NEUROCOGNITIVE STIMULATION IN MILITARY TRAINING: IMPACT ON PERFORMANCE AND EMOTIONAL REGULATION

Iasmina-Georgiana SAUCIUC

”HenriCoandă” Air Force Academy, Braşov, Romania (iasmina271@yahoo.com)

DOI: 10.19062/1842-9238.2025.23.1.10

Abstract:*This research investigates the impact of neurocognitive stimulation on performance and emotional regulation in military training. Historically, research has focused on the physical and objective factors of performance, often neglecting the neurocognitive and emotional aspects that are crucial in high-stress operational conditions. The study proposes an integrated approach combining EEG monitoring with non-invasive neurostimulation using the HALO Sport device to assess its impact on focus, emotional regulation, and physical performance. In a simulated military biathlon experiment, participants were exposed to complex tasks under three experimental conditions: no stimulation, active stimulation, and placebo stimulation. The results revealed that neurostimulation with HALO Sport significantly improved cognitive and motor performance while reducing negative emotional responses such as anxiety and enhancing mental resilience. The study demonstrates that neurocognitive stimulation can be an effective method for optimizing military training, contributing to better emotional self-regulation and more efficient operational performance under stress. The findings suggest that this integrated neurocognitive approach could revolutionize military training strategies, fostering a balance between physical and mental performance crucial for critical operational contexts.*

Keywords: *neurocognitive stimulation, emotional regulation, performance, EEG, HALO Sport neurostimulation, military training, operational stress, self-regulation, cognitive performance, motor performance.*

1. INTRODUCTION AND RESEARCH PROBLEM

For a long time, research in the field of operational performance psychology has predominantly focused on external and objective factors of training—such as tactical routines, workload, or physical conditions. Only recently have cognitive science and applied neuroscience begun to integrate more subtle, yet essential, variables into performance analysis: cognitive stress, sustained focus, mental engagement, and emotional self-regulation under pressure.

In the military environment, where each decision made under pressure can have major implications, the ability to maintain focus, manage acute stress, and remain functional in a hostile climate becomes critical. Additionally, the reality of modern military training involves increasing task complexity, sustained cognitive effort, and constant emotional expenditure. These aspects can no longer be ignored in operational preparation, but must be analyzed and optimized through scientific methods.

In the military environment, characterized by intense demands, constant pressure, and a high level of unpredictability, the emotional component plays an essential role in determining professional efficiency.

Emotions are not merely transient reactions, but complex psychophysiological processes that influence perception, decision-making, attention regulation, and the ability to act in critical situations. Unlike other fields, where emotional management can be flexible, in the military system, emotional balance is a key determinant of safety, cohesion, and operational performance (Rusu, 2024).

Flood and Keegan (2022) emphasize that cognitive resilience is a key factor in managing operational stress among military personnel, and neurocognitive interventions can effectively support maintaining performance under pressure.

Similar to how emotions were once considered disruptive elements in organizations (and therefore neutralized or ignored), stress or cognitive fluctuations are often treated as secondary or inevitable factors. However, like emotions, these mental states decisively influence behavior, efficiency, and adaptability. They cannot simply be eliminated from the performance equation, but must be understood, measured, and, where possible, regulated.

This research aims to address these needs through an integrative approach combining neurophysiological data (obtained via EEG), behavioral analysis, and the application of an emerging neurostimulation technology HALO Sport.

Modern military training requires a comprehensive approach that integrates both physical and cognitive training, considering that performance under operational stress depends on the ability to respond quickly and efficiently to challenges. Blacker *et al.* (2018) emphasize the importance of cognitive training for enhancing executive functions and adaptability in demanding environments (Yanilov & Boe, 2014; Dugan, 2020; Lesenciuc & Sauciuc, 2022; 2023).

In my previous dissertation research titled "The Impact of Cognitive Stress on Pilot Performance: An Analysis Using EEG Monitoring," I explored in-depth the relationship between cognitive stress and the operational performance of military personnel from a neuropsychological perspective.

The main focus of the research was on the neurophysiological changes induced by stress and the possibility of monitoring and interpreting these changes through EEG biosignals. The experiment took place in a controlled yet simulated environment, using a military biathlon scenario where participants were exposed to complex tasks involving movement, rapid decision-making, and sustained focus under controlled stress conditions designed to replicate operational stress. Since implementing such a protocol in real flight conditions was not feasible, the simulation provided a controlled but intense environment. The experiment lasted for three days:

- **Day 1**: Participation without external interventions, for baseline comparison.
- **Day 2**: Introduction of the HALO Sport neurostimulator, aimed at optimizing cognitive and motor performance while supporting emotional balance.
- **Day 3**: Testing the effect to verify the observed outcomes.

