CASE STUDY

Neuroguided Performance Training Improves Mental Health
Outcomes in **First Responders** Utilizing the Vital Neuro Method

White Paper by Susie Reiner, PhD, ACSM-EP, CSCS

CONTENTS

SUMMARY

First responders are the first to mitigate danger and provide aid in the case of an emergency, environmental disaster, structural fire, terrorist attack, or crime. These careers carry some of the highest risk and uncertainty, resulting in higher rates of cardiovascular disease risk and PTSD than the general population. Interventions that promote improved sleep, well-being, and stress management are essential to maintaining long-term physical and mental health. Vital Neuro leverages advanced neurofeedback technology to provide a highly accessible solution that can be seamlessly integrated into daily life, effectively reducing the barriers to seeking help for mental health concerns. **In this case study, a group of 30 first responders including firefighters, EMS, and law enforcement officers engaged in a 6-week intervention integrating the Vital Neuro method into their daily routines.** While these are preliminary findings, the results indicate a substantial decrease in anxiety, depression, stress, and burnout levels, accompanied by notable enhancements in sleep quality and overall well-being.

THE POPULATION OF INTEREST

As the name implies, first responders are tactical professionals who are first on the scene in an emergency—including law enforcement officers (LEOs), firefighters, emergency medical services (EMS), and other rescue medical professionals.

First responders endure highly physical demands, repeated exposures to traumatic events, unpredictable and potentially dangerous environments, and the strains of shift work[1]. They are also regularly exposed to traumatic critical incidents, thus placing them at a higher risk for developing stress-related mental and physical health issues than the general population[2,3]. Chronic stress is also associated with higher sympathetic nervous system response (flight or fight response) at rest, characterized by a low heart rate variability. Research has shown that HRV is indirectly correlated to performance on a physical performance test, indicating higher stress negatively affects job task performance[4,5]. This routine occupational stress when compounded with sleep disturbances and healthy coping mechanisms may predict the development of post traumatic stress syndrome (PTSD) in first responders[6] and may influence coping behaviors such as alcohol and nicotine use, sleep disturbances, and occupational burnout[7].

While improving mental health is a priority in this particular population, 33% of first responders feel there is a stigma to seeking mental health assistance[8]. LEOs cite barriers to utilizing mental health services such as negative perceptions, concerns of confidentiality and job consequences, and lack of social support for seeking help[9]. When using mental health resources could result in a misconstrued perception to their commanding officers that they are not ready to return to duty, it may be easier to avoid seeking help. However, mental health difficulties as a result of trauma-related psychopathology, left untreated, are likely to negatively affect quality of life and work performance, making strategies for prevention crucial[10]. Previous interventions aimed to improve mindfulness have improved self-reported perceived stress, resilience, burnout, emotional intelligence and regulation, physical health, fatigue, sleep, and anger[11].

In terms of physical health, LEOs show high prevalence of metabolic risk factors for cardiovascular disease including hypertension, dyslipidemia, and obesity[12-14].

Similar findings are evident in career firefighters with higher rates than the general population of metabolic syndrome and obesity[15,16]. One study found 49% of the sampled firefighter population did not meet the VO2max cutoff point, indicating low cardiorespiratory fitness[17]. Higher BMI and older age is associated with high blood pressure, dyslipidemia, and high glucose levels in career firefighters[18]—indicating a need for early and sustained interventions to mitigate risks of chronic health complications.

First responders play a vital role in mitigating the effects of disasters, violence, and uncertainty in everyday life. The demands placed upon this population creates a necessity for interventions that facilitate resilience and healthy coping mechanisms.
While exercise on duty may reduce short-term work efficiency[19,20], Neuroguided Performance Training may be a viable and accessible tool for first responders to recover and refocus before going out on another call and improve overall experiences of relaxation and sleep throughout the day. The current case study explores the potential benefits of the Vital Neuro method in improving mental and physical health in first responders.


VITAL NEURO TECHNOLOGY

Developed by best-in-class technology and based on decades of neuroscience research, Vital Neuro hardware and software together provides scalable solutions that can rewire the brain for optimal performance. The brain fluidly adapts based on subtle environmental cues. The ability of neural networks of the brain to change through growth and reorganization is called neuroplasticity—and it can be harnessed by the individual through neurofeedback, deep meditation, focus, and music.

Whether the goal is to manage stress and anxiety or increase focus and productivity, Vital Neuro's Neuroguided Performance Training leverages real-time electroencephalography (EEG) neurofeedback and personalized music therapy, to seamlessly shifts the brain state. The technology monitors the electrical activity of the brain and provides visual cues to improve self-regulation[21]. Research suggests that by controlling brain waves through neurofeedback, participants can improve attention, working memory, and executive function[22]—

improving productivity and potentially staving off age-related cognitive decline. In other words, neurofeedback is a way to train your brain for optimal performance. In a clinical or laboratory setting EEG and other neural measures can be costly and invasive, but the Vital Neuro method brings this technology into the real-world using comfortable bluetooth headphones. Aimed to improve mental, emotional, and physical well-being, Vital Neuro helps people live their best life.

Vital Neuro is a simple yet effective tool that can be performed from the privacy of ones' home—a key feature for the First Responder. Mental performance scores are confidential and anonymous to an outside user—making it easier to improve mental health outcomes without the barriers of seeking traditional mental health care. Aimed to improve mental, emotional, and physical well-being, Vital Neuro helps people live their best life.
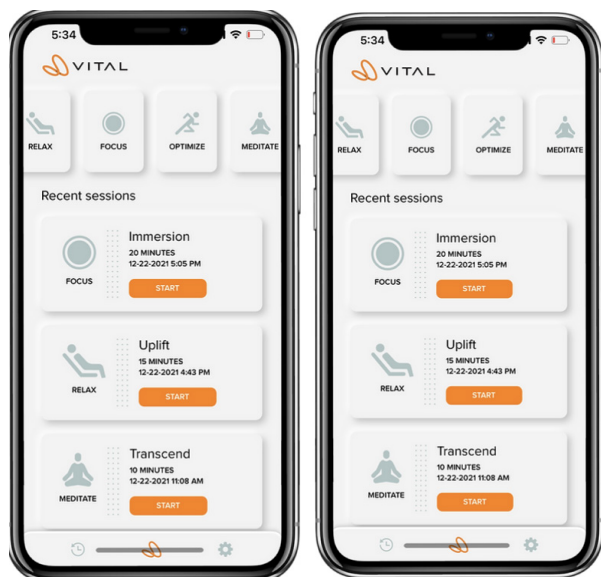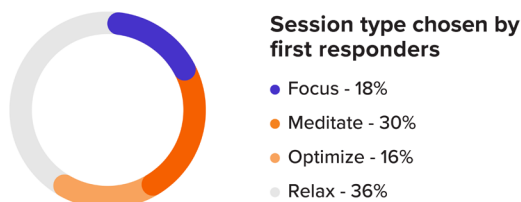

