Managing Workplace Anxiety during the Pandemic: A Pilot Study of Natural Imagery through 4K Video and Virtual Reality

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Abstract

Background: Workplace anxiety has become an increasing priority to address. To date, professional interventions that address workplace anxiety involve medications or talk-therapy, yet the response to these modalities is limited or partial. As a result, there is room for other modalities of care. **Aim**: In this pilot study, we examined whether imagery of nature delivered through 4K Video or virtual reality (VR) headsets could be safe and feasible when administered in a workplace setting. We also examined whether they could reduce anxiety and worry. **Methods:** Sixteen employees at a large health insurance company were recruited to participate in the study. All participants completed "pre" and "post" surveys that measured worry or state-anxiety before and after viewing the video or VR interventions respectively. They were instructed to use the interventions at least once a day, three times a week over a two-week period. **Results**: Overall, the Reulay nature-based interventions were safe and feasible. In addition, there were strong signals of efficacy in reducing anxiety and worry for the 4K Video and virtual reality interventions. In certain instances, VR was superior to the 4K Video. **Conclusion**: Nature-based imagery may be a useful intervention to reduce anxiety in the workplace if it is delivered using 4K video or VR headsets. Further studies in larger samples are needed to confirm these findings.

Keywords: Anxiety, Worry, Nature-based imagery, Video, Virtual reality, Panic, Social Anxiety

Introduction

Improving resilience among employees who are distressed, anxious or depressed has long been considered a priority. Such negative sentiments can diminish workplace productivity (Ivandic et al., 2017), increase errors (Rajgopal, 2010), and also result in absenteeism and presenteeism (Street et al., 2019). Approximately one-third of the mental health cost burden is related to productivity losses including unemployment, disability and lower work performance (Birnbaum et al., 2010; Dewa et al., 2011). And in the US, the annual cost of depressive and anxiety disorders is $1.1 trillion (Michalak & Ashkanasy, 2020). Given these widespread emotional and financial costs, the pandemic has heightened the focus on these concerns.

While noninfectious chronic disease patients, quarantined persons, and COVID-19 patients have a higher risk of depression and anxiety (Wu et al., 2021), there is a clear overall increase in anxiety, depression, post-traumatic stress, and "wear and tear" in the population even excluding psychiatric symptoms directly resulting from the viral infection (Nardi & Cosci, 2021). For example, one study compared the prevalence rates of anxiety and depressive disorder of 2019 with those of April-May 2020 in the USA (Twenge & Joiner, 2020). In the latter period, individuals were three times more likely to have anxiety disorders, depression, or both, with more than one in three individuals presenting with one or both disorders. In fact, many experts consider anxiety to be a parallel pandemic along with the viral infection.

While the proper care for anxiety and stress should always begin with a primary care physician who is capable of excluding medical precipitants, many people still do not receive effective and timely treatment due to the low availability, accessibility, and acceptability of traditional counseling (Ha & Kim, 2020). As a result, managers frequently seek solutions for the workplace itself.

One such solution is meditation apps, and some might also work well (Bostock et al., 2019). However, the use of meditation differs by religious group (NW et al., n.d.) (higher among Buddhists and Jehovah's witness and lower among atheists, Christians and Jews) and only 14.2% of American adults surveyed in 2017 said they had practiced meditation at least once in the last year (*Products - Data Briefs - Number 320 - September 2018*, 2020). While this number may be increasing, there is still a gap in research-based alternatives to enhance wellbeing other than traditional meditation for the other 86% of the US population and approximately the same proportion of people globally who do not meditate.

One potential alternative, especially given the lockdown conditions in many parts of the world, is viewing natural imagery. Many studies have demonstrated that nature-based guided imagery can be helpful to boost mood and decrease anxiety (Brown et al., 2013; Case et al., 2018; Nguyen & Brymer, 2018). In addition, especially for people who have no exposure to nature, virtual reality can produce the feeling of immersion

in relaxing imagery that adds another dimension of exposure (Browning et al., 2020; Gorini & Riva, 2008; White et al., 2018).

In this paper, we report on the results of studying whether negative sentiments (e.g. anxiety, sadness, overwhelm, and frustration) can be reduced by brain-based guided imagery experiences delivered as 4K videos with audio immersion or as virtual reality. We used three different experiences which were designed to produce overall calmness, reduce worry, or reduce body tension. These three outcomes correspond with brain circuitry implicated in anxiety (Akirav & Maroun, 2007; Gold et al., 2016), worry (Barker et al., 2018; Buff et al., 2016) and body tension (Kobayashi & Koitabashi, 2016) respectively.

We hypothesized that both the video imagery with audio immersion (VI) and the virtual reality (VR) would be safe and feasible, and that they would decrease negative sentiments, anxiety, worry, and body tension.

Materials and Methods

Participants

Sixteen participants were recruited in two separate rounds by human resource professionals at a large health insurance company to perform a pilot study. They were assigned by that professional to be either in a VI or VR group.

All subjects signed an informed consent form, and they were screened for head injury, seizures, major mental illness, headaches, eyestrain, lightheadedness, nausea, seizures in individuals with photosensitivity, disorientation, and temporary (short term) loss of spatial awareness. No subjects had any of the contraindications to join.

