Simultaneously, budget cuts and shortages of trained professionals are reducing the amount of support and healthcare available to those suffering from mental health conditions.

Between 2009 and 2019 the U.K.'s National Health Service (NHS) experienced a reduction in mental health nurses of almost 11%[4], coinciding with a reduction in availability of hospital beds and treatments that contributed to 90% of U.K. doctors in a recent MedeConnect survey feeling that the mental health services were inadequate for at risk youths.[5]

[1] https://cognitiontoday.com/2019/08/effect-of-social-media-on-mental-health-well-being/
[2] https://www.ajpmonline.org/article/S0749-3797(17)30016-8/fulltext
[3] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5143470/
[4] https://www.nurses.co.uk/nursing/blog/the-number-of-mental-health-nurses-has-dropped
  -by-106-in-10-years/
[5] MedeConnect Healthcare Insight Nov 2018, reported by https://www.theguardian.com/society/
  2018/dec/30/inadequate-nhs-services-put-under-18s-with-mental-health-issues-at-risk

It's good to talk

Talking therapies such as Cognitive Behavioural Therapy (CBT) are the accepted treatment for anxiety disorders and the de facto alternative to antidepressants for depression. 1.4 million people in England and Wales were referred for talking therapy in 2016/17, with just two thirds of them starting therapy in that period.

Meanwhile the number of people with anxiety disorders or depression who can access talking therapies through IAPT (the Adult Improving Access to Psychological Therapies programme) is planned to increase to 1.9 million by 2023/24. However, this figure, according to the NHS Mental Health Implementation Plan 2019, will provide services to just 25% of adults in need.

Therapies are expensive, time consuming and require a full course of treatment to be effective. It is estimated that the market for privately delivered talking therapies in the UK is at least as large as that provided by the NHS and growing rapidly.

Overlay these trends onto our world today; the global health crisis has driven our societies to actively isolate, and companies to enforce distributed remote working using digital technologies.

Individual impact

For individuals, increased isolation, job insecurity and health worries are leading to an increase in the factors commonly associated with mental health triggers.

Health care impact

For health workers, the number of undiagnosed patients in need of help is increasing at the same time as it is becoming harder to reach and treat patients.

Organisational impact

From an organisations point of view, business survivability concerns are driving rapid deployments of digital technologies and new processes across unplanned distributed teams, making it exponentially harder to ensure the mental well-being of their staff.

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One of the biggest problems affecting patients with mental health problems trying to access help is the disorder themselves. If you have an anxiety disorder, getting out of the house represents the first challenge, finding a clinician with the time to understand your problems is the second problem, then accessing the therapist may cause further distress requiring repeated visits to a clinic. The scope of what's on offer varies tremendously and does not provide feedback to the user or clinician about objective responses.

Professor Hugo Critchley Consultant Psychiatrist

The new remote working practices and hurried digital technology adoption aside, history shows that large-scale disasters, such as the COVID-19 pandemic, lead to increases in depression, post-traumatic stress disorder (PTSD), substance use disorder, and a range of other psychological and behavioural disorders.

Considering these factors, the challenge of managing and treating mental and psychological health conditions has been increasing for many years, and the recent pandemic-driven changes to our societies pose an even greater threat to our collective well-being and prosperity.

To meet these challenges, technological solutions show promise in many areas, specifically:

- Programmatic and individualised therapeutic treatments

- Effective remote delivery of treatments and training

- Personalised remote training and support for distributed teams

- Emotionally intelligent automated training for soft-skills, resilience and adverse-environment learning and development

During an interview on the Emotion Lab podcast, William Hamilton, Founder of Virtual Reality company, Mimerse commented on the huge potential for VR to help close the gulf between demand and supply of mental health therapies and treatments:

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We're not going to be able to educate enough therapists to deal with this global mental health problem that humanity is facing, so the grand solution to this problem needs to be some type of scalable technological platform...we're probably going to see brand new paradigms where you a therapist is very skillfully controlling what's going on inside of different simulations.

[6] https://jamanetwork.com/journals/jamainternalmedicine/fullarticle/2764404

The Opportunity for VR in Mental Health

For decades Virtual Reality technology has been steadily growing with a sophistication and capability that has the potential to tackle the impending mental health pandemic.

Virtual Reality has been shown to increase empathy, to have positive effects on mental well-being and to deliver outstanding collaboration, preparatory and training results.[7]

Availability of lower cost devices and increased enterprise adoption is driving more availability, use-cases and affordability, meaning VR technologies are well positioned to help provide distributed training solutions and CBT treatments for individuals in remote scenarios.