THE STUDY PROTOCOL

The sample included 5 law enforcement officers, 9 career firefighters, and 17 career firefighter paramedics (Mean age=39 years ± 10 years, 7 female and 23 male). Close to half of the participants held their position for 15 years or more, 6 held their position for 6-10 years, and 8 were early career first responders with 0-1 (one participant) and 2-5 years (7 participants). The sample included first responders from across the United States including Arizona, Utah, New York, Illinois, Wisconsin,

Washington, and Colorado. Participants completed survey questionnaires prior to starting Vital Neuro sessions, at the 3-week mark, and following the 6-week intervention. Participants were provided the following protocol recommendation:

Upon Waking	10-20 min Relax
Before Shift	10-20 min Focus
On Breaks	10-20 min Relax
After Shift	10-20 min Relax If overly stressed or sleep deprived.
Before Bed	10-20 min Meditate

Keeping the recommendations in mind, participants ultimately self-selected the timing, type, and length of Vital sessions based on their schedule and preferences. No other instructions were provided to change lifestyle habits including physical activity, sleep, or nutrition and there was no attempt to control for those factors in the study design.

A total of 29 participants participated in the 6-week intervention and completed all pre-testing, mid-point, and post-testing. The participants engaged in 12, 665 minutes of Vital Neuro sessions over the 6-week period with an average session length of 14 minutes at a time. The most popular type or goal of session that the participants chose was "Relax", followed by "Meditate." The pie chart below shows the breakdown by type/goal of session participation.

Session type chosen by first responders
- Focus - 18%
- Meditate - 30%
- Optimize - 16%
- Relax - 36%

THE OUTCOME MEASURES

Anxiety: Anxiety is a normal human emotion, but in excess, it can become pervasive and even take on pathological significance as a disorder. At this stage, anxiety can interrupt activities of daily living, compromising personal and professional life. The Generalized Anxiety Disorder scale-7 (GAD-7)* is a seven-item diagnostic tool validated in the general population[23,24].

Depression: Characterized by a depressed mood or loss of interest in activities for long periods of time, depression is a common mental disorder that can impact all aspects of daily life. Not only is quality of life affected, but physical health may be affected. Factors associated with depression, like physical inactivity or alcohol dependence, may result in an increased risk of cardiovascular disease, diabetes, cancer, and other chronic conditions. Given the exposure to traumatic critical incidents in first responders, it is crucial to understand current mental health challenges and effectiveness of interventions. The Patient Health Questionnaire-8* is a scale that is valid and reliable within the general population[25].

Stress: Your body and mind adapt to daily stressors, but chronic stress can negatively impact physical and mental health. First responders endure high levels of occupational stress, making perceived stress a common and effective measure to assess effectiveness of an intervention. To measure their perception of stress, the Perceived Stress Scale (PSS)* was used to understand how unpredictable, uncontrollable, and overloaded participants found their lives and how Vital Neuro impacted these perceptions[26].

General Well-Being: Well-being is a state of thriving influenced by an individual's wellness and the communities to which they belong. Well-being is an all-encompassing term including emotional, environmental, financial, intellectual, occupational, physical, social, and spiritual wellness. The World Health Organization Well-Being Index (WHO-5)* is a simple and widely used questionnaire measuring subjective psychological well-being, providing insights into the quality of life of first responders and how Vital Neuro plays a role in improving well-being[27,28].

Scoring: The 5 questions on the WHO-5 result in a total raw score ranging from 0 to 25. The raw total is multiplied by 4 to give the final score, with 0 representing the worst

imaginable well-being and 100 representing the best imaginable well-being.

Sleep: Adequate rest profoundly impacts your cognition, exercise performance, and emotional well-being[29-31]. Sleep loss is also associated with impaired hormone regulation, glucose homeostasis, and higher rates of obesity–increasing the risk of developing cardiovascular disease[32-34]. Shift work and unpredictable calls is common for first responders, impacting circadian rhythms and sleep patterns. Any changes brought on by using Vital Neuro to aid in sleep was assessed using the Sleep Condition Indicator (SCI-8)* scale[35].

All responses are totaled on the SCI-8 and higher scores indicate better sleep, lower scores indicate poorer sleep and/or insomnia.

Self-Efficacy: Self-efficacy is the belief that one can perform a novel or difficult task, or cope with adversity. When someone perceives they have high self-efficacy, they are more successful in goal setting, persistence in face of barriers, and recovery from setbacks[36]. The Generalized Self Efficacy (GSE)* scale assesses a general sense of perceived self-efficacy to predict coping with daily stressors[37]. Improved scores in a first responder population would indicate more resilience to daily life stressors and improved self-confidence.

The sum of the responses yields a composite score between 10 and 40, higher scores indicate better self-efficacy.

Burnout: Burnout appears to be a global phenomenon of occupational stress described as energy depletion due to chronic stress, manifesting with feelings of emotional and physical exhaustion and cognitive weariness[38]. Similar to traditional stress maladaptation, burnout is associated with increased cardiovascular risk factors and other physical and mental chronic health issues[39]. The Copenhagen Burnout Inventory (CBI)* was used to measure burnout and how Vital Neuro may improve this aspect of psychological health[40].

Scores on the CBI are ranked as how often one experiences personal, work-related, and client-related burnout:

Post Traumatic Stress Disorder (PTSD): PTSD is a

serious mental health disorder that may develop following exposure to traumatic life events, significantly impacting mental and physical health and reduced quality of life[41,42]. Approximately 3.6% of adults experience PTSD symptoms in their lifetime[43]. However, prevalence of PTSD in first responders is significantly and consistently higher—affecting 20% of the population[44]. The Primary Care Post-Traumatic Stress Disorder Screen for the Diagnostic and Statistical Manual of Mental Disorders (5th Edition) (PC-PTSD-5) has excellent diagnostic accuracy for potential PTSD cases[45,46].

The 5-item scale is scored 0-5. The threshold for a probable case of PTSD is 4 and 5 for male respondents and somewhat lower in female respondents.

*Instruments used in this study were strategically and carefully chosen based on rigorous reliability and validity testing (including testing for internal consistency, test-retest reliability, inter-rater reliability, face validity, content validity, and construct validity). Tens of thousands of participants are surveyed across multiple studies to ensure the questionnaire is consistently measuring what it is purports to measure within a specific population[46].

STUDY RESULTS

Anxiety: The first responders included in this analysis saw a significant reduction in anxiety levels based on the GAD-7 scale from baseline to follow-up (p<.001, η_p^2 = 0.37). At baseline, they reported an average of 7.48, which reduced to 5.97 at midpoint and further reduced to 4.21 following the intervention. The Neuroguided Performance Training intervention appeared to reduce their anxiety by up to 44%.

