Studying Anxiety in the Workplace of Generation Y And Z Through Brain Science Methods

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ABSTRACT:
This study examines personality traits at the intersection of human resource management, psychology, and neuroscience, using experimental research methodologies. The outcomes were analyzed through both quantitative and qualitative methods. The research explored how individual personality traits influence workplace group dynamics and compared behavioral characteristics across different age groups. A distinguishing feature of the study was the combined application of the Five Factor Model and the Neuropsychological Model of Emotion (positive and negative emotion models). In human resource management, personality traits are commonly analyzed within the framework of the Five Factor Model in relation to situational factors. Meanwhile, in neuroscience, emotional triggers of positive and negative behavior are studied using the Neuropsychological Model of Emotion. This study integrates these theoretical frameworks and incorporates brain activity analysis methods to investigate behavioral patterns in workplace group interactions. To induce anxiety experimentally, selected negative workplace behaviors—such as interpersonal conflicts, misunderstandings, and disputes between supervisors and subordinates—were recorded and presented to participants in video format. As participants viewed the video stimuli, their anxiety responses were observed through changes in alpha and beta wave activity, which are known to reflect emotional states. The results indicated that heightened anxiety was associated with increased beta and decreased alpha wave activity. Statistical analysis confirmed the reliability of the research model, with a Cronbach's alpha of 0.826 (82.6%). These findings validate the experimental framework as a reliable tool for examining how negative social stimuli in organizational settings influence both group behavior and corresponding changes in brain activity.

Keywords: Five Factor Model, Neuropsychological model of emotion (NME), ICA (Independent Component Analysis).

I. INTRODUCTION

The state of organizational group dynamics is defined by the characteristics of interpersonal relationships between individuals and groups. The cohesion and quality of collaboration within a group directly influence an organization's goals, productivity, and cultural patterns [1]. In organizations where positive relationships prevail, employees' attitudes and psychological states tend to be positive, resulting in increased productivity.

In contrast, dysfunctional communication can lead to misunderstandings that negatively affect organizational operations [2][3]. The root causes of negative influences on group dynamics are often closely linked to age-related differences among employees and individual personality traits. Contemporary research on workplace relationships highlights the need for systematically studying patterns of group interactions to implement effective human resource policies.

Karl Mannheim's Theory of generations explains changes in individual behavior through the influence of social context, education, and technological exposure [4]. In management studies, individual personality traits are systematically categorized using the Five Factor Model (Big Five Model) developed by Louis Goldberg and Raymond Cattell [5][6]. This model provides a statistically grounded framework for identifying personality characteristics and modeling patterns of group behavior. In neuroscience, aligning personality traits with experimental and measurement-based methodologies also supports the use of the Five-Factor Model.

Based on this model, the present study considers negative workplace interactions involving colleagues, managers, and leadership as psychological stressors that induce anxiety. The study integrates organizational behavior, group dynamics, and individual psychological responses into a comprehensive framework. Through both statistical and neurophysiological measurement techniques, the study explains the correlations between individual personality traits, negative group interactions, and brain activity changes.

The brain activity of individuals experiencing anxiety is analyzed using theoretical and methodological approaches from neuroscience, alongside neurophysiological data. This neurophysiological data—specifically, brain wave patterns—varies depending on an individual's psychological state. Each type of brain wave, such as alpha and beta waves, reflects corresponding physiological and psychological conditions, and the variations in their activation levels are closely associated with individual emotional responses and behavioral traits. The International 10–20 electrode placement system was employed to localize brainwave activity across standardized cortical regions. This system, originally developed by Hans Berger [8], enables the measurement of electrical activity in designated brain regions by placing electrodes at standardized points across the scalp. The use of this model allows for precise detection and analysis of changes in neural activation across specific car Research conducted by Burrhus F. Skinner, Patricia K. Casper, and Edward D. Hopkins has confirmed that differences in electrical activation between the right and left hemispheres of the brain are key factors influencing an individual's psychological state and interpersonal group dynamics. The asymmetry of brainwave activity across hemispheres has been further modeled and studied by Marion Heller and Edward Nitschke. These scholars developed the Positive and Negative Emotion Model, which theorizes an inverse relationship between alpha and beta waves and validated this relationship at the theoretical level [9][10]. This interdisciplinary, integrative study establishes a theoretical and methodological foundation for explaining organizational behavior, individual personality traits, and group interaction patterns in the field of management through the lens of neurophysiological areas.