The use of VR in organisational training and psychological therapy scenarios might, at first appearance, seem separate issues. However, with the societal changes taking place in the wake of the COVID-19 pandemic the role of employers in the well-being of their employees is being tested and stretched beyond previous norms, and this is creating striking similarities between the two fields.

Therapeutic Virtual Reality

From the therapy point of view, there were challenges with the delivery of talking therapies and CBT even before COVID-19. Adherence for non-face-to-face, remote, interventions is typically low (65%), and treatment outcomes are notoriously difficult to quantify, being based on subjective surveys. Compounding this, up to 75% of people with mental health problems do not seek treatment in the first place.

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Many patients with psychosis experience everyday social situations as anxiety-provoking. The fears can arise, for example, from paranoia, hallucinations, social anxiety or negative self beliefs. The fears lead patients to withdraw from activities, and this isolation leads to a cycle of worsening physical and mental health. Breaking this cycle requires highly active treatment directly in the troubling situations so that patients learn that they can safely and confidently enter them. However, patients with psychosis seldom receive such life-changing interventions.[8]

[7] https://www.pwc.com/us/en/services/consulting/technology/emerging-technology/vr-study-2020.html

[8] Freeman D, Yu L-M, Kabir T, et al. Automated Virtual Reality (VR) cognitive therapy for patients with psychosis: study protocol for a single-blind parallel group randomised controlled trial (gameChange). BMJ Open 2019;9:e031606.doi:10.1136/bmjopen-2019-031606

Whilst talking therapies can be conducted remotely, for them to be most effective they require the empathetic relationships to be built, and observation of non-verbal communication cues. This necessitates regular in-person patient engagement, something that was already increasingly difficult to deliver, and impossible during the current global COVID-19 pandemic crisis.

In response to the widening gap between demand and supply of mental health provision, health providers are turning to digital technologies for answers.

The U.K.'s National Institute for Health Research (NIHR) funded a collaboration between health care providers and technology companies to develop technology and clinical trials with the aim of producing scalable and accessible digital solutions for the treatment of mental health issues.

Led by the University of Oxford and the Oxford Health NHS Foundation Trust, gameChange[9] worked with VR company OxfordVR to create automated psychological therapies in immersive virtual environments.

gameChange created a Virtual Reality environment to help patients with severe mental health problems that was both fun and challenging. The system would coach patients through their therapy, allowing them to practice their coping strategies and techniques in increasingly more difficult and complex scenarios. This graded approach enabled participants to be sufficiently challenged without presenting them with situations that they couldn't cope with.

The digital nature of these virtual therapies facilitates individualised treatments that can be automated and scaled, and it transpires that lessons from virtual immersion seem to efficiently transfer to the real world.

Through multi-sensory stimulation involving visual, auditory and often other senses, immersive experiences blur the distinction between the virtual and real worlds, facilitating users to become so involved that they disconnect from the real world, and form a sense of "being" within the artificial construction.

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[9] https://gamechangevr.com/

Due to this level of attachment, user experiences and learnings can often be seen to transcend from virtual to real worlds, in very powerful ways. This discovery is echoed in the gameChange research, "The beauty is that the benefits transfer to the real world."

The Opportunity for Virtual Reality in Therapy

Immersive technologies such as Virtual Reality are increasingly seen as a huge benefit to talking therapies, as VR can put the individual directly in contact with their phobia, cheaply, effectively and repeatedly through immersive simulations that mimic the specific environment and/or stimulus that is the root of the patient's anxiety.

> "
> There are tremendous opportunities to do great things with VR. It's what we've dreamed about in psychology—a controlled stimulus environment where you make things happen, monitor patient responses, and activate emotions in ways far beyond what we could ever do in a clinical office." Skip Rizzo, PhD, research professor in gerontology and psychiatry at the University of Southern California (USC).[10]

Beyond talking therapies, Virtual Reality has demonstrated it is a powerful tool in delivery of pain relief. Virtual Reality is able to capture the patient's attention so fully that it disrupts and often blocks pain signals from reaching the brain.[11] A study into the effectiveness of Virtual Reality in pain relief from Cedars-Sinai concluded that VR can significantly reduce patient-reported pain across a wide range of cases, regardless of the cause of pain or reason for hospitalisation.[12]

> "
> The brain is a very powerful tool and if we can convince your brain to think about other stuff when you are in pain, it helps you cope. Your brain is like the CPU (central processing unit) of a computer. Once you overload the CPU with vision and sound, pain doesn't take such a big priority.