Depression: First responders reported a score of 8.28 at baseline on the PHQ-8. This number lowered to 7.24 by the midpoint of the intervention—to a score of 7.24—after using Vital Neuro for three weeks. The significant difference occurred between baseline and follow-up, when they rated a 5.00 (p<.001, η_p^2 = 0.36), close to a 40% reduction in symptoms of depression while performing Neuroguided Performance Training.

Stress: First responders reported improved perceived stress over the 6-week Vital Neuro intervention. The results indicate a 19% reduction in stress level on the PSS from 17.32 to 16.61 to 14.04 across baseline, midpoint, and follow-up (p=.003, η_p^2 = 0.22). The corresponding non-parametric Friedman's test indicated similar differences

between the median perceived stress reported, however it just missed reaching significance. Given the unpredictable and dangerous nature of first responders' work, it's difficult to eliminate stress, however perceived stress almost reaching "low stress levels" indicates it may be possible to reduce the stress response using Vital Neuro.

General Well-Being: Participants reported well-being ratings of 10 at baseline, 13.18, at midpoint, and 14.04 again at follow-up on the WHO-5 (p<.001, η_p^2 = 0.36). The changes from baseline to mid-point and baseline to follow-up represent a significant improvement, indicating a beneficial effect of Neuroguided Performance Training in enhancing overall well-being and quality of life.

Sleep: First responders moderately improved their sleep while using Vital Neuro. Starting at 13.14 at baseline then increasing to 15.36 at midpoint and again to 16.96 at follow-up indicated a significant change from baseline to follow-up (p=.002, η_p^2 = 0.20). The Neuroguided Performance Training does not solve for constantly interrupted shift work, however the higher SCI-8 score indicates they did experience better sleep including improved: concerns about getting to sleep, remaining asleep, sleep quality, daytime personal functioning, daytime performance, duration of sleep problems, nights per week experiencing a sleep problem, and extent of which they are troubled by poor sleep.

Self-Efficacy: General self-efficacy, or the belief that one can accomplish hard things, improved only slightly over the intervention. While not a significant change, first responders reported a change from 32 to 33 on the GSE scale over the six weeks. The corresponding non-parametric Friedman's test indicated a change trending towards significance. The GSE scale only accounts for general feelings of self-efficacy, not considering domain work-related self-efficacy which may be higher in first responders.
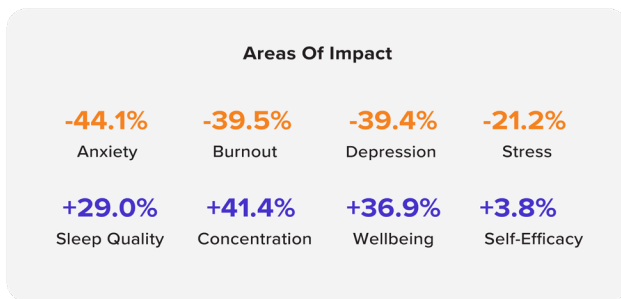
Burnout: First responders experience high levels of occupational burnout. On the CBI, participants reported personal and work-related burnout at 48 on the CBI prior to the intervention. At midpoint, this rating reduced to 44, and then significantly reduced further to 29 (p<.001, η_p^2 = 0.58). The Neuroguided Performance Training with Vital Neuro appeared to improve experiences of burnout, potentially influencing job satisfaction and psychological

stress, particularly in the latter half of the intervention.

PTSD: Post Traumatic Stress Disorder rates can be as high as 20% in first responders, suggesting it is a useful measure to include when assessing mental health interventions and subsequent outcomes. The threshold for probable PTSD on the PC-PTSD-5 is 4 and above for men, and slightly lower for women. Only 3 participants in this analysis ranked above these thresholds for both sexes, indicating low levels of PTSD in the sample overall. The data indicate a moderate reduction of possible symptoms of PTSD (p=.018, η_p^2 = 0.18), particularly between baseline and follow-up. Similar findings were apparent on the corresponding non-parametric Friedman's test indicating a significant change in median ratings of PTSD from baseline to follow-up.

Note: A repeated-measure analysis of variance (ANOVA) with one within-subjects factor was performed to measure changes for each outcome across three timepoints. There were no confounding variables in the analysis and non-parametric testing was reported where necessary. A paired t-test and Wilcoxon Signed Rank Test was conducted for pre- and post-intervention data analysis. Outside of General Self-Efficacy, all results discussed in this whitepaper showed statistically significant changes (p<.05) with moderate to large effect sizes between baseline and follow-up.

Areas Of Impact

-44.1%	**-39.5%**	**-39.4%**	**-21.2%**
Anxiety	Burnout	Depression	Stress
+29.0%	**+41.4%**	**+36.9%**	**+3.8%**
Sleep Quality	Concentration	Wellbeing	Self-Efficacy

in self-report measures. However, this case study lays important groundwork in the exploration of Neuroguided Performance Training for a variety of mental and physical health outcomes.

FACTORS TO CONSIDER

While the study provided preliminary evidence of efficacy in using novel Neuroguided Performance Training in mental health outcomes and well-being, there were some limitations to this study. The study lacked a control group nor were other lifestyle factors controlled to understand whether the Vital Neuro method was the specific variable that caused the change. There are challenges inherent to meditation-like interventions such as individual differences, placebo effects, and limitations

CONCLUSIONS & IMPLICATIONS

First responders are frequently exposed to traumatic critical incidents, sleep-disrupting shift hours, and physically demanding tasks—placing them at a higher risk for developing chronic psychophysiological health problems than the general population. Interventions to improve psychological well-being and resilience can help to protect the health of this high-risk population, improving public safety in the process. In congruence with previous findings, the current case study results indicate that a 15-minute daily session of Vital Neuro Neuroguided Performance Training produced clinically meaningful improvements in psychological outcomes[11], with the potential to create a long-lasting impact on both physical and mental health.

First responders consistently step into unpredictable, potentially dangerous, and traumatic environments. While PTSD is more common in this population, so are stigmas to seeking mental health help. Vital Neuro's Neuroguided Performance Training provided a non-invasive, private, and effective solution for reducing levels of burnout, depression, anxiety, and perceived stress while improving sleep and overall well-being.

The improvements following the intervention may suggest that the Neuroguided Performance Training can serve as a catalyst for adopting other health-promoting behaviors such as regular physical activity, balanced nutrition, or better sleep hygiene throughout the day which are essential to improve the risk of cardiovascular disease in this population. Furthermore, the mindfulness and focus gained from using the Vital Neuro Method may enhance the relaxation effect of health-promoting behaviors, such as improved sleep quality. This makes it a practical solution for individuals in the general population seeking to enhance their daily functioning, as well as for specific occupational groups facing excessive stress in their work environments.