The central issue of the research stems from the question: Can the cognitive and emotional performance of military personnel be optimized, or in other words, can the neurocognitive architecture of military personnel be effectively modified through non-invasive neurostimulation methods? And, additionally, can these transformations be objectively measured with the help of brain biosignals?

To capture ongoing phenomena, such as focus, relaxation, or cognitive alertness methods of investigation beyond behavioral observation are needed. In this regard, real-time EEG monitoring and applied neurostimulation technology open new horizons for applied research in the military field. Capturing brain activity is no longer solely a medical mission, but becomes an adaptive training tool for performance optimization (Sauciuc, 2023).

2. RESEARCH RELEVANCE

Current literature on operational performance in a military context increasingly highlights the need for a more nuanced approach that integrates the neurophysiological dimension and the impact of cognitive stress on operational efficiency. Particularly, there is a noticeable underrepresentation of studies systematically addressing neurocognitive variables such as acute mental stress, attention fluctuations, or emotional self-regulation, all of which are essential for optimizing individual performance in high-demand contexts. While many studies examine tactical and physical performance aspects, few have successfully correlated these dimensions with their cerebral substrates, measurable in real-time, and with optimization possibilities using non-invasive methods (Sauciuc, 2023).

This work seeks to fill a significant gap in the literature by addressing a topic with direct and immediate applicability to military training: optimizing emotional performance under simulated stress conditions, using modern neurostimulation technologies and EEG monitoring. The relevance of this research stems from the fact that modern military preparation can no longer be conceived solely as physical or procedural training; an integrated approach is needed that takes into account brain and emotional responses to operational challenges.

In this context, previous research, such as that conducted by Blacker *et al.* (2018), shows that applied cognitive training can support the development of essential skills for military performance, such as concentration, quick decision-making, and adaptability under stress.

Moreover, this research advocates for a paradigm shift in military training: from an exclusively physical-tactical perspective to one where emphasis is placed on the neurocognitive development of the soldier. Non-invasive brain stimulation, combined with EEG analysis and behavioral observation, could become a key component in the future of operational training, both at the individual level and in the development of adaptive training programs (Rusu, 2024).

Therefore, the contribution of this research lies in proposing an integrated model of analysis and intervention, which would allow for the identification and regulation of critical mental factors influencing military performance.

This approach can be further expanded and validated in real operational contexts, offering a solid methodological framework for future research in the field of neuro-performance applications.

3. SCIENTIFIC CONTRIBUTION AND NOVELTY ELEMENTS OF THE RESEARCH

The originality of this research stems from the convergence of several current scientific directions - applied neuroscience, performance psychology, and non-invasive brain stimulation technology—and their integration into a specific military framework, which has rarely been explored in the literature. In a field where performance analysis is typically centered on quantitative and behavioral criteria (accuracy, reaction time, tactical efficiency), this work proposes a deeper approach, focused on the cerebral substrate of performance from an emotional perspective.

The experimental approach conducted with the military biathlon simulator, under standardized conditions, provides a controlled but realistic environment for studying cognitive and emotional reactions in stressful settings.

The application of an emerging technology—HALO Sport neurostimulator—along with real-time EEG brain activity monitoring, allows not only passive observation of mental states but also active intervention, in an adaptive and non-invasive manner (Rusu, 2024).

The innovative contribution of this research includes the following directions:

- Introducing a triadic experimental protocol conducted over three consecutive days: one day without stimulation, one day with active neurostimulation, and one day with a placebo, allowing for a rigorous inter-condition comparison.
- Combining EEG data with behavioral observations and psychological self-reports, providing a comprehensive picture of military personnel's neurocognitive responses in stressful simulated conditions.
- Applying a commercially available technology in a professional military context, thus bridging fundamental research with immediate applicability in operational training.
- Identifying correlations between the use of neurostimulation and improvements in attention, stress reduction, and increased motor efficiency—factors that could underpin future neurocognitive training protocols.

Furthermore, this research leverages a user-friendly and accessible technology (HALO Sport) that can be easily integrated into training scenarios without requiring sophisticated equipment or hard-to-access resources.

Through all of this, the study not only explores the theoretical relationship between stress, focus, performance, and emotional states but also proposes a concrete method of intervention, empirically tested and supported by objective data. This gives the research a pronounced applied character, with potential for replication and expansion in military personnel training programs.

4. EMOTIONAL REGULATION IN TACTICAL CONTEXTS: EEG RESULTS AND NEUROFUNCTIONAL INTERPRETATIONS

In simulated tactical contexts, such as the military biathlon scenario, performance is strongly influenced by emotional state. Emotions such as frustration, time pressure, or anticipation of failure trigger automatic neurophysiological reactions in the brain, which can directly affect: attentional focus, decision-making accuracy, fine motor control, as well as impulse regulation under stress.