Prior to the study, the participants filled out demographic forms and baseline questionnaires including the STAI-Y1(*The State-Trait Anxiety Inventory (STAI)*, n.d.), GAD-2 (*Generalized Anxiety Disorder 2-Item (GAD-2) - Mental Disorders Screening - National HIV Curriculum*, n.d.), PROMIS-Anxiety short form (*PROMIS Anxiety Short Form.Pdf*, n.d.) and the Reulay Mental Shift Questionnaire (RMSQ), an in-house exploratory tool to measure mental shifts.

To be included in the study, participants had to be at least 18 years old. There were no specifications with regard to level of anxiety or meditation practice.

All 16 participants completed the study, but only 13 of them filled out the questionnaires correctly, so we only included 13 in the final sample.

Overall, there were 14 women and 2 men in the original sample, and 11 women and 2 men completed the surveys to provide usable data. The mean age of the sample was 43.07 ± 7.2 years of age.

Measures

Demographic Questionnaire: This questionnaire asked participants to identify information related to their sex, age, race, education level, experience with meditative practices and history of mental illness.

GAD-2: This questionnaire asks participants to rank how nervous, anxious, on edge or worried they feel on a scale from 0-3, with 0 being "not at all" and 3 being "every day The sensitivity of the GAD-2 is 0.76 (95% CI 0.55-0.89), and specificity is 0.81 (95% CI 0.60-0.92) (Plummer et al., 2016).

STAI-Y1: This 20 item self-report measure indicates the intensity of feelings of anxiety; it distinguishes between state anxiety (a temporary condition experienced in specific situations) and trait anxiety (a general tendency to perceive situations as threatening). This uses a 4-point visual analog scale and the participant indicates how they feel in the moment (1=not at all to 4=very much so). We only tested for state anxiety. Internal consistency coefficients for the scale have ranged from 0.86 to 0.95; test–retest reliability estimates have ranged from 0.65 to 0.75 over a 2-month interval (Gaudry et al., 1975; *Manual*, n.d.).

PROMIS-ANXIETY SHORT FORM (Pilkonis et al., 2011; *PROMIS Anxiety Short Form.Pdf*, n.d.): This questionnaire has 8-items: "I feel fearful", "I found it hard to focus on anything other than my anxiety", "my worries overwhelm me", "I felt uneasy", I felt nervous", "I felt like I needed help for my anxiety", "I felt anxious" and "I felt tense." Participants are asked to rank this as never, rarely, sometimes, often, or always.

RMSQ: This is an internal screening tool for mindset shifts which we constructed prior to the study. Subjects rank (five degrees from strongly agree to strongly disagree) the following questions: I feel annoyed or irritable; 2. I feel tense and stressed out; 3. I feel overwhelmed 4. I feel bored; 5. I feel sad or down; 6. I feel angry or upset; 7. I feel distracted

Negative sentiment scores (NSS): On the basis of these reports, we generated NSS to estimate across the board, whether these interventions decreased negative sentiments. To determine this, we assigned numeric values to the responses that participants gave in their surveys. For example, here are the mapping for participant's answers to the question "How much do you agree with the following statement: I feel overwhelmed": Strongly Disagree – 1; Disagree – 2; Neutral – 3; Agree – 4; Strongly Agree -5

If a question asks about a more positive sentiment, such as "I feel calm", then the mappings shown above are reversed so that higher scores continue to represent negative sentiment. The numerical mappings of a participant's responses are then added up to calculate the negative sentiment score of a given test.

Participants filled out the STAI-Y1 and Promis only at the beginning and end of the entire 2 weeks. They filled out the GAD-2 and RMSQ before and after each experience (six times over the two weeks.)

Procedures

VI Experience: : Study participants were asked to complete a set of questionnaires, followed by being seated at a computer and asked to watch a video with one of three scenes: (Scene 1) natural scenery such as trees, streams and deer; (Scene 2) natural scenery such as a herd of buffalo and shooting stars and (Scene 3) designed to help release body tension with a series of progressive relaxation instructions with a background of a nature scene including stars, a canoe, and a visit to an island of plush green trees. After this viewing they were asked to complete another set of surveys.

VR Experience: Study participants were asked to complete a set of questionnaires, followed by being seated in a room, having been given basic instruction on the VR headgear *[Oculus Quest].* They then initiated the first of the intervention events. They were all approximately 10-minute VR events that involves one of three scenes: (Scene 1) designed for relaxation in nature with natural scenery such as trees, streams and deer, and (Scene 2) designed to help worry with natural scenery such as a herd of buffalo and shooting stars and (Scene 3) designed to help release body tension with a series of progressive relaxation instructions with a background of a nature scene including stars, a canoe, and a visit to an island of green.

After this VR period, participants were asked to complete a second round of two questionnaires. At the conclusion of the experience, the headgear was removed.

After this viewing they were asked to complete a set of surveys as well.

Details of experience:

Experience 1 (Calming) (Abbreviation: Calm)

The in-nature experience was 9-min and 57 seconds in length and produced by Reulay Inc. (New York, NY, United States) using computer graphic imagery (CGI). As the scene opens, there is a forest with redwood trees and a path (Example: see Figure 1). The sky is blue and soft generative music begins playing in the background. Approximately 20 seconds into the experience, a voice begins guiding the viewer through a mindfulness meditation as you are 'walked' through the forest. Near the end of the scene, you come across a river and see a buck from a far distance that looks at the user. From there you continue down the path hearing the sounds of the forest, birds chirping and water streams. The scene ends as you enter a meadow with the sun above while dissolving to white.