Eran Orr CEO of XRHealth

[10] https://www.apa.org/monitor/2019/09/cover-virtual-worlds
[11] Mark Young, MD, MBA, FACP, Oasis Centre for Natural Pain Management https://www.practicalpainmanagement.com /patient/virtual-reality-for-pain-depression
[12] Spiegel B, Fuller G, Lopez M, et al. Virtual reality for management of pain in hospitalized patients: A randomized comparative effectiveness trial. PLOS ONE. 2019;14(8): e0219115

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In Sweden, Virtual Reality company, Mimerse, partnered with Swedish clinics, Samsung Electronics, the Swedish Government and Stockholm University to create phobia ("Itsy") and pain distraction ("Happy Place") programmes in Virtual Reality.
In controlled demonstrations to hundreds of Swedish medical practitioners of their pain-distraction therapy, Happy Place, they reported overwhelmingly positive feedback.

Speaking about their findings, Mimerse said: "The cost of pain-related health care is nearly 30% higher than the combined cost of cancer and diabetes, estimated at nearly $300 billion annually in the US alone. The potential for technologies like Happy Place in healthcare, even if only adding value to a small subset of users with pain in need of solutions, is arguably huge." [13]

emteq labs' role

We have worked with healthcare professionals, researchers and software developers. Working within the healthcare environment, with our NHS partner organisations, we have highlighted the need for effective treatments that can be delivered at scale and tailored to the varying requirements of different conditions and of individual service users. Most research on VR for mental health has focused on the patient and therapist being in the same room. One of the concerns when managing mental health conditions remotely is the inability to understand how the user is responding to the VR simulation.

Our work in collaboration with the National Institute for Health Research, as well as academic researchers and software developers, has identified the need for common ground between those delivering and evaluating therapies and those with the technical skill to develop these technologies.
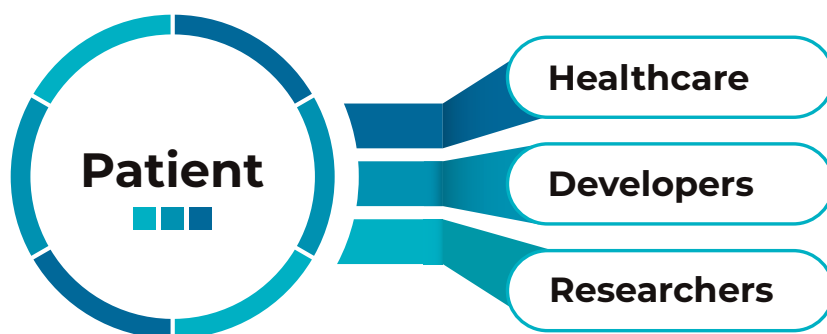
Our cloud-based hardware will enable joined-up working between those developing the content for, and evaluating the effectiveness of novel therapies.

[13] https://medium.com/@williamjphamilton/creating-a-happy-place-f972bef24823
[14] Kings Fund, 2008, Paying the Price: The cost of mental healthcare in England to 2026

A remote biometric therapy has the potential to deliver significant economic benefits. For example, the average cost of treating a patient with an anxiety disorder in the UK is £1460/person/year[14]. We anticipate that developers using our solution can reduce costs by 30%, and therefore will save >£483/person by enabling remote treatment,   reducing the need for face-to-face therapist sessions.

Patients will also see economic benefit from reduced costs to travel to therapy sessions, probably also including unpaid time off work. Extrapolating this across the UK, potential cost/benefit (given an adoption rate of 10% achieved by 2026) could be up to £163m/year, comprised of both healthcare costs and productivity gains achieved through more efficient therapy delivery of this one aspect of mental health disorder.

Further, our technology will enable content creators to make therapy more accessible and enable delivery even in times of restricted movement, as we face today with COVID-19.

Many mental health conditions have yet to be sub-categorised which leads to patients receiving the wrong treatment and needless suffering. Our technology will enable clinical endpoints to be quantified that may lead to the discovery of novel patterns or behavioural responses to therapies.

Organisations, VR and Well-Being Beyond Office Walls

For organisations, Virtual Reality provides an opportunity to both care for employee well-being and improve productivity.

Organisations have an obligation to protect the safety and well-being of their employees, whether they are office based, working alone or in hazardous environments. Many organisations whose staff routinely work in remote or dangerous situations already understand that the reach of the organisation's responsibility to their staff goes beyond set boundaries. However with the shift to remote working that has come about due to the COVID-19 pandemic, organisations that were more used to managing the safety and well-being of staff within carefully controlled office environments are finding new challenges with staff now working remotely, in less well managed locations.