Thus, emotions in the military environment are not a secondary factor but a core element of psychological preparation, with a direct impact on cognitive and decision-making functions. Understanding, measuring, and optimizing them should become a strategic priority for maintaining human efficiency in modern operations.

The experimental study I will present was initially conducted as part of my dissertation, with the general objective of investigating the effects of transcranial neurostimulation on military performance in a simulated stress context. At that stage, the analysis integrated motor and cognitive dimensions using a military biathlon simulator within the COMIND (Combat Mindset) laboratory - Fig. 1, which includes the cross-country skiing and shooting tests - Fig. 2 (for measuring time and shooting accuracy), in combination with the Halo Sport neurostimulator - Fig. 3 (for analyzing the impact of transcranial electrical stimulation on cognitive and motor performance) and the Emotiv EPOC+ EEG headset - Fig. 4 (for evaluating brain activity, specifically brain waves and various emotional and cognitive states).

Previous studies have shown that transcranial direct current stimulation (tDCS) using the Halo Sport device can significantly enhance physical and cognitive performance.

For example, a study by Huang et al. (2019) demonstrated that the application of tDCS significantly increased average power in repeated sprint cycling and improved cognitive performance in the Stroop test.

FIG. 1 The COMIND Laboratory with the SymWay Biathlon Simulator

FIG. 2 The Cross-Country Skiing and Shooting Tests within the Biathlon Simulator

FIG. 3 The Halo Sport Neurostimulator

FIG. 4 The Emotiv EPOC+ EEG Headset

The subjects were exposed over three days to the same complex tasks in three different conditions: no stimulation, active stimulation, and placebo effect. In all conditions, EEG biosignals were monitored, and physical-cognitive performance and emotional responses were recorded.

The new direction of analysis proposed in this paper focuses exclusively on the emotional dimension, with an emphasis on brain activation in areas involved in affective processing (prefrontal cortex, limbic system, amygdala, hippocampus, anterior cingulate cortex) and on how neurostimulation influences emotional self-regulation in operational stress situations.

By reevaluating EEG data, with a focus on alpha, theta, beta, and gamma brain waves, the goal is to identify objective correlations between brain activity and emotional states reported by participants. The current objective is to determine to what extent neurostimulation with HALO Sport contributes to maintaining emotional control, reducing affective reactivity, and increasing emotional resilience, compared to the lack of stimulation and the placebo effect.

To understand how the participants' emotional states were analyzed, it is important to mention that these processes are based on brain waves, which result from the synchronized activity of neurons. Through EEG, five types of waves were monitored: theta (4-8 Hz), alpha (8-12 Hz), beta (12-30 Hz), and gamma (30-100 Hz), each reflecting distinct mental and emotional states. For example, alpha waves indicate relaxation and calm, beta waves reflect a state of concentration and vigilance, and gamma waves are associated with advanced cognitive processes and emotional integration. These oscillations were correlated with parameters such as stress, engagement, relaxation, and emotional control, providing an objective picture of how participants emotionally responded in the three testing conditions (Sauciuc, 2023).

Cerebral activity during the training reflects the task intensity, stress level, and emotional involvement. In the study, we analyzed the distribution of brain waves (theta, alpha, beta, and gamma) at three distinct moments. The intensity of each wave was visually highlighted, providing clues about the level of neuronal activation and emotional regulation at each stage (Sauciuc, 2023; Lesenciuc & Sauciuc, 2023).