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CASE STUDY

A Six-Week Neuroguided Performance Training Intervention
Monitoring Mental and Emotional Well-Being Outcomes in
Flight Attendants Using the Vital Neuro Headphones

White Paper by Susie Reiner, PhD, ACSM-EP, CSCS

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SUMMARY

Flight attendants face inordinate levels of occupational stress, abnormal work hours, and interrupted sleep patterns—increasing their risk of developing chronic mental and physical health issues. Vital Neuro provides a highly accessible means of stress management using advanced neurofeedback technology. In this case study, 30 flight attendants participated in a 6-week intervention using Neuroguided Performance Training within their everyday life. **Results suggest that the use of Vital Neuro significantly reduced levels of anxiety, depression, stress, and burnout while improving general well-being, sleep, and self-efficacy.** While the study was uncontrolled in several ways, the trend towards improved mental health was clear through the use of Vital Neuro and the behaviors and habits it may influence in an individual's daily life.

THE POPULATION OF INTEREST

Flight attendants (FAs) are an occupational cohort that is widely understudied, despite facing unique adverse job-related stressors. FAs are consistently exposed to circadian rhythm disruption due to night shift work and frequently crossing time zones, high levels of occupational noise, heavy physical and emotional job demands, and verbal and sexual harassment[1-4]. In addition, FAs experience an increased exposure to illness, sleep deprivation, prolonged time within a confined space, and time away from friends and family, compromising FAs overall physical and mental health.

In a study of over 5,000 FAs published in BMC Public Health, researchers reported an increased prevalence of adverse sleep and mental health outcomes among flight crew when compared to the general population[1]. FAs with more years of experience on a flight crew were more likely to experience anxiety, depression, sleep disorders, and alcohol abuse. FAs also reported work-related disruptions to both meal timing and availability of nutritious food, which could potentially impact multiple health outcomes as well.

Identifying and participating in healthy coping mechanisms for the stresses of a flight crew is crucial in improving psychological outcomes. Neuroguided Performance Training using Vital provides a time-efficient, affordable, and accessible means to effectively manage stress and anxiety within the FA population.

VITAL NEURO TECHNOLOGY

Developed by best-in-class technology and based on decades of neuroscience research, Vital Neuro hardware and software together provides scalable solutions that can rewire the brain for optimal performance. The brain fluidly adapts based on subtle environmental cues. The ability of neural networks of the brain to change through growth and reorganization is called neuroplasticity—and it can be harnessed by the individual through neurofeedback, deep meditation, focus, and personalized music.

Whether the goal is to manage stress and anxiety or increase focus and productivity, Vital Neuro's

Neuroguided Performance Training leverages real-time electroencephalography (EEG) neurofeedback and personalized music, to seamlessly shift the brain state. The technology monitors the electrical activity of the brain and provides visual cues to improve self-regulation[5]. Research suggests that by controlling brain waves through neurofeedback, participants can improve attention, working memory, and executive function[6]—improving productivity and potentially staving off age-related cognitive decline. In other words, neurofeedback is a way to train your brain for optimal performance. In a clinical or laboratory setting EEG and other neural measures can be costly and invasive, but the Vital Neuro headphones bring this technology into the real-world using comfortable wireless headphones. Aimed to improve mental, emotional, and physical well-being, Vital Neuro helps people live their best life.
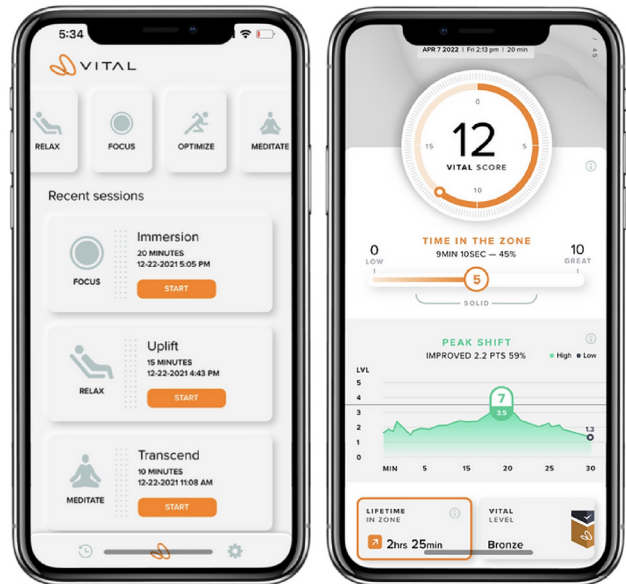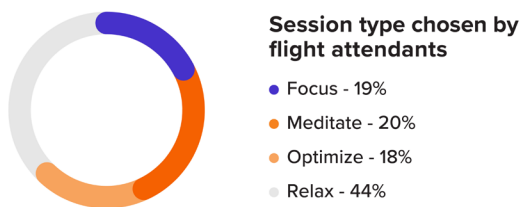

THE STUDY PROTOCOL

The sample included 30 flight attendants that flew at least 10 days per month on two major airlines. Participants completed survey questionnaires prior to starting Vital Neuro sessions, at the 3-week mark, and following the 6-week intervention. Participants were provided the following protocol recommendation:

Upon Waking	10-20 min Relax (Air)
Before Shift	10-20 min Focus (Awaken)
On Breaks	10-20 min Relax (Air)
After Shift	10-20 min Relax (If overly stressed or sleep deprived)
Before Bed	10-20 min Meditate (Transcend)

However, the participants self-selected the timing, type, and length of Vital sessions based on their schedule and preferences. No other instructions were provided to change lifestyle habits including physical activity, sleep, or nutrition and there was no attempt by study researchers to control for those factors.

A total of 18 participants participated in the 6-week intervention and completed all pre-testing, mid-point, and post-testing. The participants engaged in 13,750 minutes of Vital Neuro sessions over the 6-week period with an average session length of 15 minutes at a time. The most popular type or goal of session that the participants chose was "Relax." The pie chart below shows the breakdown by type/goal of session participation.

Session type chosen by flight attendants
- Focus - 19%
- Meditate - 20%
- Optimize - 18%
- Relax - 44%

THE OUTCOME MEASURES

Anxiety: Anxiety is a normal human emotion, but in excess, it can become pervasive and even take on pathological significance as a disorder. At this stage, anxiety can interrupt activities of daily living, compromising personal and professional life. The Generalized Anxiety Disorder scale-7 (GAD-7)* is a seven-item diagnostic tool validated

in the general population[7,8].