[15] https://time.com/5886228/depression-covid-19-pandemic/

This new decentralised and distributed working comes with both benefits and pitfalls. One of the biggest challenges is what is being described as COVID Blues, or COVID Depression.

TIME magazine reported[15] that the number of US adults showing signs of mild depression and anxiety rose from 16.2% pre-pandemic to 24.6% between March and April 2020, when the lockdowns were introduced.

Even more concerning, the number of adults experiencing severe levels of depression rose by over 700% in the same time period.

The major factors in these reported rises can be attributed to what are known as "COVID-19 stressors". These include job insecurity, financial burdens and the illness or death of loved ones. Additionally, the sudden severing of social interactions that "sheltering in place" or "social distancing" enforced has created a pandemic of loneliness.

Twenty-eight percent of American adult households are single occupancy, for these people sheltering in place, this meant weeks and months of virtual solitary isolation. Relying solely on digital technologies for interpersonal communications, these people risk developing chronic loneliness and according to leading researcher John Cacioppo, chronic loneliness, and trauma can induce the same psychophysiological responses.

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Victims of chronic loneliness have something in common with victims of trauma: Both groups are subject to that part of the mind-body memory system that, beyond our control, stores and regenerates our sensations of loneliness and fear.[16]

For organisations, this increased level of mental health illness amongst staff poses significant business risk and a moral burden of care.

Technology is rapidly evolving to help provide mental health first aid, helping organisations spot potential indicators of mental health stressors. These technologies use artificial intelligence techniques such as natural language processing and sentiment analysis, to interpret both written and verbal communications and spot the early warning signs, allowing interventions and preventative measures to be made where necessary.

Virtual reality training and therapies can help organisations in terms of both prevention (training) and intervention (therapeutics).

[16] https://www.psychologytoday.com/us/blog/are-you-lonely/202004/loneliness-and-covid-19
J.T. Cacioppo and S. Cacioppo (2018). Lancet, 391(10119), 426. doi: 10.1016/S0140-6736(18)30142-9.

VR Training - Pushing Boundaries, Safely, Remotely

Organisations are already familiar with the need and value in providing staff with training to help prepare them for new, unusual, stressful or dangerous situations.

Virtual reality is now increasingly becoming part of the training mix, as studies show immersive training experiences lead to the improved knowledge retention and increased willingness to apply newly developed skills and knowledge.
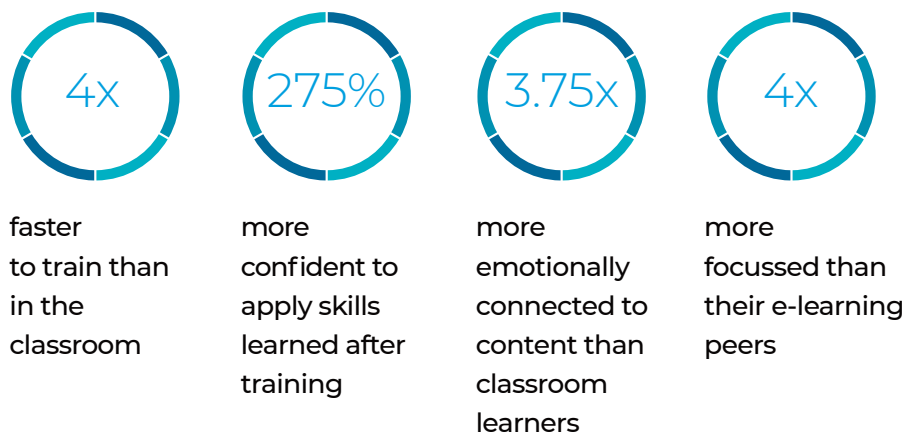
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Technology is continuously advancing and in many cases becoming more affordable, so this study gives us a taste of what's to come. By improving training strategies with the use of technology and stimulated sensory experiences, we are heading in a direction where the workforce will not just enjoy a more immersive and interesting training course but participate in an effective learning experience, so they are better prepared and equipped to stay safe, healthy and well at work.

Mary Ogungbeje Research Manager at IOSH[17]

The IOSH13 research also shows that the increased cognitive engagement afforded by virtual immersion leads to more comprehensive and well established mental models, and in turn, improvements in knowledge recall.

VR learners were:

4x faster to train than in the classroom

275% more confident to apply skills learned after training

3.75x more emotionally connected to content than classroom learners

4x more focussed than their e-learning peers

In a recent study from PWC[18], Virtual Reality training programmes were shown to improve speed, confidence, focus, empathy and emotional connectivity.