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Experience 2 (Worry reduction) (Abbreviation: Distraction)

The distraction-nature experience (Experience # 2) used identical music and identical length at 9-min and 57 seconds produced by Reulay Inc (New York, NY, United States) using computer graphic imagery (CGI). As the scene opens, you are in an open field looking at a flock of birds fly across the sky (Example: see figure 2). Approximately 20 seconds into the experience, a woman's voice begins guiding the viewer through a mindfulness meditation as you are 'walked' through field and see a herd of buffalo and shooting stars (3 mins & 20 seconds). During this experience, the user is gently guided through 3 distraction experiences starting with a flock of birds. Secondarily the user looks at a herd of buffalo. And lastly, as the user makes their way through the experience, they approach the last distraction exercise, which is to look at shooting stars. The scene ends as you look out onto a lake with the moon's light above while dissolving to white.

Experience 3 (Reducing body tension) (Abbreviation: Relaxation)

The somatic-nature experience (Experience # 3) uses similar music produced by Reulay Inc (New York, NY, United States) using computer graphic imagery (CGI). As the scene opens, you are staring at an island in the distance with blue clouds reflecting off the water below (Example: see Figure 3). Approximately 15 seconds into the experience, a woman's voice begins guiding the viewer through a somatic meditation as you are made aware to the sky, water and music around. During this experience, the user is gently guided through a breathing exercise (2:50 mins) while the clouds match your air movement. The user than gently glides in a canoe to a beach side sunset (6min 30 sec). The scene ends with a star light show as the user is how they are unique just as each star is. The sun rises and dissolves to white.

Hypotheses:

Prior to the study, we articulated the following hypotheses:

Hypothesis 1: The Reulay Virtual Reality (VR) and Reulay Online (VI) interventions will be safe and acceptable (measured by participant report and survey)

Hypothesis 2: Participants will demonstrate high adherence to the VR and VI (measured by comparison of actual usage time to usage time prescribed)

Hypothesis 3: Using VR and VI will help reduce anxiety symptoms, worry and body tension) as well as shift negative mindsets to ward positive ones (measured by pre- and post GAD-2 scale and pre and post Reulay Mental Reset Questionnaires)

Hypothesis 4: Using VR and VI will help to decrease STATE ANXIETY as measured by STAI-Y1 at the beginning and end of the study as well as PROMIS at the beginning and end of the study

Hypothesis 5: The majority of participants will find the experience worthwhile and will recommend it

Results

Of the 16 participants recruited, only 13 provided usable data. Below are the results as they relate to the hypotheses.

Hypothesis 1: The Reulay Virtual Reality (VR) and Reulay Online (VI) interventions will be safe and acceptable (measured by participant report and survey)

Sixteen subjects signed up to the trial (9 for the online portal and 7 for the VR experience). All 9 subjects completed the online experience with no side effects and no discomfort. Six of the 7 people completed the VR experience. One person had cybersickness which reversed immediately upon discontinuation. All people were able to complete one 10- minute experience at least once a day for 3 days of the week.

Hypothesis 2: Participants will demonstrate high adherence to the VR and VI (measured by comparison of actual usage time to usage time prescribed)

Aside from the one person who dropped out after 2 full digital experiences, all other people used the VR and VI interventions as prescribed.

Hypothesis 3: Using VR and VI will help reduce anxiety symptoms, worry, and body tension) as well as shift negative mindsets to ward positive ones (measured by pre- and post GAD-2 scale and pre and post Reulay Mental Reset Questionnaires)

GAD-2:

For all 13 participants who completed the study, the mean change in GAD-2 for VR and VI combined was -0.58 ± 0.86 (t = -2.45; p =.03, paired t-test).

When each experience was examined separately, for CALM the mean change in GAD-2 for VR and VI was -0.36 ± 0.55 (N = 11; t =-2.19; p =0.05, paired t-test). For DISTRACTION the mean change in GAD-2 for VR and VI was -0.83 ± .98 (N = 8; t =-2.08; p =0.09, paired t-test). For RELAXATION the mean change in GAD-2 for VR and VI was -1.60 ± 1.6 (N = 6; t =-2.20; p =0.06, paired t-test).

For VR alone, the mean change in GAD-2 was -0.83 ± 1.11 (N = 7; t =-1.99; p =0.09, paired t-test). For VI alone, the mean change in GAD-2 was -0.29 ± 0.33 (N = 6; t =-2.15; p =0.08, paired t-test).

Tables 2 a, b, and c summarize these data

RMSQ

For all 13 participants who completed the study, the mean change in RMSQ for VR and VI combined was -3.12 ± 4.17 (t = -2.7; p =.02, paired t-test).

When each experience was examined separately, for CALM the mean change in RMSQ for VR and VI was -3.64 ± 4.24 (N = 11; t =-2.84; p =0.02, paired t-test). For DISTRACTION the mean change in RMSQ for VR and VI was -0.42 ± 2.33 (N = 6; t =-.43; p =0.67, paired t-test). For RELAXATION the mean change in RMSQ for VR and VI was -2.75 ± 3.96 (N = 8; t =-1.96; p =0.09, paired t-test).