Theoretical And Experimental Research Methodology

A. Research Methodology

Contemporary theoretical perspectives in management studies assert that generational cohorts are characterized by distinct behavioral profiles. Such intergenerational disparities substantially influence the formation and expression of individual personality constructs. Accordingly, the systematic examination of generational behavioral variation has emerged as a strategic imperative for human resource professionals, particularly in efforts to foster constructive interpersonal dynamics and enhance intra-organizational collaboration. In pursuit of a more granular understanding of organizational human resource policy frameworks, the present study employs an integrated model to investigate the associations between interpersonal conflict and anxiety-inducing stimuli within workplace group contexts. A schematic representation of the research model is presented in Figure 1.

Theory of Generations: The theory of generations provides a foundational framework for the theoretical classification of emotional variability and behavioral typologies within peer groups.

Big Five Model: The adverse facets of the Big Five personality dimensions—neuroticism, extraversion, openness, agreeableness, and conscientiousness—were empirically delineated through controlled experimental procedures. These maladaptive personality traits were subsequently analyzed as potential antecedents contributing to workplace conflict and interpersonal discord [11].

Model of Positive and Negative Affective States: Individual anxiety and negative responses were measured using electroencephalography (EEG), with alpha and beta wave activity analyzed in the frontal cortex. Emotional responses were interpreted by examining how activation differed between the right and left hemispheres of the brain, thereby explaining individual experiences of anxiety and negative affect.+

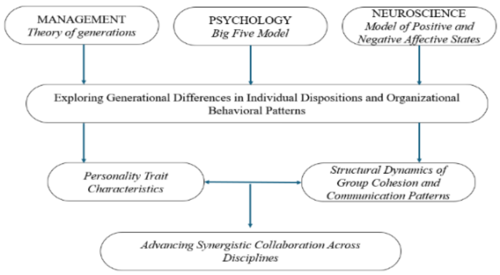

Fig. 1 Theoretical and Methodological Framework for Conducting nterdisciplinary Research

B. Experimental Methodology and Research Design

In this study, a series of stimulus materials depicting prototypical instances of interpersonal conflict and negative social interactions within workplace groups were systematically developed and administered to participants. The ensuing negative affective responses were captured through neuroscientific instrumentation—specifically, neurophysiological monitoring—and subsequently analyzed in terms of brainwave activity patterns.

- Heightened neural activation was predominantly localized in the right frontal cortex, suggesting increased vulnerability to anxiety and negative affective states among the participants.
- These findings provide empirical evidence that both individual personality traits and intergenerational differences serve as significant determinants of organizational conflict and associated behavioral responses.

II. Empirical Results Derived from the Experiment

When an individual psychologically processes a stimulus-driven situation, neurophysiological electrical activity is generated in the brain. This neural activity is directly influenced by the individual's emotional patterns, whether positive or negative [12]. To elicit changes in personality traits, the study selected negative behavioral indicators defined within the Five Factor Model (Big Five Personality Traits) framework [13][14]. Following the presentation of the stimulus, the interaction of neural cells in the brain produced alpha (α) and beta (β) electrical waves in the frontal region. The activation of alpha and beta waves was most prominent during states of anxiety, which are typically localized in the frontal lobe of the brain [15]. To record emotional activation in the frontal cortex, electrodes were placed according to the International 10/20 system developed by Herbert Jasper [8].

The study employed a targeted selection of electrode positions:

- FP1 and FP2 to represent the left and right anterior frontal regions
- FPz for the midline frontal zone
- F1 and F2 as intermediate frontal sensory location
- Fz to denote the central frontal site
- Oz corresponding to the posterior occipital region associated with visual response termination.