The following cut-offs correlate with level of anxiety severity on the GAD-7:
Score 0-4: Minimal Anxiety
Score 5-9: Mild Anxiety
Score 10-14: Moderate Anxiety
Score greater than 15: Severe Anxiety

Depression: Characterized by a depressed mood or loss of pleasure or interest in activities for long periods of time, depression is a common mental disorder that can impact all aspects of daily life. Not only is quality of life affected, but physical health may be affected. Factors associated with depression, like physical inactivity or alcohol dependence, may result in an increased risk of cardiovascular disease, diabetes, cancer, and other chronic conditions. Screening for depression or depressive symptoms in occupations that may be vulnerable to the disorder, like FAs, is crucial to understand current mental health challenges and effectiveness of interventions meant to improve mental health. The Patient Health Questionnaire-8* is a scale that is valid and reliable within the general population[9].

The following PHQ-8 Score is associated with Depression Severity:

Score 0-4: None-minimal
Score 5-9: Mild
Score 10-14: Moderate
Score 15-19: Moderately Severe
Score 20-27: Severe

Stress: Your body and mind adapt to daily stressors, but when these stressors are constant, chronic stress can negatively impact your physical and mental health. FAs face an inordinate amount of stress within their occupation, making stress management a priority. To measure their perception of stress, the Perceived Stress Scale (PSS)* was used to understand how unpredictable, uncontrollable, and overloaded participants found their lives and how Vital Neuro impacted these perceptions[10].

Scores on the PSS are totaled with the following criteria:
0-13: low stress
14-26 : moderate stress
27-40: high perceived stress

General Well-Being: Well-being is a state of thriving influenced by an individual's wellness and the communities to which they belong. Well-being is an all-encompassing term including emotional, environmental, financial, intellectual, occupational, physical, social, and spiritual wellness. The World Health Organization Well-Being Index (WHO-5)* is a simple and widely used questionnaire measuring subjective psychological well-being, providing insights into the quality of life of FAs and how Vital Neuro plays a role in improving well-being[11,12].

Scoring: The 5 questions on the WHO-5 result in a total raw score ranging from 0 to 25. The raw total is multiplied by 4 to give the final score, with 0 representing the worst imaginable well-being and 100 representing the best imaginable well-being.

Sleep: Adequate rest profoundly impacts your cognition, exercise performance, and emotional well-being[13-15]. Sleep loss is also associated with impaired hormone regulation, glucose homeostasis, and higher rates of obesity—increasing the risk of developing cardiovascular disease[16-18]. As FAs circadian rhythms are consistently interrupted with abnormal work hours, finding ways to improve sleep is crucial. Any changes brought on by using Vital Neuro to aid in sleep was assessed using the Sleep Condition Indicator (SCI-8)* scale[19].

All responses are totaled on the SCI-8 and higher scores indicate better sleep, lower scores indicate poorer sleep and/or insomnia.

Self-Efficacy: Self-efficacy is the belief that one can perform a novel or difficult tasks, or cope with adversity. When someone perceives they have high self-efficacy, they are more successful in goal setting, persistence in face of barriers, and recovery from setbacks[20]. The Generalized Self Efficacy (GSE)* scale assesses a general sense of perceived self-efficacy to predict coping with daily stressors[21]. If FAs improve self-efficacy with the use of Vital Neuro, they can experience more resilience to daily hassles and have a stronger sense of self and confidence in their actions.

The sum of the responses yields a composite score between 10 and 40, higher scores indicate better self-efficacy.

Burnout: Based on the literature, burnout appears to be a global phenomenon of occupational stress described as energy depletion due to chronic stress, manifesting with feelings of emotional and physical exhaustion and cognitive weariness[22]. Similar to traditional stress maladaptation, burnout is associated with increased cardiovascular risk factors and other physical and mental chronic health issues[23]. The Copenhagen Burnout Inventory (CBI)* was used to measure burnout within the FA population[24].

Scores on the CBI are ranked as how often one experiences personal, work-related, and client-related burnout:

100: always
75: often
50: sometimes
25: seldom
0: never

*Instruments used in this study were strategically and carefully chosen based on rigorous reliability and validity testing (including testing for internal consistency, test-retest reliability, inter-rater reliability, face validity, content validity, and construct validity). Tens of thousands of participants are surveyed across multiple studies to ensure the questionnaire is consistently measuring what it purports to measure within a specific population[25].

STUDY RESULTS

Anxiety: At baseline, the FAs scored a 9.5 on the GAD-7 scale, rating as mild to moderate anxiety. A score of 8 or above on this scale is normally categorized as a case of generalized anxiety disorder. At midpoint, this number came down to 4.9 (rated as mild anxiety) and at the end of the intervention, they scored a 3.9, reaching the minimal anxiety threshold. Based on the survey results, the FAs felt less nervous, anxious, restless, worried, and irritable after completing the Vital Neuro intervention, effectively improving their state of mind, and reducing their chances overall of having generalized anxiety disorder by close to 60-percent.

Depression: At the start of the study, FAs scored an 11 on the PHQ-8 scale on average, falling into moderate severity of depression. When a participant scores above 10 on the PHQ-8, a treatment plan including counseling and/or pharmacotherapy is recommended. At the midpoint of the study however, this number fell

to 6 (mild) and following the intervention, their scores fell to 4 (none/minimal). FAs saw a dramatic 59.1-percent reduction in depressive symptoms including little interest in doing things, feeling hopeless or bad about oneself, trouble sleeping, low energy levels, poor nutritional habits, trouble concentrating, or having thoughts of hurting oneself. It appears that Vital Neuro is a powerful tool in improving mental health and within this cohort, potentially eliminating a clinical diagnosis for depression.

Stress: Prior to the Vital Neuro intervention, FAs rated their stress at a 20 on the PSS composite score. At midpoint, this number came down to 15 and at the end of the intervention, it fell to 14. While all three checkpoints fall into the "moderate" stress level on the PSS, the change was significant and came close to the cut-off for low stress levels. FAs experienced more control in their everyday lives, felt they could cope better with what came their way, and experienced less overall stress. With a high-stress occupation and conditions, moving closer to low stress levels is a feat for lasting mental and physical health.

General Well-Being: The FAs in this case study saw an improvement in well-being from a score of 46 at the start of the study and increasing close to 10 points to 55 following the 6-week intervention. An indicator of quality of life and overall wellness, the positive changes shown on the WHO-5 suggests Neuroguided Performance Training enhances different dimensions of wellness.

Sleep: Self-reported sleep improved over the course of the intervention. At baseline, FAs scored 13 on the SCI-8, at midline this rose to 17, and at the concluding follow-up, it rose again to 19. A higher SCI-8 score indicates better sleep patterns including improving the following factors: concerns about getting to sleep, remaining asleep, sleep quality, daytime personal functioning, daytime performance, duration of sleep problem, nights per week experiencing a sleep problem, and extent of which they are troubled by poor sleep. Utilizing Vital Neuro regularly appeared to boost the participants' restful sleep, and in turn potentially any physiological or psychological system affected by sleep in the human body.