For VR alone, the mean change in RMSQ was -2.97 ± 2.59 (N = 7; t =-3.04; p =0.02, paired t-test). For VI alone, the mean change in RMSQ was -3.29 ± 5.79 (N = 6; t =-1.39; p =0.22, paired t-test).

See Tables 3 a, b, and c for summaries

Negative sentiment scores

For all 13 participants who completed the study, the mean change in negative sentiment for VR and VI combined was -3.71 ± 4.24 (t = 3.02; p =.01, repeated measures ANOVA).

When each experience was examined separately, for CALM the mean change in negative sentiment for VR and VI was -4.0 ± 4.3 (N = 11; t =-3.09; p =0.01, repeated measures ANOVA).

For DISTRACTION the mean change in negative sentiment for VR and VI was -1.25 ± 3.03 (N = 6; t =-1.01; p =0.35, repeated measures ANOVA). For RELAXATION the mean change in negative sentiment for VR and VI was -4.0 ± 5.3 (N = 8; t =-2.14; p =0.07, repeated measures ANOVA).

For VR alone, the mean change in negative sentiment was -3.81 ± 3.4 (N = 7; t =-2.96; p =0.03, repeated measures ANOVA). For VI alone, the mean change in negative sentiment was -3.58 ± 5.7 (N = 6; t =-1.52; p =0.19, repeated measures ANOVA).

Hypothesis 4: Using VR and VI will help to decrease STATE ANXIETY as measured by STAI-Y1 at the beginning and end of the study as well as PROMIS at the beginning and end of the study

PROMIS:

There was only one participant who completed the test correctly for two weeks in a row so Week 1 had a sample size of 10 and Week 2 had a sample size of 1. We were unable to extract any meaningful data here as people only answered some of the questions.

Post-hoc, where there were sufficient questions on these items that were answered, the items "I feel tense and stressed out" and "I feel sad both showed meaningful reductions across all participants (N =13, W = 4.5, p = .01 and N = 13; W = 4.0; p = .02 , Wilcoxon signed-rank test)

STAI-Y1

There was only one participant who completed the test correctly for two weeks in a row so Week 1 had a sample size of 10 and Week 2 had a sample size of 1. We were able to extract limited meaningful data here as people only answered some of the questions.

Overall, for VR and VI, the mean change in STAI-Y1 was -5.8 ± 16.9 (N = 10, t = -.18; p =-.31, paired t-test). For VR alone, the mean change in STAI-Y1 was -9.2 ± 10.7 (N = 6, t = -2.1; p =.09, paired t-test). For VI alone, the mean change in STAI-Y1 was -7.5 ± 24.8 (N = 4, t = -.06, p = .96).

Table 4 summarizes these findings

Post hoc, for the item "I feel calm" there were statistically significant reductions after 2 weeks (SS =10; W = 5; p = .02)

Hypothesis 5: The majority of participants will find the experience worthwhile and will recommend it

Seventy five percent of participants found this study worthwhile to participate in, 17% were unsure, and 8% did not. Eighty three percent of them agree that the imagery was a welcome break and 67% said they felt more relaxed after seeing it. There was a 50% / 50% split on whether or not the imagery should be longer or shorter.

Discussion

In this sample of 13 corporate employees who were randomly assigned to VR and VI groups, 10-minutes of exposure to guided imagery through nature using VR or 4 K video proved to be safe feasible and appealing if experienced at least once daily, three times a week. In addition, there were strong signals that a 10-minute guided experience through nature could provide a much-needed break during the day.

For this group of individuals, we found statistically significant changes in GAD-2 for the group as a whole, and trends toward statistical significance for VR and VI separately. Among the three experiences, exposure to the "calm" experience only resulted in statistically significant changes in GAD-2, whereas there was a trend toward significance in the somatic relaxation group, but no statistical significant changes in GAD-2 the group exposed to the distraction experience. In addition, statistically significant changes were found for all experiences together for the VR group, but not for the VI group. When we used our exploratory RMSQ Tool, we found statistically significant differences after the experience compared to prior to the experience across the entire two weeks for VR and VI combined, for the calm experience only, and for VR but not VI. There was a trend toward statistical significance for the somatic relaxation experience. For state-anxiety, there were no

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statistically significant changes at 2 weeks compared to baseline for VR and VI combined, but for VR alone there were statistically significant changes in state anxiety.

Overall, these findings indicate that nature-based guided imagery may be helpful for nervousness, anxiety, feeling on edge, or worrying, as well as "emotional distress" characterized by annoyance, tension, overwhelm, boredom, sadness, anger, or distraction. In addition, in this setting an experience designed to induce calmness is more powerful than one designed to induce somatic relaxation or distraction at a group level. Also, while VR and VI are both potentially helpful, it spears that for this group, VR was superior for annoyance, tension, overwhelm, boredom, sadness, anger, or distraction as well as state-anxiety.