The spatial distributions of neural activation were interpreted within the theoretical framework of dipole modeling, and the dynamics of wave propagation were subsequently analyzed through both two-dimensional and three-dimensional cortical surface mapping techniques.

A. Power Spectral Density Outcomes Derived from the Experiment

The evaluation of brain electrical activity was interpreted based on the Neuropsychological Model of Positive and Negative Emotion. During neural responses, electrical impulses generated between neurons appear in the form of directional, polarized signals [16]. According to the dipole model, these impulses were visualized in two dimensions, with voltage distributions differentiated by polarity—positive voltages represented in red and negative voltages in blue—as observed in the experimental results [16][17]. This spatial voltage differentiation was clearly illustrated using Independent Component Analysis (ICA), a method that isolates the sources of EEG signals and enables detailed mapping of functional differences across brain regions. For example, Marion Heller and Edward Nitschke's research noted increased alpha (α) wave activity in the right frontal region of the brain in association with negative emotional states. Their Positive and Negative Emotion Model serves as a foundational theoretical framework that defines the systematic relationship between brainwave spectra and emotional states.

B. Performance Analysis of Machine Learning Models for EEG Signal Interpretation

Brain electrical activity data represents a composite of various biological signals, including brainwaves, muscle movements, cardiac activity, and eye movements. To isolate the sources of brainwave signals, Independent Component Analysis (ICA) was employed. This method applies statistical transformations to separate distinct components of brain activity, making it a more suitable and effective approach for extracting the primary EEG signals from overlapping biological noise [18].

C. The Independent Component Analysis (ICA)

The method applied in this study operates based on machine learning algorithms for data computation. The machine learning model was configured to run across 512 processing steps, with a learning rate adjusted between 0.001 and 0.00001. This setup enabled high-precision processing of brainwave signals at a resolution of one millisecond, thereby creating the conditions necessary for detailed classification of emotional states. In the analysis, biophysical parameters such as alpha and beta wave power and wavelength were used as input variables for the machine learning model. Their statistical properties—including variance, kurtosis, and skewness—were calculated to analyze how EEG data patterns correspond to human emotional states. The emotional conditions and tendencies observed in the study were interpreted based on the Positive and Negative Emotion Model proposed by Heller and Nitschke (1997). According to this model, increased alpha wave activity in the right prefrontal cortex is considered a physiological marker of negative emotional states such as anxiety. Therefore, the primary aim of this study was to explain emotional states in relation to the spatial distribution of brainwave activity [18], electrical potential, and brainwave characteristics from a neurophysiological perspective. This approach explains the neurophysiological basis of emotional responses to negative stimuli within workplace group dynamics more precisely.

D. Emotion-Related Neuronal Activation and Independent Component Analysis of Brain Dynamics

The study investigated the correlation between neural activation and anxiety states in the brain as participants viewed videos designed to induce negative emotions. The electrical charge transfer of each neuron generates an energy difference, thereby influencing the distribution of spatial electric potential in the brain [19][20]. This type of potential change can be understood through the 'dipole' model. In EEG spatial mapping, these potential fluctuations are represented using color coding. When high-intensity, bipolar oscillations are detected, the corresponding brain region is marked in deep red (positive pole) and blue (negative pole) colors. As the activity decreases, the color gradient shifts in the following order: red → green → yellow → blue. This type of color coding is an effective method for visually representing the brain wave activity observed in EEG recordings, making it more comprehensible at the spatial level [17]. According to the emotional model by Heller and Nitschke, negative emotions, particularly states of anxiety, tend to increase the α-wave activity in the right frontal region of the brain. In this study, color-coded matrices derived from EEG data were utilized as input features for machine learning analysis [21]. In this regard, the intensity, direction, and statistical characteristics of brain wave fluctuations, including variance, skewness, and kurtosis, were calculated and analyzed in relation to emotional states. Although measures were taken to reduce artifacts caused by eye movement and muscle contractions during the processing of the waves, it was impossible to completely distinguish the cross influences in some areas. Therefore, Independent Component Analysis (ICA) was used to perform the analysis, statistically identifying the sources of emotional waves. The distribution of waveforms during anxiety from the EEG recordings of the first group of participants was illustrated using spectral analysis (as shown in Fig. 2).