[17] https://www.sciencedaily.com/releases/2019/09/190916212516.htm
[18] https://www.pwc.com/us/en/services/consulting/technology/emerging-technology/vr-study-2020.html

Average emotional connection felt to learning content

Classroom	4.29
E-learn	5.29
VR	20.43

Source PwC VR Soft Skills Training Efficacy Study, 2020

The immersive nature of VR creates a sense of "being", through which the participant can experience greater emotional attachment and embodied cognition with the material.

With the possibility of being able to practice and experience the new skills in a safe environment, VR training facilitates better knowledge assimilation and retention, as well as a greater willingness and confidence to apply the new skills outside of the virtual environment.

Virtual training can offer significant upgrades to an organisation's ability to appropriately prepare and equip their staff with critical key skills. Critically, VR learning outcomes show significant improvement versus traditional training. Data from the frontline journalist training company, *head set*, shows up to 40% improvement in outcomes and cost reductions of up to 52%[19] versus other methods.

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We think VR is so powerful for simulating hostile environments because you can learn by feeling and doing. A well-crafted VR narrative brings up the all the emotion of 'being there,' but in a space where mistakes are free. Especially now that COVID is making in-person training difficult, it's a much more engaging and memorable learning tool than training over a video call.

Aela Callan Founder, Head Set

[19] https://www.accenture.com/_acnmedia/pdf-86/accenture-extended-reality-immersive-training.pdf

Pushing boundaries, safely

Whilst VR is technically a safe environment, multi-sensory immersion breaks through the barriers of disbelief and enables participants to fully experience the virtual world in a way that has psychophysiological impact on their real-world body.

Through the emotional and physiological stimulation, Virtual Reality can help participants explore, practice and build empathy in situations that are otherwise difficult, dangerous or undesirable to create in the real world, such as:

- Crime scene and fire forensic investigations

- High risk operational environments, such as offshore oil rigs[20] and mining[21]

- High performance training such as Formula 1 racing[22]

- Hazardous environment, including security services and front-line journalism[15]

- Soft skill development, including; behavioural awareness and change such as diversity, harassment, cognitive bias, and,

- Leadership, resilience and change management[23]

> **"**
> Unbelievable.
> It felt like I was there.
> Brilliant!
>
> **Steve Priest**
>
> Crime Scene Coordinator Lecturer at Wolverhampton University[24]

> **"**
> I felt swept up in it.
> I definitely felt that panicked sensation of; what am I going to do now?
>
> **Head Set participant**
>
> Junior reporter

> **"**
> Training like this makes you think more. It's a really useful tool that takes you right into the thick of that moment.
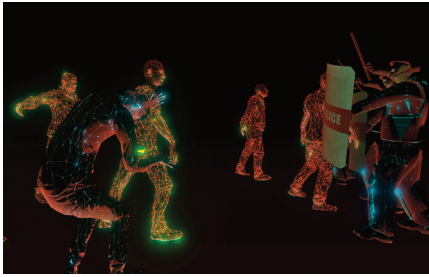>
> **Head Set participant**
>
> Senior experienced reporter

[20]https://www.bp.com/en_us/united-states/home/who-we-are/our-commitment/safety/perfecting-skills-before-we-use-them.html
[21] https://www.cdc.gov/niosh/mining/UserFiles/works/pdfs/vrimt.pdf
[22]https://www.wareable.com/vr/virtual-reality-formula-1-teams-drivers-fans-5554
[23]https://bodyswaps.co/
[24]Participant comments, RiVR crime and fire scene training demonstrations. https://youtu.be/2jbSzh1Hh7Y https://rivr.uk/investigate/

Public Disorder training module, Head Set

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Health and safety training can fail to motivate and engage employees and can lack relevance to real-life contexts. Our research, which has been funded by the Institution of Occupational Safety and Health, suggests that virtual environments can help address these issues, by increasing trainees' engagement and willingness to participate in further training. There are also business benefits associated with the use of virtual environment training, such as the ability to deliver training at or near the workplace and at a time that is convenient to the employee.

Dr Glyn Lawson Associate Professor in the Faculty of Engineering, University of Nottingham

Workplace Therapeutics

Virtual training programmes can help organisations more effectively equip staff for their roles and prepare them for the unexpected. However well prepared staff may be, there will be situations and events that impact well-being and health.

In the US, almost one in five[25] workers report having mental health conditions in any given month, ranging from anxiety disorders including PTSD, obsessive-compulsive and panic disorders, to depression, attention deficit disorder, bipolar disorders and schizophrenia. It is worth noting that, as mentioned in the top of this paper, mental health has more of an economic impact in the U.K. than the most common physical ailment, back pain.