Our findings are consistent with prior studies that demonstrate the positive effects of viewing nature on anxiety (Brown et al., 2013; Jo et al., 2019; Nguyen & Brymer, 2018), as well as studies that have demonstrated the anxiety -reducing impact of nature in VR (Browning et al., 2020; Ioannou et al., 2020; White et al., 2018). Given that burnout rates and psychological distress are both high in the workforce especially when there are large-scale changes (Alrawashdeh et al., 2021; Sklar et al., 2021), this intervention could be a much needed and helpful one for people at work. In addition, given the impact of anxiety on work-family balance (Mahgoub et al., 2021), this intervention could also have profound consequences on a person's home life. Also, rates of anxiety were found in one study to be more than three times the baseline high rate of anxiety in the general population, so additional interventions could be very helpful indeed (Santabárbara et al., 2021). Many people are also experiencing tremendous anxiety due to job insecurity as a result of changes in the workplace (Ganson et al., 2021), and younger people may be especially susceptible to anxiety (Varma et al., 2021).

Limitations of this study include the relatively small sample size, the lack of a waitlist control, and the large standard deviations in some of the analyses, which might have benefitted from machine learning over a longer period of time and with a larger sample. Also, while the RMSQ is an exploratory questionnaire, it is not validated.

However, the GAD-2 and STAI-Y1 have been validated extensively, and the strong findings from these small samples suggest that the anxiety-reduction signal is worth noting. Also the this study has the strength of exploration of a relatively unique but feasible method of reducing anxiety at a time when companies appear to be acquiring VR headsets for their employees (*Accenture Orders Record 60,000 Oculus Headsets*, 2021; careers & Clients, n.d.). Also, this intervention can be delivered at scale in wellness rooms or departments that have partially returned to work.

Perhaps most notable is the fact that that 75% of participants found this experience worthwhile, and 83% of them experienced it as a welcome break. Given the harmful

impact of work-related stress on factors as wide-ranging as productivity(Bui et al., 2021), absenteeism(HEO et al., 2015), presenteeism (Van Der Feltz-Cornelis et al., 2020), and even genes (Gottschalk et al., 2020), it would be worth exploring if this intervention can demonstrate an impact on all of these variables as well. Also, given that half of all people with generalized anxiety disorder will not respond to first-line treatment (Ansara, 2020), and given that most clinical trials of anxiety disorders document response rates of 50% to 60% and remission rates between 25% and 35% (Roy-Byrne, 2015), there is clearly a place for additional potentially helpful tools such as nature-based imagery, and in particular VR, which offers a unique and distinct ability for immersion in nature (Diemer et al., 2015; Gutiérrez et al., 2007; Joo et al., 2021).

Overall, this pilot study provides strong signals that nature-based imagery can provide a welcome break and reduce generalized anxiety and state anxiety, especially if delivered through VR. Future studies using larger sample sizes with a control condition would significantly add to the current line of inquiry. Also, examining individualized responses would help to further understand how interventions may be tailored toward specific groups of people.

References

[1] Accenture Orders Record 60,000 Oculus Headsets. (2021, October 19). XR Today. https://www.xrtoday.com/virtual-reality/accenture-orders-record-60000-oculus-headsets/

[2] Akirav, I., & Maroun, M. (2007). The Role of the Medial Prefrontal Cortex-Amygdala Circuit in Stress Effects on the Extinction of Fear. Neural Plasticity, 2007. https://doi.org/10.1155/2007/30873

[3] Alrawashdeh, H. M., Al-Tammemi, A. B., Alzawahreh, M. Kh., Al-Tamimi, A., Elkholy, M., Al Sarireh, F., Abusamak, M., Elehamer, N. M. K., Malkawi, A., Al-Dolat, W., Abu-Ismail, L., Al-Far, A., & Ghoul, I. (2021). Occupational burnout and job satisfaction among physicians in times of COVID-19 crisis: A convergent parallel mixed-method study. BMC Public Health, 21, 811. https://doi.org/10.1186/s12889-021-10897-4

[4] Ansara, E. D. (2020). Management of treatment-resistant generalized anxiety disorder. The Mental Health Clinician, 10(6), 326–334. https://doi.org/10.9740/mhc.2020.11.326

[5] Barker, H., Munro, J., Orlov, N., Morgenroth, E., Moser, J., Eysenck, M. W., & Allen, P. (2018). Worry is associated with inefficient functional activity and connectivity in prefrontal and cingulate cortices during emotional interference. Brain and Behavior, 8(12), e01137. https://doi.org/10.1002/brb3.1137

[6] Birnbaum, H. G., Kessler, R. C., Kelley, D., Ben-Hamadi, R., Joish, V. N., & Greenberg, P. E. (2010). Employer burden of mild, moderate, and severe major

depressive disorder: Mental health services utilization and costs, and work performance. Depression and Anxiety, 27(1), 78–89. https://doi.org/10.1002/da.20580

[7] Bostock, S., Crosswell, A. D., Prather, A. A., & Steptoe, A. (2019). Mindfulness on-the-go: Effects of a mindfulness meditation app on work stress and well-being. Journal of Occupational Health Psychology, 24(1), 127–138. https://doi.org/10.1037/ocp0000118

[8] Brown, D. K., Barton, J. L., & Gladwell, V. F. (2013). Viewing Nature Scenes Positively Affects Recovery of Autonomic Function Following Acute-Mental Stress. Environmental Science & Technology, 47(11), 5562–5569. https://doi.org/10.1021/es305019p