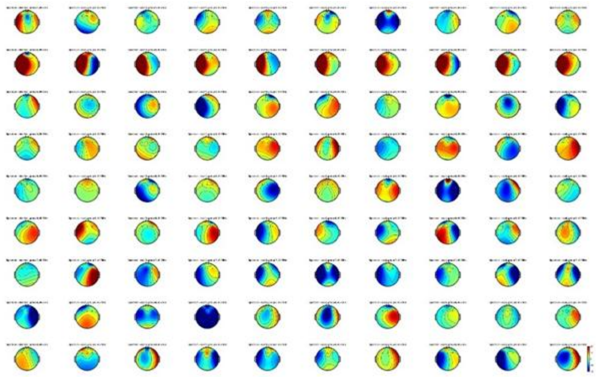

Fig. 2. Independent Component Analysis (ICA) of EEG data from Group 1 participants, highlighting brainwave alterations associated with anxiety states, as spatially localized using dipole source modeling.

During the viewing of emotion-inducing events recorded in the session, participants in Group Y demonstrated a generally lower tendency to experience anxiety [22]. Their EEG signals, particularly the α and β spectra, showed no significant changes in areas of high activity, confirming this observation. This indicates that emotional and anxiety responses to stimuli vary among participants of that period. However, in videos related to themes such as job loss or unemployment, a slight increase in α-wave activity in the right frontal region of the brain was observed. This phenomenon aligns with the Model of Positive and Negative Emotions described by Marion Heller and Edward Nitschke, which explains that negative emotions are associated with increased activity in the right frontal region of the brain. We used the spatial distribution, intensity, and spectral statistical characteristics (variance, kurtosis, skewness) of brain wave frequencies as input variables in a machine learning algorithm. When the frequency range of the above waves was examined in detail, the following results were obtained when the brain wave frequency was changed from 8 Hz to 14 Hz. The results are mentioned in Figure 3.

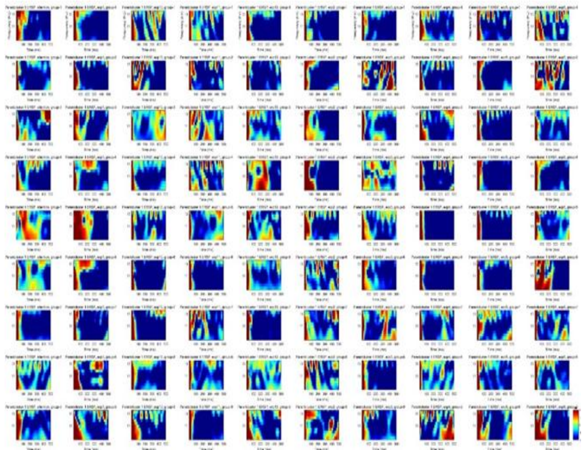

Fig. 3. Brain activity mapping during anxiety episodes, generated from EEG data of Group 1 participants and processed through a supervised machine learning algorithm to produce comparative outcomes.

This indicates that the brain remains relatively calm while processing the situation. The brainwave mapping of a participant from Group 2 can be seen in Figure 4 below.

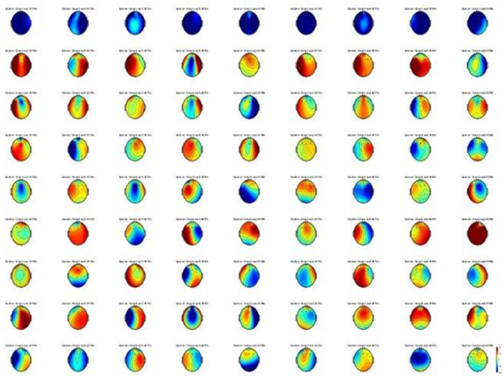

Fig. 4. EEG recordings from Group 2 participants processed through Independent Component Analysis (ICA), revealing brainwave alterations associated with anxiety episodes, with spatial localization performed using dipole source modeling.