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Anxiety issues are now a massive problem globally. Even before the era of COVID-19 it was estimated that 300 million people worldwide suffer from clinical anxiety disorders. It's clear that the combination of exposure therapy using VR simulations and objective measurement through biometrics offers one of the most powerful tools to improve outcomes and even enable self-treatment, a mission that we in emteq labs have set out to deliver on.

Graeme Cox CEO emteq labs

[25]https://adata.org/factsheet/health

It is important for organisations to build trust with, and support for staff with mental health requirements. Virtual training and therapy programmes can provide an effective, yet discrete solution.

A study into the use of Virtual Reality for the treatment of acrophobia[26] showed how Virtual Reality coaches, or trainers, can help participants successfully address, understand and manage their conditions. In the acrophobia study (fear of heights) participants were coached through various coping mechanisms for managing their fear, and progressively exposed to higher heights. For those who took part in the VR training, on average they showed a reduction in their fear of almost 50%.

Pain, stress, anxiety and mental health are interlinked, psychophysiological responses which cause reinforcement and amplification of physical and mental behaviours and habits. Workplace environments, and external factors, can cause anxiety and stress, which lead to changes in both mental and physical behaviour. The behavioural changes can the lead to further anxiety and stress.

Addressing the link between stress and pain, Virtual Reality company, BehaVR, uses VR to teach stress resilience and emotional balance. Their programmes teach users how to turn off their body's natural stress response, through activation of the parasympathetic nervous system.

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Stress is intertwined with pain. Chronic pain is both physical and emotional.

Aaron Gani BehaVR founder and CEO

[26]https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366(18)30226-8/fulltext

The Opportunity for Mental Well-Being and VR in Organisations

As more organisations embrace and encourage remote distributed teams, their sphere of responsibility towards staff well-being expands beyond their traditional walls, and the lines between occupational training and therapy begin to blur.

In today's COVID-19 climate, organisations are rapidly adapting operations to deal with forever changing regulation, and their staff are finding themselves under new pressures and stresses, without the training or time to adapt. During these changes, workforces and the systems they use are transforming faster than people can train for them using traditional online, or face to face techniques. Beyond technological skills, digitally capable soft skills such as change management, communication and leadership are at a premium, with many organisations frantically looking to up-skill or hire these talents.

During these shifting times, waves of uncertainty and doubt are triggering mental health issues in both traditional and newly distributed workplaces, across both, those predisposed to mental health conditions and those who have had no prior history.

Virtual Reality training and therapy solutions can enable organisations to support individuals discretely on their journey from sub-optimal to healthy and beyond, from healthy to resilient and better prepared for new working practices.

Organisations have much to gain from the improved learning speeds, outcomes and efficiencies that Virtual Reality can deliver in traditional workplaces, as well as in distributed, remote environments, especially when these experiences can be tailored to deliver the appropriate level of emotional challenge and response.

Organisations Delivering VR Solutions for Training and Therapeutics

Despite the well documented benefits of virtual reality in delivering therapeutical and learning development, it has historically been underutilised.

Today, technological advances are spurring improved performance for lowering costs and the latest developments in wireless connectivity sector (such as 5G) are driving industrial and enterprise adoption at greater scale. Together these are making virtual reality technologies more accessible and available for treatment and training.

> **"**
>
> Despite strong evidence of effectiveness, exposure therapy is an underutilized treatment for anxiety disorders at a time when effective treatment for anxiety is greatly needed… VR exposure therapy (VRET) permits individualized, gradual, controlled, immersive exposure that is easy for therapists to implement and often more acceptable to patients than in vivo or imaginal exposure.[27]

Given these advances, the past five years have seen significant progress in the availability and use of immersive and virtual reality solutions for both mental health and occupational training, some of which are outlined below, in alphabetical order:

- **BehaVR** (www.behavr.com) – Immersive Virtual Reality experiences that activate cognitive, emotional and physiological responses, empowering individuals with personalized educational content, emotional regulation skills and stress resilience techniques.

- **CleVR** (www.clevr.net) - Constructing VR systems to treat the fear of heights, flights and social phobias. The organization is conducting experiments to examine the effectiveness of VR as a therapeutic approach to treating social phobias and psychosis. Using dynamic virtual emotion technology, the general environment of such simulated social scenarios can be regulated.