[9] Browning, M. H. E. M., Mimnaugh, K. J., van Riper, C. J., Laurent, H. K., & LaValle, S. M. (2020). Can Simulated Nature Support Mental Health? Comparing Short, Single-Doses of 360-Degree Nature Videos in Virtual Reality With the Outdoors. Frontiers in Psychology, 10. https://doi.org/10.3389/fpsyg.2019.02667

[10] Buff, C., Brinkmann, L., Neumeister, P., Feldker, K., Heitmann, C., Gathmann, B., Andor, T., & Straube, T. (2016). Specifically altered brain responses to threat in generalized anxiety disorder relative to social anxiety disorder and panic disorder. NeuroImage : Clinical, 12, 698–706. https://doi.org/10.1016/j.nicl.2016.09.023

[11] Bui, T., Zackula, R., Dugan, K., & Ablah, E. (2021). Workplace Stress and Productivity: A Cross-Sectional Study. Kansas Journal of Medicine, 14, 42–45. https://doi.org/10.17161/kjm.vol1413424

[12] careers, I. training technology helps B. of A. teammates further develop the skills needed to grow their, & Clients, M. the D. N. of. (n.d.). Bank of America is First in Industry to Launch Virtual Reality Training Program in Nearly 4,300 Financial Centers. Bank of America. Retrieved November 26, 2021, from https://newsroom.bankofamerica.com/content/newsroom/press-releases/2021/10/bank-of-america-is-first-in-industry-to-launch-virtual-reality-t.html

[13] Case, L. K., Jackson, P., Kinkel, R., & Mills, P. J. (2018). Guided Imagery Improves Mood, Fatigue, and Quality of Life in Individuals With Multiple Sclerosis: An Exploratory Efficacy Trial of Healing Light Guided Imagery. Journal of Evidence-Based Integrative Medicine, 23. https://doi.org/10.1177/2515690X17748744

[14] Dewa, C. S., Thompson, A. H., & Jacobs, P. (2011). The association of treatment of depressive episodes and work productivity. Canadian Journal of Psychiatry. Revue Canadienne De Psychiatrie, 56(12), 743–750. https://doi.org/10.1177/070674371105601206

[15] Diemer, J., Alpers, G. W., Peperkorn, H. M., Shiban, Y., & Mühlberger, A. (2015). The impact of perception and presence on emotional reactions: A review of

research in virtual reality. Frontiers in Psychology, 6, 26. https://doi.org/10.3389/fpsyg.2015.00026

[16] Ganson, K. T., Tsai, A. C., Weiser, S. D., Benabou, S. E., & Nagata, J. M. (2021). Job Insecurity and Symptoms of Anxiety and Depression Among U.S. Young Adults During COVID-19. The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine, 68(1), 53–56. https://doi.org/10.1016/j.jadohealth.2020.10.008

[17] Gaudry, E., Vagg, P., & Spielberger, C. D. (1975). Validation of the State-Trait Distinction in Anxiety Research. Multivariate Behavioral Research, 10(3), 331–341. https://doi.org/10.1207/s15327906mbr1003_6

[18] Generalized Anxiety Disorder 2-item (GAD-2)—Mental Disorders Screening—National HIV Curriculum. (n.d.). Retrieved April 13, 2021, from https://www.hiv.uw.edu/page/mental-health-screening/gad-2

[19] Gold, A. L., Shechner, T., Farber, M. J., Spiro, C. N., Leibenluft, E., Pine, D. S., & Britton, J. C. (2016). Amygdala-cortical connectivity: Associations with anxiety, development, and threat. Depression and Anxiety, 33(10), 917–926. https://doi.org/10.1002/da.22470

[20] Gorini, A., & Riva, G. (2008). The potential of Virtual Reality as anxiety management tool: A randomized controlled study in a sample of patients affected by Generalized Anxiety Disorder. Trials, 9, 25. https://doi.org/10.1186/1745-6215-9-25

[21] Gottschalk, M. G., Domschke, K., & Schiele, M. A. (2020). Epigenetics Underlying Susceptibility and Resilience Relating to Daily Life Stress, Work Stress, and Socioeconomic Status. Frontiers in Psychiatry, 11. https://doi.org/10.3389/fpsyt.2020.00163

[22] Gutiérrez, F., Pierce, J., Vergara, V. M., Coulter, R., Saland, L., Caudell, T. P., Goldsmith, T. E., & Alverson, D. C. (2007). The effect of degree of immersion upon learning performance in virtual reality simulations for medical education. Studies in Health Technology and Informatics, 125, 155–160.

[23] Ha, S. W., & Kim, J. (2020). Designing a Scalable, Accessible, and Effective Mobile App Based Solution for Common Mental Health Problems. International Journal of Human–Computer Interaction, 36(14), 1354–1367. https://doi.org/10.1080/10447318.2020.1750792

[24] HEO, Y.-S., LEEM, J.-H., PARK, S.-G., JUNG, D.-Y., & KIM, H.-C. (2015). Job stress as a risk factor for absences among manual workers: A 12-month follow-up study. Industrial Health, 53(6), 542–552. https://doi.org/10.2486/indhealth.2015-0021

[25] Ioannou, A., Papastavrou, E., Avraamides, M. N., & Charalambous, A. (2020). Virtual Reality and Symptoms Management of Anxiety, Depression, Fatigue, and Pain: A Systematic Review. SAGE Open Nursing, 6, 2377960820936163. https://doi.org/10.1177/2377960820936163