The experimental conditions were identical to those in the previous group. Compared to the previous group, the perception of anxiety appeared to be similar across individual participants. As shown in Figure 5, participants in Group 2, or Group Z, exhibited more active anxiety responses compared to those in Group Y.

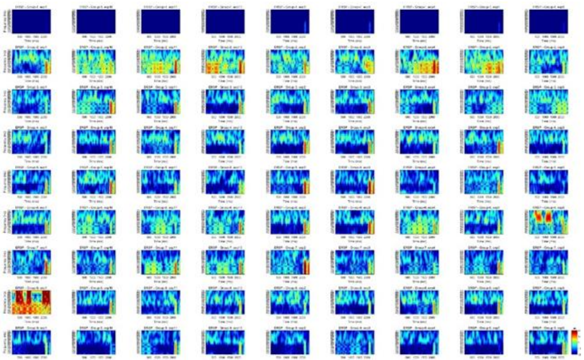

Fig. 5. Brain activity mapping during anxiety episodes derived from EEG recordings of Group 2 participants, with signal processing performed using a supervised machine learning algorithm to produce comparative outcomes.

Furthermore, the distinct neural activation patterns observed in Figures 4 and 5 suggest group-level differences in the perception or processing of anxiety-related stimuli.

E. Statistical Analysis Results

To verify the reliability of the experimental measurements, Cronbach's alpha coefficient was calculated for fourteen dependent variables (DVs). This approach ensures a robust evaluation of the internal consistency across multiple variables. In accordance with international benchmarks, a Cronbach's alpha coefficient exceeding 0.70 is deemed acceptable, while values above 0.80 are considered indicative of high reliability. In the present study, the obtained reliability score (α = 0.83) surpassed this threshold, demonstrating a strong degree of internal consistency among the measurement items (refer to Table 1).

Table 1. Cronbach's Alpha Reliability Coefficients for Experimental Design Instruments

Study Reliability	
Cronbach's Alpha	Items
.826(82.6%)	14

Descriptive statistical analysis of the results revealed that there was a total of 66 participants in the control and experimental groups, with an average age of 26.48 years (SD = 6.15), ranging from 20 to 44 years. From the initial pool of 80 participants, 14 individuals who did not report experiencing anxiety during the experiment were excluded from the analysis. Consequently, the study proceeded with an EEG analysis involving 66 participants: 33 (n = 33) individuals in the control group who reported no anxiety and 33 (n = 33) individuals in the experimental group who reported anxiety following the intervention. The anxiety levels of these 66 participants were classified based on self-assessment questionnaires using the Hospital Anxiety and Depression Scale (HADS). When categorized by age groups, 36 participants (54.5%) belonged to the Z-generation group aged 27 and below, while 30 participants (45.5%) were in the Y-generation group aged 28 and above. A summary of the age analysis results is presented in Table 19. Regarding gender distribution, 48.5% of the participants were male (n = 32), and 51.5% were female (n = 34), indicating that gender balance was successfully achieved in the study. In terms of occupation, the random sample included individuals from seven different professions.

The reliability of this experiment was analyzed and compared with the findings of international researchers, as outlined in the table below.

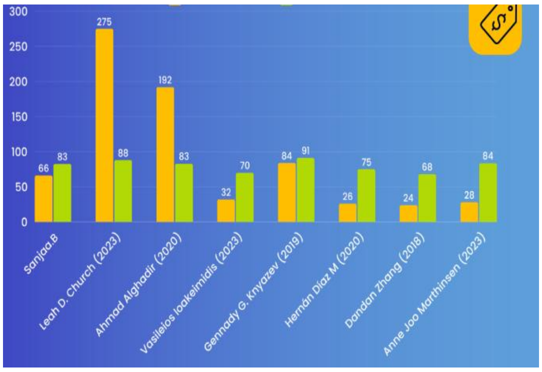

Fig. 6. Brain activity mapping of Group 2 participants under experimentally induced anxiety, illustrating region-specific neural activation patterns.