[27]Boeldt D, McMahon E, McFaul M, Greenleaf W. Using Virtual Reality Exposure Therapy to Enhance Treatment of Anxiety Disorders: Identifying Areas of Clinical Adoption and Potential Obstacles. Front Psychiatry. 2019 Oct 25;10:773. doi: 10.3389/fpsyt.2019.00773. PMID: 31708821; PMCID: PMC6823515. https://pubmed.ncbi.nlm.nih.gov/31708821/

- **DR.VR by Rescape** – a virtual reality distraction therapy solution to support pain relief, anxiety/stress and improving patient experience.

- **Head Set** (www.headset.studio) – Use carefully constructed virtual environments to help prepare journalists for the challenges of reporting from hazardous environments, such as riots, conflicts and war zones

- **Healium** (www.tryhealium.com) – Offer a virtual and augmented reality tool for the self-management of stress, powered by the user's own brainwaves and heart rate.

- **Mimerse** (www.mimerse.com) – Provide a virtual reality platform for evidence-based apps for both therapy and training; currently includes relaxation and presentation skills, other projects have included phobia therapy ("Itsy") and pain relief ("Happy Place")

- **oVRcome** (www.ovrcome.io) – Developing a VR platform for overcoming anxiety and phobia disorders, such as fear of spiders and heights or social anxiety.

- **RiVR** (www.rivr.uk) – Using immersive experiences to help safely and efficiently train crime scene and fire specialists for hazardous and emotionally challenging environments.

- **Talespin** (www.talespin.com) – Provide Virtual Reality, Augmented Reality and Mixed Reality to help organisations and individuals up-skill for new business and customer expectations.

- **WarpVR** (www.warpvr.com) – VR training solutions for use in Sales, Recruitment, Safety and Security. The company was involved in helping hospitals train and prepare nurses for the emotional overload of dealing with COVID-19.

- **XRHealth** (www.xr.health) – A virtual reality powered telehealth clinic that treats patients recovering from physical injury, chronic pain, memory decline, hot flashes, chronic stress, and respiratory illness.

The Catch – Use Emotions Responsibly

Immersive virtual training and therapies can provide powerful outcomes in distributed and remote scenarios. The power of these experiences lies in the emotional connection the participant creates with the virtual scenario. Even the most sceptical of participants find it difficult to resist the unconscious detachment from the real world.

In a study into the impact of VR on learning, researchers from the University of Warwick noted the importance and link between emotion and the overall outcome and effectiveness of the training, especially in remote and self-taught scenarios.

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VR was also found to have a very positive impact on mood, with participants having an overall increase in positive emotions and an overall decrease in negative emotions… The positive effects on emotion and engagement in VR are important benefits for both within and outside classroom learning (e.g. distance learning, self-teaching)…it has been demonstrated that individuals' emotions, engagement and motivation are highly linked with each other and they are all important aspects of learning.

Devon Allcoat, Adrian Von Muhlenen [28]

With this rises the need for emotional awareness in virtual reality

In both VR training and therapy scenarios, one size does not fit all. Different participants react differently to the same stimuli; however, the overall effectiveness is hinged on the successful balance between just the right amount of psychophysiological stimulation, and too much. A study into the effectiveness of VR in safety training highlighted that "The higher degree of fear that was induced, the more effective the safety training was." [29]

The key to successfully managing this balance is the ability to accurately measure and adapt to an individual's emotional response to the particular situation.

[28]https://www.researchgate.net/publication/329292469_Learning_in_virtual_reality_Effects_on_performance_emotion_and_engagement/
[29]https://www.iaarc.org/publications/2019_proceedings_of_the_36th_isarc/the_effectiveness_of_virtual_reality_in_safety_training-measurement_of_emotional_arousal_with_electromyography.html

Human emotions are notoriously difficult to measure as they are expressed through a plethora of physical and psychological dimensions, including heart rate, blood flow, pupil dilation, eye movement, skin conductivity, breath, brain activity and muscle activation.

Variations in any one of those dimensions alone could have a multitude of interpretations – increased heart rate could indicate excitement, fear, attraction, illness, recent exercise and more. Therefore, in order to be able to deliver effective and safe virtual training, it is imperative to be able to accurately measure, and adapt to, the individual's emotional response.

Emteq labs' Biofeedback Technology for VR

Emteq labs have a unique approach to delivery the necessary emotional insights, to responsibly and accurately present the appropriate levels of stimulation within personalised VR scenarios.

Our solution combines cutting-edge **Virtual Reality** with sensor data from the wearer **(biofeedback)** to enable personalised treatment and objective measurement.

The Need for Biofeedback for Virtual Environments

Immersive Virtual Reality practices are increasingly seen as a huge benefit in both talking therapies and high-risk or soft-skill organisational training and development.