Self-Efficacy: Self-efficacy, or the belief that one can accomplish hard things, improved over the intervention. While the scores on the GSE scale only increased from 30, to 32, to 33, the change from 30 to 33 from baseline

to follow-up is a statistically significant and meaningful change, meaning the FAs most likely experienced a boost in self-confidence and fervor for challenge after completing the six-week Neuroguided Performance Training.
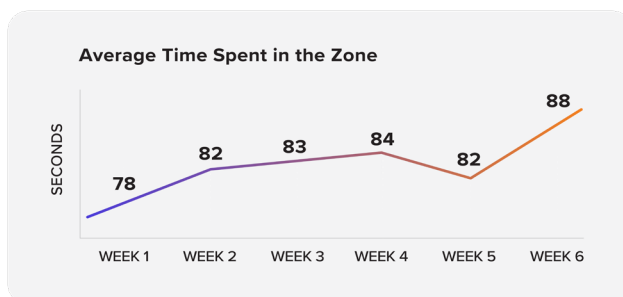
Burnout: FAs are susceptible to occupational burnout due to difficult work hours and conditions while dealing with stressful situations and passengers. At the start of the intervention, results on the CBI indicate that FAs experience burnout somewhere between "sometimes" and "often" (mean average = 59), after participating in three weeks of Vital Neuro sessions, this rating came closer to "sometimes" (mean average = 51) and at the completion of the intervention, fell to between "seldom" to "sometimes" (mean average = 48). FAs reduced their levels of burnout, and in turn improving psychological stress levels and perhaps better job satisfaction by participating in Neuroguided Performance Training.

*A repeated-measure analysis of variance (ANOVA) with one within-subjects factor was performed to measure changes for each outcome across three timepoints. The results discussed in this whitepaper showed statistically significant changes (p<.05) with large effect sizes between baseline and follow-up.

Flight Attendant Results

Users	Weeks	Sessions Completed	Session Time (hrs)
30	6	881	196

Areas Of Impact

-59.1%	-18.0%	-59.1%	-33.4%
Anxiety	Burnout	Depression	Stress
+36.6%	+8.7%	+58.1%	+50.0%
Concentration	Self-Efficacy	Sleep Quality	Well-being

Average Time Spent in the Zone

SECONDS

78 (WEEK 1), 82 (WEEK 2), 83 (WEEK 3), 84 (WEEK 4), 82 (WEEK 5), 88 (WEEK 6)

WEEK 1   WEEK 2   WEEK 3   WEEK 4   WEEK 5   WEEK 6

FACTORS TO CONSIDER

While the study provided preliminary evidence of efficacy in using novel Neuroguided Performance Training in mental health outcomes and well-being, there were some limitations to this study. The study lacked a control group nor were other lifestyle factors controlled to understand whether the Vital Neuro intervention was the specific variable that caused the change. There are challenges inherent to meditation-like interventions such as individual differences, placebo effects, and limitations in self-report measures. However, this case study lays important groundwork in the exploration of Neuroguided Performance Training for a variety of mental and physical health outcomes.

CONCLUSIONS & IMPLICATIONS

Flight attendants face inordinate levels of occupational stress that can compromise physical and mental health with literature citing higher levels of depression and anxiety compared to the general population. Flight attendants that do not participate in feasible and accessible coping mechanisms for stress management may experience an increasingly poor quality of life, ultimately leading to a lack of emotional regulation, low productivity, burnout, and even chronic health issues. **Vital Neuro provided meaningful changes in the flight attendants' experience of depression, anxiety, stress, and burnout while improving subjective well-being, self-efficacy, and sleep.**

Future research will explore the mechanism behind these changes given the integrated nature of psychology and stress. For example, improved self-efficacy may in fact facilitate other healthy behaviors, like physical activity or nutrition, throughout the day which could explain the changes in other variables. Neuroguided Performance Training, with as short as a 15-minute session a day, can make a lasting impact in physiological and psychological well-being making it a viable solution for members of the general population to function better in their daily lives and for specific occupational groups facing undue stress at work.

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CASE STUDY

The Effects of Neuroguided Performance Training on Mental and Emotional Well-Being of **Nurses** Using the Vital Neuro Method

White Paper by Susie Reiner, PhD, ACSM-EP, CSCS

CONTENTS

SUMMARY

Nurses are exposed to excessive levels of occupational stress, emotional distress, and disrupted sleep patterns. Over several years and compounded with the COVID-19 pandemic, they can potentially face an increased susceptibility to chronic mental and physical health issues. To address this challenge, Vital Neuro presents a highly accessible stress management solution that leverages advanced neurofeedback technology. **In this case study, a group of 30 nurses engaged in a 6-week intervention integrating the Vital Neuro method into their daily routines. The results demonstrate a substantial decrease in anxiety, depression, stress, and burnout levels, accompanied by notable enhancements in overall well-being, sleep quality, and potentially self-efficacy.** Although the study lacked certain control measures, the consistent evidence of improved mental health outcomes through the utilization of Vital Neuro, as well as its potential impact on an individual's daily behaviors and habits, was evident.

THE POPULATION OF INTEREST

There are over six million nurses in the United States workforce, making up 30 percent of hospital employees nationwide according to the U.S. Bureau of Labor Statistics. Nurses play a critical role in disease treatment and preventative health promotion, but as healthcare systems have grown, so have the workload demands placed on front-line workers. While there were mounting concerns of the well-being of nurses prior to 2020, front-line healthcare workers faced an unprecedented number of patients during the COVID-19 pandemic, subjecting them to individual and organizational stressors that adversely affected their long-term mental and physical health. Studies show 45 percent of nurses reported high levels of stress, 25 percent experience symptoms of anxiety and depression, and 22 percent are dealing with post-traumatic stress disorder[1,2].

Given the occupational demands placed on the nurse population, burnout, reduced job satisfaction, and leaving the profession completely is commonplace. In a study published in JAMA of over 50,000 nurses, researchers found 31 percent of nurses experienced burnout and those who worked in a hospital setting were twice as likely to leave their job over those in a clinic[3].

Nurses also experience frequent disruptions to their circadian rhythms with shift work, particularly working night shifts. This work schedule contributes to "shift work disorder" associated with increased fatigue, higher levels of anxiety and depression, reduced productivity and job satisfaction, and increased risk of cardiovascular disease[4,5].

Reducing stress, anxiety, depression, and burnout levels for nurses is imperative to improve quality of life and long-term physical health outcomes. Not only will a stress-reduction intervention impact the well-being of this heavily burdened community, but when job satisfaction and concentration increases, patient care and patient outcomes also improve. Neuroguided Performance Training using the Vital Neuro method provides a time-efficient and highly accessible way to manage the stress and well-being in front-line healthcare workers. The following case study will explore the impact of Neuroguided Performance Training in psychological well-being of nurses over a six-week intervention.