[26] Ivandic, I., Kamenov, K., Rojas, D., Cerón, G., Nowak, D., & Sabariego, C. (2017). Determinants of Work Performance in Workers with Depression and Anxiety: A Cross-Sectional Study. International Journal of Environmental Research and Public Health, 14(5). https://doi.org/10.3390/ijerph14050466

[27] Jo, H., Song, C., & Miyazaki, Y. (2019). Physiological Benefits of Viewing Nature: A Systematic Review of Indoor Experiments. International Journal of Environmental Research and Public Health, 16(23). https://doi.org/10.3390/ijerph16234739

[28] Joo, Y., Kim, E.-K., Song, H.-G., Jung, H., Park, H., & Moon, J. Y. (2021). Effectiveness of virtual reality immersion on procedure-related pain and anxiety in outpatient pain clinic: An exploratory randomized controlled trial. The Korean Journal of Pain, 34(3), 304–314. https://doi.org/10.3344/kjp.2021.34.3.304

[29] Kobayashi, S., & Koitabashi, K. (2016). Effects of progressive muscle relaxation on cerebral activity: An fMRI investigation. Complementary Therapies in Medicine, 26, 33–39. https://doi.org/10.1016/j.ctim.2016.02.010

[30] Mahgoub, I. M., Abdelrahman, A., Abdallah, T. A., Mohamed Ahmed, K. A. H., Omer, M. E. A., Abdelrahman, E., & Salih, Z. M. A. (2021). Psychological effects of the COVID-19 pandemic: Perceived stress, anxiety, work-family imbalance, and coping strategies among healthcare professionals in Khartoum state hospitals, Sudan, 2021. Brain and Behavior, 11(8), e2318. https://doi.org/10.1002/brb3.2318

[31] Manual: State-Trait Anxiety Inventory for Adults. (n.d.). Retrieved April 13, 2021, from https://www.mindgarden.com/state-trait-anxiety-inventory-for-adults/29-staiad-manual.html

[32] Michalak, R. T., & Ashkanasy, N. M. (2020). Working with monsters: Counting the costs of workplace psychopaths and other toxic employees. Accounting & Finance, 60(S1), 729–770. https://doi.org/10.1111/acfi.12369

[33] Nardi, A. E., & Cosci, F. (2021). Expert opinion in anxiety disorder: Corona-phobia, the new face of anxiety. Personalized Medicine in Psychiatry, 25, 100070. https://doi.org/10.1016/j.pmip.2021.100070

[34] Nguyen, J., & Brymer, E. (2018). Nature-Based Guided Imagery as an Intervention for State Anxiety. Frontiers in Psychology, 9. https://doi.org/10.3389/fpsyg.2018.01858

[35] NW, 1615 L. St, Suite 800Washington, & Inquiries, D. 20036USA202-419-4300 | M.-857-8562 | F.-419-4372 | M. (n.d.). Meditation common across many U.S. religious groups. Pew Research Center. Retrieved April 13, 2021, from https://www.pewresearch.org/fact-tank/2018/01/02/meditation-is-common-across-many-religious-groups-in-the-u-s/

[36] Pilkonis, P. A., Choi, S. W., Reise, S. P., Stover, A. M., Riley, W. T., Cella, D., & PROMIS Cooperative Group. (2011). Item banks for measuring emotional distress from the Patient-Reported Outcomes Measurement Information

System (PROMIS®): Depression, anxiety, and anger. Assessment, 18(3), 263–283. https://doi.org/10.1177/1073191111411667

[37] Plummer, F., Manea, L., Trepel, D., & McMillan, D. (2016). Screening for anxiety disorders with the GAD-7 and GAD-2: A systematic review and diagnostic metaanalysis. General Hospital Psychiatry, 39, 24–31. https://doi.org/10.1016/j.genhosppsych.2015.11.005

[38] Products—Data Briefs—Number 320—September 2018. (2020, June 26). https://www.cdc.gov/nchs/products/databriefs/db325.htm

[39] PROMIS Anxiety Short form.pdf. (n.d.). Retrieved April 13, 2021, from https://ogg.osu.edu/media/documents/MB%20Stream/PROMIS%20Anxiety%20Short%20form.pdf

[40] Rajgopal, T. (2010). Mental well-being at the workplace. Indian Journal of Occupational and Environmental Medicine, 14(3), 63–65. https://doi.org/10.4103/0019-5278.75691

[41] Roy-Byrne, P. (2015). Treatment-refractory anxiety; definition, risk factors, and treatment challenges. Dialogues in Clinical Neuroscience, 17(2), 191–206.