From the reliability analysis ratios presented in the table, it can be concluded that this experimental model represents an average level of reliability. However, the observed differences in the study's outcomes are attributed to variations in national and cultural characteristics, socio-economic factors, and differences in education and cultural contexts.

5. Inter-variable Correlation Outcomes

The results of Pearson correlation analysis performed on the EEG recordings of participants indicate that the power of alpha and beta waves exhibited a moderate negative correlation with participant age. The correlations were most prominently observed in the frontal anterior/inferior regions of the brain.

Specifically, alpha wave activity demonstrated statistically significant negative correlations with age at the frontal electrode sites FP1 ($r = –0.31$, $p < 0.05$), FPz ($r = –0.42$, $p < 0.001$), FP2 ($r = –0.33$, $p < 0.01$), and F4 ($r = –0.44$, $p < 0.001$). Similarly, beta wave activity exhibited comparable negative correlations at the same locations: FP1 ($r = –0.28$, $p < 0.05$), FPz ($r = –0.37$, $p < 0.01$), FP2 ($r = –0.36$, $p < 0.01$), and F4 ($r = –0.41$, $p < 0.001$). In contrast, neither alpha nor beta wave activity showed significant correlations with age at the F3, Fz, or Oz sites.

This finding aligns with the neurophysiological model of emotions, consistent with Heller and Nitschke's "Model of Positive and Negative Emotions," which suggests that increased alpha-wave activity in the right frontal region is associated with negative emotional expressions. The age-related decrease in wave intensity in this area indicates a connection between emotional processes, particularly the physiological basis of anxiety. The observed negative correlation between the power of alpha and beta brain waves and age, especially in the lower frontal region, highlights the relationship between brain activity in this area and the physiological states underlying emotions.

F. Interaction Effects of Anxiety, Age, and Gender on Brain Activity Patterns

The T-test analysis demonstrates how alpha and beta brain waves are activated depending on anxiety states, age groups, and gender. When comparing the control and experimental groups using a two-tailed T-test, alpha waves showed statistically significant increases in the anxiety-induced experimental group at the FPz, FP2, F3, and Fz locations. Similarly, beta waves exhibited significant increases exclusively at the F3 location in the experimental group. In detail, the alpha wave power showed a moderate difference at the FPz location, $t(64) = -2.23$, $p < 0.05$, Cohen's $d = -0.55$; at the FP2 location, $t(64) = -2.82$, $p < 0.01$, Cohen's $d = -0.69$; at the F3 location, $t(64) = -2.81$, $p < 0.01$, Cohen's $d = -0.69$; and at the Fz location, $t(64) = -2.31$, $p < 0.05$, Cohen's $d = -0.57$. On the other hand, the beta wave power exhibited a strong difference at the F3 location, $t(64) = -3.41$, $p < 0.001$, Cohen's $d = -0.84$. These findings suggest that when the human brain processes anxiety-related information about job security, it emits moderately diffuse alpha waves and strongly localized beta waves on the left side. This observation supports the "Positive and Negative Affect" theoretical model. In other words, alpha and beta waves play distinct roles in responding to anxiety stimuli.

G. Comparative Analysis of Functional Activity in the Left and Right Cerebral Hemispheres

The alpha and beta waves emanating from the frontal upper/lower regions are closely associated with the functioning of the brain's prefrontal cortex, which is responsible for higher cognitive functions. These waves, however, are also significantly linked to the emotional response, particularly the perception of anxiety, depending on their localization in the right or left hemisphere of the brain [15].