VITAL NEURO TECHNOLOGY

Developed by best-in-class technology and based on decades of neuroscience research, Vital Neuro hardware and software together provides scalable solutions that can rewire the brain for optimal performance. The brain fluidly adapts based on subtle environmental cues. The ability of neural networks of the brain to change through growth and reorganization is called neuroplasticity—and it can be harnessed by the individual through neurofeedback, deep meditation, focus, and personalized music.

Whether the goal is to manage stress and anxiety or increase focus and productivity, Vital Neuro's Neuroguided Performance Training leverages real-time electroencephalography (EEG) neurofeedback and personalized music, to seamlessly shift the brain state. The technology monitors the electrical activity of the brain and provides auditory and visual cues to improve
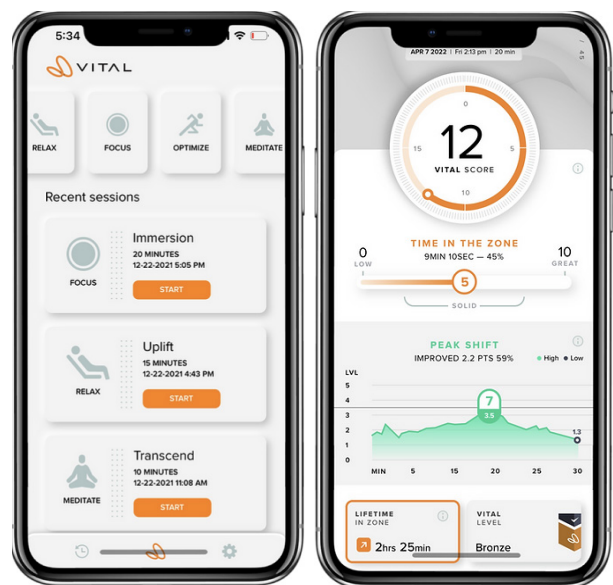
self-regulation[5]. Research suggests that by controlling brain waves through neurofeedback, participants can improve stress regulation, attention, working memory, and executive function[6]—improving productivity and potentially staving off age-related cognitive decline. In other words, neurofeedback is a way to train your brain for optimal performance. In a clinical or laboratory setting EEG and other neural measures can be costly and invasive, but the Vital Neuro brain monitoring headphones bring this technology into the real-world using comfortable wireless headphones. Aimed to improve mental, emotional, and physical well-being, Vital

Neuro helps people live their best life.

Session type chosen by nurses
- Focus - 13%
- Meditate - 30%
- Optimize - 13%
- Relax - 44%

THE STUDY PROTOCOL

The sample included 30 full-time nurses working in various medical settings. Participants completed survey questionnaires prior to starting Vital Neuro sessions, at the 3-week mark, and following the 6-week intervention. Participants were provided the following protocol recommendation:

Upon Waking	10-20 min Relax
Before Shift	10-20 min Focus
On Breaks	10-20 min Relax
After Shift	10-20 min Relax
Before Bed	10-20 min Meditate

Keeping the recommendations in mind, participants ultimately self-selected the timing, type, and length of Vital sessions based on their schedule and preferences. No other instructions were provided to change lifestyle habits including physical activity, sleep, or nutrition and there was no attempt to control for those factors in the study design.

A total of 21 participants participated in the 6-week intervention and completed all pre-testing, mid-point, and post-testing. The participants engaged in 9,650 minutes of Vital Neuro sessions over the 6-week period with an average session length of 14 minutes, completing 8,300 minutes. The most popular type of session that the participants chose was "Relax", followed by "Meditate." The pie chart below shows the breakdown by type of session participation.
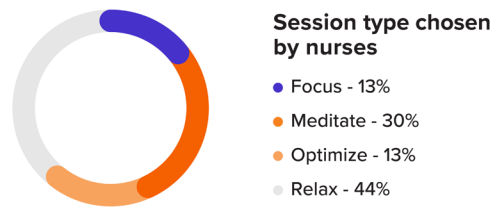
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The following PHQ-8 Score is associated with Depression Severity:
Score 0-4: None-minimal
Score 5-9: Mild
Score 10-14: Moderate
Score 15-19: Moderately Severe
Score 20-27: Severe

Stress: Your body and mind adapt to daily stressors, but when these stressors are constant as they are in nursing, chronic stress can negatively impact your physical and mental health. Compounded with the stress of caring for patients with COVID-19 and organizational limitations, understanding how an intervention improves the perception of stress is vital. To measure their perception of stress, the Perceived Stress Scale-10 (PSS-10)* was used to understand how unpredictable, uncontrollable, and overloaded participants found their lives and how Vital Neuro impacted these perceptions[11].

Scores on the PSS-10 are totaled with the following criteria:
0-13: low stress
14-26 : moderate stress
27-40: high perceived stress

General Well-Being: Well-being is a state of thriving influenced by an individual's wellness and the communities to which they belong. Well-being is an all-encompassing term including emotional, environmental, financial, intellectual, occupational, physical, social, and spiritual wellness. The World Health Organization Well-Being Index-5 (WHO-5)* is a simple and widely used questionnaire measuring subjective psychological well-being, providing insights into the quality of life of nurses and how Vital Neuro plays a role in improving well-being[12,13].

Scoring: The 5 questions on the WHO-5 result in a total raw score ranging from 0 to 25. The raw total is multiplied by 4 to give the final score, with 0 representing the worst imaginable well-being and 100 representing the best imaginable well-being.

Sleep: Adequate rest profoundly impacts your cognition, exercise performance, and emotional well-being[14-16]. Sleep loss is also associated with impaired hormone regulation, glucose homeostasis, and higher rates of obesity—increasing the risk of developing cardiovascular disease[17-19]. Shift work in nursing is common, where circadian rhythms are consistently interrupted affecting sleep patterns and various biological functions. Any changes brought on by using Vital Neuro to aid in sleep was assessed using the Sleep Condition Indicator-8 (SCI-8)* scale[20].

All responses are totaled on the SCI-8 and higher scores

indicate better sleep, lower scores indicate poorer sleep and/or insomnia.

Self-Efficacy: Self-efficacy is the belief that one can perform a novel or difficult tasks, or cope with adversity. When someone perceives they have high self-efficacy, they are more successful in goal setting, persistence in face of barriers, and recovery from setbacks[21]. The Generalized Self Efficacy (GSE)* scale assesses a general sense of perceived self-efficacy to predict coping with daily stressors[22]. Improved scores in a nurse population would indicate more resilience to daily life stressors and improved self-confidence.

The sum of the responses yields a composite score between 10 and 40, higher scores indicate better self-efficacy.

Burnout: Based on the literature, burnout appears to be a global phenomenon of occupational stress described as energy depletion due to chronic stress, manifesting with feelings of emotional and physical exhaustion and cognitive weariness[23]. Similar to traditional stress maladaptation, burnout is associated with increased cardiovascular risk factors and other physical and mental chronic health issues[24]. The Copenhagen Burnout Inventory (CBI)* was used to measure burnout within the nurse population and how Vital Neuro may improve this aspect of psychological health[25].