VR can put the individual either directly in contact with their phobia, or place them in environments that are difficult, costly or dangerous to manage in the real world. Best of all, VR can do this cheaply, effectively and repeatedly.

However, to quote Peter Drucker, "if you can't measure it, you can't improve it". Subjective measures of the stress and fear felt by the participant are imprecise and can lead to negative outcomes – a risk heightened when the therapist or trainer cannot see the participant's response or the environment that they are experiencing.

Therefore, psychological therapies and immersive training delivered though VR could be greatly enhanced by allowing the operator or patient to dial up or down the level of stimulus experienced, based on real-time multi-sensory emotional feedback. However, to date there has been little emphasis on measuring physiological responses for the delivery of personalised experiences.
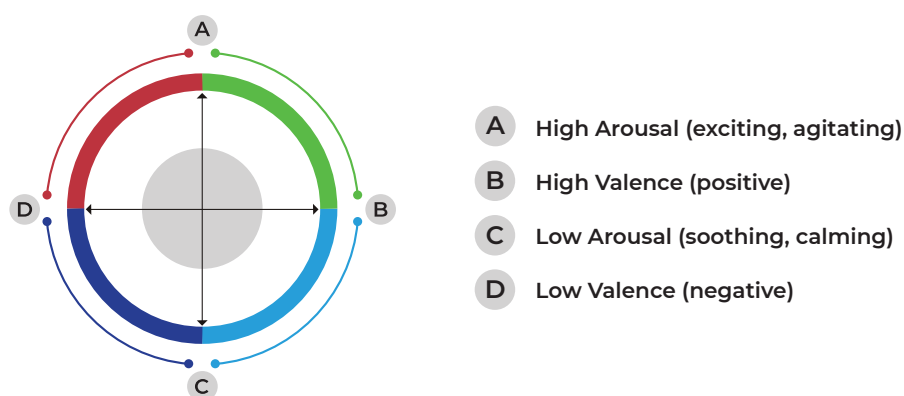
Most mental illness is categorised and shaped by emotional response; anxiety disorders such as phobias, obsessive compulsive disorder or social anxiety are driven by strong emotional responses to stimuli. Data from multiple studies show that depression is characterised by behavioural changes that could be measured over time non-invasively, such as by monitoring changes in physical activities and a reduction in smile activity, together with increased frowning. It is important to recognise that one size does not fit all and taking into account individual differences and contexts is important.

Similarly, research has shown that the level of emotional response to an immersive virtual experience can greatly impact the effectiveness and longevity of the training.

So, there is much to gain from accurate non-invasive measurement of emotional response to virtual stimuli.

Emotional Awareness in VR by emteq labs

Dimensional model

A **High Arousal (exciting, agitating)**

B **High Valence (positive)**

C **Low Arousal (soothing, calming)**

D **Low Valence (negative)**

Emteq labs have spent the last five years researching and developing biofeedback technology that can sense changes in emotional valence (a measurement of positive/negative emotion), attention, gaze, physical movement and physiological measures including skin conductivity, heart rate and heart rate variability within a Virtual Reality experience.

When combined with the virtual scene, trainers and therapists can identify the participants specific emotional response to any given virtual scenario, thereby enabling control over the intensity of the experience for that specific participant.

Through Artificial Intelligence (AI) enabled sensory fusion, emteq labs have refined the output of multiple sensors into an easy to understand two-dimensional model of arousal vs valence that can be accessed via an application programming interface (API).

- **Valence** – a measurement of positive or negative emotion

- **Arousal** – a measurement of physiological activation; engagement, excitement

How does it work?

Our fEMG (facial Electromyography) sensors are built into the facial interface of the VR headset (for Vive Pro, our emteqPRO system replaces the manufacturer provided facial interface).
It requires no gels, wires or other connectors. In addition to the multiple fEMG sensors, we have incorporated PPG sensors within the facial interface to record pulse data.

Features

- Dry EMG sensors array embedded into the headset insert

- No inter-sensory latency

- EMG sampling rate of 1000 samples/sec'

- 24-bit EMG signal resolution

- Photoplethysmographic (PPG) pulse rate

- Heart Rate Variability (HRV)

- Integrated 9DOF accelerometer/gyroscope

- Movement and posture analysis at 50Hz

- Gaze tracking (eye tracking available via HTC Vive Pro Eye integration)

- Live data streaming to Unity via open API

- Automated annotation of context

- Real-time signal quality monitoring

- Export to file for ingest by 3rd party tools (e.g. Matlab)

- SDK for Unity3D engine

- emteq labs dashboard app for data collection and system monitoring. Requires Windows 10.

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