[42] Santabárbara, J., Lasheras, I., Lipnicki, D. M., Bueno-Notivol, J., Pérez-Moreno, M., López-Antón, R., De la Cámara, C., Lobo, A., & Gracia-García, P. (2021). Prevalence of anxiety in the COVID-19 pandemic: An updated meta-analysis of community-based studies. Progress in Neuro-Psychopharmacology & Biological Psychiatry, 109, 110207. https://doi.org/10.1016/j.pnpbp.2020.110207

[43] Sklar, M., Ehrhart, M. G., & Aarons, G. A. (2021). COVID-related work changes, burnout, and turnover intentions in mental health providers: A moderated mediation analysis. Psychiatric Rehabilitation Journal, 44(3), 219–228. https://doi.org/10.1037/prj0000480

[44] Street, T. D., Lacey, S. J., & Somoray, K. (2019). Employee Stress, Reduced Productivity, and Interest in a Workplace Health Program: A Case Study from the Australian Mining Industry. International Journal of Environmental Research and Public Health, 16(1). https://doi.org/10.3390/ijerph16010094

[45] The State-Trait Anxiety Inventory (STAI). (n.d.). Https://Www.Apa.Org. Retrieved April 13, 2021, from https://www.apa.org/pi/about/publications/caregivers/practice-settings/assessment/tools/trait-state

[46] Twenge, J. M., & Joiner, T. E. (2020). U.S. Census Bureau-assessed prevalence of anxiety and depressive symptoms in 2019 and during the 2020 COVID-19 pandemic. Depression and Anxiety, 37(10), 954–956. https://doi.org/10.1002/da.23077

[47] Van Der Feltz-Cornelis, C. M., Varley, D., Allgar, V. L., & de Beurs, E. (2020). Workplace Stress, Presenteeism, Absenteeism, and Resilience Amongst University Staff and Students in the COVID-19 Lockdown. Frontiers in Psychiatry, 11, 588803. https://doi.org/10.3389/fpsyt.2020.588803

[48] Varma, P., Junge, M., Meaklim, H., & Jackson, M. L. (2021). Younger people are more vulnerable to stress, anxiety and depression during COVID-19 pandemic: A global cross-sectional survey. Progress in Neuro-Psychopharmacology & Biological Psychiatry, 109, 110236. https://doi.org/10.1016/j.pnpbp.2020.110236

[49] White, M. P., Yeo, N. L., Vassiljev, P., Lundstedt, R., Wallergård, M., Albin, M., & Lõhmus, M. (2018). A prescription for "nature" – the potential of using virtual nature in therapeutics. Neuropsychiatric Disease and Treatment, 14, 3001–3013. https://doi.org/10.2147/NDT.S179038

[50] Wu, T., Jia, X., Shi, H., Niu, J., Yin, X., Xie, J., & Wang, X. (2021). Prevalence of mental health problems during the COVID-19 pandemic: A systematic review and meta-analysis. Journal of Affective Disorders, 281, 91–98. https://doi.org/10.1016/j.jad.2020.11.117

Table 1: Demographics

Mean Age (± SD)	43.07 ± 7.2
Female/Male	11/2

Table 2: GAD-2

Post-pre differences in GAD-2 Overall (R-VR and R-NI)

N	Mean	SD	t	p
13	-0.58	0.9	2.45	.031**

** Statistically significant

Table 2a: Mean changes in GAD-2 for VR and VI combined

Post-pre differences in GAD-2 (VR and VI)

N	Mean	SD	t	p

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Calm	11	-0.36	0.55	-2.19	.05**
Distraction	8	-1.25	1.6	-2.20	.06*
Relaxation	8	-0.83	0.98	-2.08	.09*

** Statistically significant; * Statistical trend

Table 2b: Mean changes in GAD-2 for VR and VI combined for each experience separately

Post-pre differences in GAD-2 (VR and VI separately)

	N	Mean	SD	t	p
R-VR	7	-0.83	1.1	-1.99	.09*
R-NI	6	-0.29	0.3	-2.15	.08*

* Statistical trend

Table 2c: Mean changes in GAD-2 for VR and VI separately

Table 3

RMSQ

Post-pre differences in RMSQ Overall (R-VR and R-NI)

N	Mean	SD	t	p
13	-3.12	4.17	2.70	.02**

** Statistically significant

Table 3a: Mean changes in RMSQ for VR and VI combined

Post-pre differences in RMSQ (VR and VI)

	N	Mean	SD	t	p
Calm	11	-3.64	4.24	-2.84	.02**
Distraction	8	-2.75	3.96	-1.96	.09*
Relaxation	6	-0.41	2.33	-.43	NS

** Statistically significant; * Statistical trend

Table 3b: Mean changes in RMSQ for VR and VI combined for each experience separately

Post-pre differences in RMSQ (VR and VI separately)

	N	Mean	SD	t	p
R-VR	7	-2.97	2.6	-3.05	.02**
R-NI	6	-3.29	5.8	-1.39	NS

** Statistical trend; NS = non-significant

Table 3c: Mean changes in RMSQ for VR and VI separately

Table 4

STAI-Y1

Post-pre differences in STAI-Y1 Overall (R-VR and R-NI)

N	Mean	SD	t	p
10	-5.8	16.9	-1.08	NS

NS = non-significant

Table 4a: Mean changes in STAI-Y1 for VR and VI combined

Post-pre differences in GAD-2 (VR and VI separately)

	N	Mean	SD	t	p
R-VR	6	-9.2	10.7	2.11	.09**
R-NI	4	-0.75	24.8	0.06	NS

**Statistical trend

¶Sample sizes were too small to examine each paradigm separately

Table 4b: Mean changes in RMSQ for VR and VI separately¶

Figure 1: Photograph of a segment of the first VR and VI experience called "walk in the woods"

Figure 2: Photograph of a segment of the second VR and VI experience called "distraction-nature"

Figure 3: Photograph of a segment of the third VR and VI experience called "somatic-nature"