Scores on the CBI are ranked as how often one experiences personal, work-related, and client-related burnout:

100: always
75: often
50: sometimes
25: seldom
0: never

*Instruments used in this study were strategically and carefully chosen based on rigorous reliability and validity testing (including testing for internal consistency, test-retest reliability, inter-rater reliability, face validity, content validity, and construct validity). Tens of thousands of participants are surveyed across multiple studies to ensure the questionnaire is consistently measuring what it purports to measure within a specific population[26].

STUDY RESULTS

Anxiety: The nurses included in this analysis saw a significant reduction in anxiety levels based on the GAD-7 scale. At baseline, they reported an average of 9.3, which reduced to 7.1 at midpoint and further reduced to 5.9 following the intervention. The starting scores fell into general anxiety disorder (any score above 8), however, the results suggest the Neuroguided Performance Training helped nurses reduce their anxiety by up to 37-percent to mild, trending towards minimal anxiety levels.

Depression: Nurses reported a score of 10 at baseline on the PHQ-8, which rates as a moderate level of depression. This number significantly dropped by the midpoint of the intervention—to a score of 7—after using Vital Neuro for three weeks. The nurses reported a further reduced score of 6 at follow-up, resulting in almost a 43-percent reduction in symptoms of depression while performing Neuroguided Performance Training.

Stress: Perceived stress improved over the 6-week Vital Neuro intervention. The nurses reported a 22-percent reduction in stress level on the PSS-10 from 21 to 18 to 16 across baseline, midpoint, and follow-up. While it may be impossible to eliminate stress from this particularly demanding occupation, these changes in perceived stress were statistically and practically significant—even trending towards "low stress levels" if continued. In an occupation where coping with difficult situations and rapid decision-making is central to their responsibilities, reducing stress levels is paramount.

General Well-Being: Participants reported well-being ratings of 9 at baseline, 12, at midpoint, and 12 again at follow-up (and trending upwards, improvement of nearly 28-percent) on the WHO-5. The changes from baseline to follow-up represent a significant improvement, indicating a beneficial effect of Neuroguided Performance Training in enhancing overall well-being and quality of life.
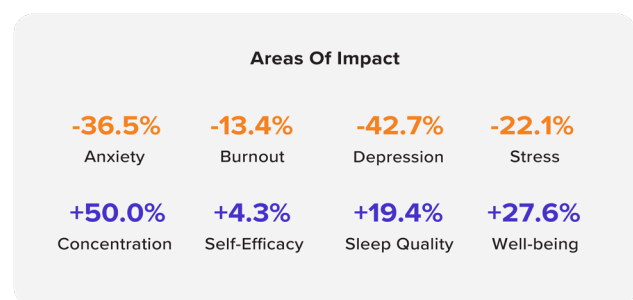
Sleep: With a 4-point improvement of self-reported sleep—from 16 to 20 on the SCI-8—nurses enjoyed better sleep while using Vital Neuro. A higher SCI-8 score indicates better sleep patterns including improving the following factors: concerns about getting to sleep, remaining asleep, sleep quality, daytime personal functioning, daytime performance, duration of sleep problem, nights per week experiencing a sleep problem, and extent of which they are troubled by poor sleep. Neuroguided Performance Training appeared to boost the nurses' overall sleep quality and quantity by over 19-percent, and in turn potentially any physiological or psychological system affected by sleep in the human body.

Self-Efficacy: General self-efficacy, or the belief that one can accomplish hard things, improved slightly over the intervention. The nurses experienced an increase from 30 to 32 on the GSE scale during the six weeks however, this change was not statistically significant. The GSE scale does not account for potential domain self-efficacy where the nurses may feel like they can accomplish tasks in one aspect of their lives but perhaps not others, and there was no data gathered of daily tasks or patients they encountered which could alter perceptions of self-efficacy.

Burnout: With high volume patient loads and the mental and emotional stress of the nursing profession, it's no surprise that over 30-percent of nurses experience burnout. Nurses reported personal, work-related, and client-related burnout at 65 on the CBI prior to the intervention landing between "sometimes" and "often" in frequency. At midpoint, this rating came significantly down to 55, and then reduced further to 50, reaching a frequency of "sometimes", bordering on "seldom." The Neuroguided Performance Training with Vital Neuro appeared to improve experiences of burnout, potentially influencing job satisfaction and psychological stress.

Note: A repeated-measure analysis of variance (ANOVA) with one within-subjects factor was performed to measure changes for each outcome across three timepoints. Outside of General Self-Efficacy, all results discussed in this whitepaper showed statistically significant changes ($p < .05$) with large effect sizes between baseline and follow-up.

Areas Of Impact			
-36.5%	**-13.4%**	**-42.7%**	**-22.1%**
Anxiety	Burnout	Depression	Stress
+50.0%	**+4.3%**	**+19.4%**	**+27.6%**
Concentration	Self-Efficacy	Sleep Quality	Well-being

FACTORS TO CONSIDER

While the study provided preliminary evidence of efficacy in using novel Neuroguided Performance Training in mental health outcomes and well-being, there were some limitations to this study. The study lacked a control group nor were other lifestyle factors controlled to understand whether the Vital Neuro method was the specific variable that caused the change. There are challenges inherent to meditation-like interventions such as individual differences, placebo effects, and limitations in self-report measures. However, this case study lays important groundwork in the exploration of Neuroguided Performance Training for a variety of mental and physical health outcomes.

CONCLUSIONS & IMPLICATIONS

Nurses endure an exorbitant number of daily stressors that can significantly impact long-term physical and mental well-being. As a result, studies indicate that nurses exhibit high levels of burnout, depression, and anxiety. Failure to engage in feasible stress management techniques can lead to a decline in quality of life, difficulties regulating emotions, reduced productivity to the point of leaving the profession, and the potential development of chronic health conditions. It is therefore vital for nurses to actively adopt effective coping mechanisms to mitigate the detrimental effects of occupational stress and promote their overall well-being. **Nurses experienced lower levels of depression, anxiety, perceived stress, and burnout while improving their sleep and overall well-being using Vital Neuro's Neuroguided Performance Training.**

The improvements following the intervention may suggest that the Neuroguided Performance Training serves as a catalyst for adopting other health-promoting behaviors such as regular physical activity, balanced nutrition, or better sleep hygiene throughout the day, potentially accounting for the changes in other variables. Nonetheless, even as little as a 15-minute daily session of the Vital Neuro method has the potential to create a long-lasting impact on both physiological and psychological well-being. This makes it a practical solution for individuals in the general population seeking to enhance their daily functioning, as well as for specific occupational groups facing excessive stress in their work environments.

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