In this study, alpha wave activity was found to be relatively symmetrical across the left and right hemispheres during the majority of stimulus presentations. However, in response to specific high-intensity, anxiety-inducing stimuli, alpha wave dominance shifted markedly toward the right hemisphere. In contrast, beta waves exhibited a general predominance in the left hemisphere under typical stimulus conditions. Yet, similar to alpha wave patterns, a lateral shift toward right-hemisphere dominance was observed in response to certain strong anxiety triggers. Importantly, beta wave power was consistently higher than that of alpha waves across most electrode sites (Appendix 1: Graph 3 – Hemispheric Wave Differences).

H. Measurement of Anxiety Reactivity in Peer Contexts

When comparing the age groups Y (above 28) and Z (below 27), the alpha waves in the Z group were significantly higher than in the Y group at the FP1, FPz, FP2, Fz, and F4 locations, while similar results were observed at the F3 and Oz locations. In contrast, for beta waves, the alpha wave power in the Z group was significantly higher than in the Y group at the FP1, FPz, FP2, and F4 locations, but no significant difference was found at the Fz, F3, and Oz locations.

PROPOSED CONCEPTUAL FRAMEWORK AND EVIDENCE-BASED RECOMMENDATIONS

The findings of the study indicate that emotional responses can be systematically characterized by specific parameters of brain electrical activity, particularly alpha and beta wave parameters. Drawing on these empirical results, a set of strategic recommendations for organizational human resource policies has been formulated and is presented in Table 2.

Table 2. Evidence-Based Recommendations for Enhancing Human Resource Policy.

Recommendation	Rationale
Provision of Psychological Support Aligned with Generational and Age-Specific Traits	Given the distinct patterns of emotional responsiveness observed among Millennial (Generation Y) and Generation Z employees, calibrating task assignments to align with their respective psychological profiles may facilitate increased workplace engagement and optimize organizational performance.
Early Identification of Anxiety and Stress Indicators through Preliminary Screening	Utilizing neurophysiological assessments—such as electroencephalography (EEG)—facilitates the early detection of elevated stress responses among employees, thereby enabling timely psychological interventions and targeted support strategies.
Structuring Workplace Interactions to Reduce Negative Emotional Triggers	The study's findings suggest that negatively valenced emotional stimuli exert a direct and deleterious impact on interpersonal dynamics within organizational teams.
Implementation of Psychophysiological Training Programs for Managerial Personnel	The implementation of neuroscience-informed emotional regulation training for managerial personnel has the potential to significantly improve team productivity by

	cultivating emotionally intelligent leadership and mitigating reactive interpersonal conflicts.
Internal Assessment of Team Dynamics to Identify Psychosocial and Behavioral Risk Factors	Establishing an organizational decision-support system based on psychophysiological metrics—such as EEG and HRV—can improve the accuracy of targeted interventions by detecting intra-team communication barriers and emotional stress responses.

Conclusion

The Five Factor Model provides a robust framework for examining the external variables that influence employee job satisfaction, workplace attitudes, and interpersonal relationships. Within the field of human resource management, this model is widely applied to inform employee selection by assessing psychological disposition, role compatibility, and behavioral tendencies. Moreover, the Five Factor Model is regarded as one of the most empirically validated approaches for investigating individual personality traits through experimental methodologies. In psychological science, the Big Five Personality Traits Model is similarly employed to categorize and interpret dimensions of human behavior. The theoretical alignment of these two models ensures measurement consistency in personality research.

The Five Factor Model is directly associated with core psychological traits and may be theoretically integrated with the Positive and Negative Emotion Model commonly utilized in neuroscience. Behavioral alterations at the individual level are closely linked to the activity of neurotransmitter systems, which mediate emotional responses. As such, fluctuations in emotional and behavioral states correspond with the generation of brain electrical activity at specific frequency bands.

The causal antecedents of emotional responses can be conceptualized through the Five Factor Model, while the corresponding emotional expressions can be interpreted neurologically via the Positive and Negative Emotion Model. This integrative framework elucidates the pathways through which stable emotional traits modulate brain activity patterns.

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Appendix 1 — Figure 3. Comparative Analysis of Brainwave Activity in the Left and Right Cerebral Hemispheres