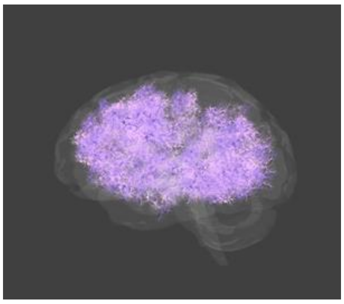

FIG. 5 Activation of Alpha Waves

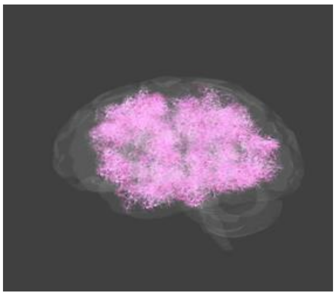

FIG. 6 Activation of Beta Waves

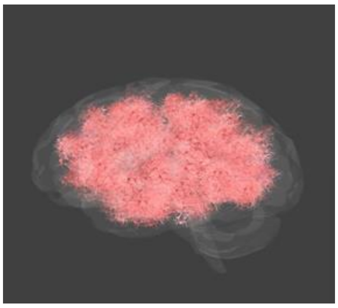

FIG. 7 Activation of Gamma Waves

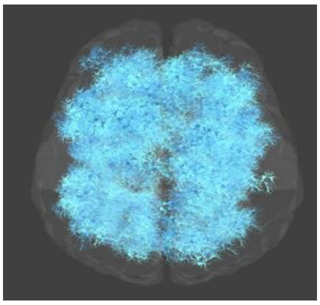

FIG. 8 Activation of Theta Waves

Brain Areas Involved in Emotional Processing and Observed EEG Changes

Applied neuroscience studies suggest that areas such as the prefrontal cortex (involved in self-control and decision-making), the amygdala (regulating fear and responses to threats), and the insula (awareness of emotions) are actively involved in adapting military personnel to specific military system conditions. Dysregulation of these circuits can significantly affect emotional regulation, responses under pressure, and even moral judgment in demanding operational contexts. Therefore, modern military training increasingly integrates emotional regulation techniques, biofeedback, or even neurostimulation, with the aim of enhancing mental resilience and performance.

This analytical shift toward the emotional dimension has allowed for a deeper understanding of how neurocognitive stimulation influences affective regulation in challenging contexts. Based on the EEG data collected at three key moments during training, significant variations were observed in beta wave activity (associated with alertness and cognitive control) and gamma waves (linked to information integration and emotional awareness). Additionally, the correlations between the activation of certain brain regions (such as the medial prefrontal cortex, anterior cingulate gyrus, and limbic structures) and levels of perceived stress or emotional self-regulation reported by participants suggest a direct impact of neurostimulation on emotional balance.

This analysis emphasizes that military performance cannot be separated from the individual's emotional state, and neurocognitive interventions may represent a viable solution for optimizing emotional responses under pressure. The main findings from the EEG analysis, affective self-reports, and comparisons between the three experimental conditions will be presented next.

The analysis focused on four key brain regions, which play a major role in emotional balance and stress adaptation: the medial and dorsolateral prefrontal cortex, the amygdala, the anterior cingulate cortex, and the insula.

To understand the emotional impact of each key moment during the military biathlon test, I will first analyze the brain areas involved in emotional processing based on the three distinct sequences: before training, the actual physical effort, and the shooting test moment.

1. **Before Training** - The EEG analysis highlighted predominant activation in the medial prefrontal region, Brodmann areas 10 and 11, associated with cognitive anticipation, emotional self-regulation, and preparation for executive control.
2. **During Physical Effort (Cross-Country Skiing)** – Activation was redistributed toward the motor and premotor areas (BA 4, BA 6), while gamma activation was maintained in the anterior insula and anterior cingulate – regions involved in interoceptive monitoring, awareness of bodily sensations, and emotional response integration to effort. This activation suggests a neurophysiological adaptation combining physical endurance with emotional regulation under stress.
3. **During the Shooting Test** – Psychological pressure and the need for emotional inhibition led to a peak in gamma wave activation in the dorsolateral prefrontal cortex and stabilization of beta waves in the posterior parietal cortex, reflecting intense attentional focus, as well as an increased capacity for emotional control and impulse inhibition. This configuration is crucial for maintaining calm, precision, and quick decision-making under pressure.

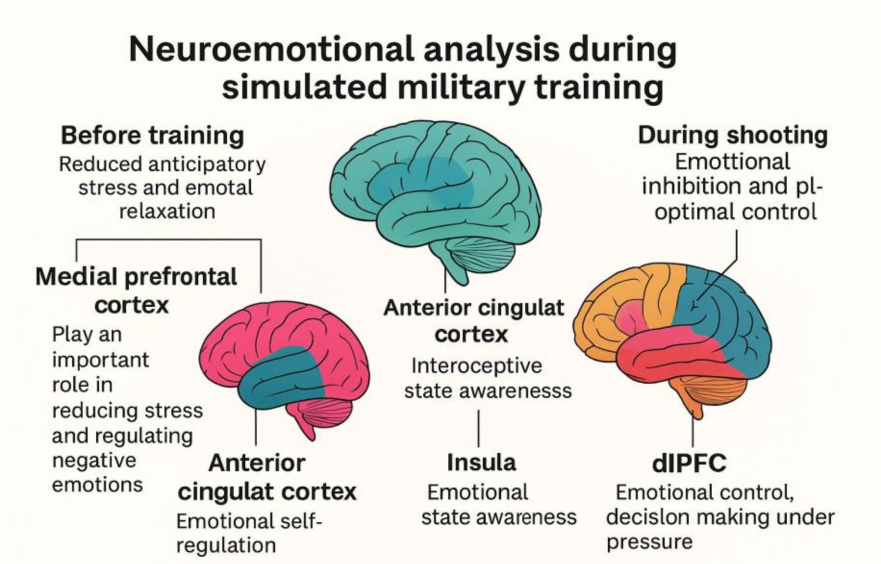

FIG. 9 Neuroemotional Analysis During Training Sessions

This spatial and temporal distribution of neural activation demonstrates that military performance is not strictly a function of physical effort or motor accuracy, but rather a deeply integrated emotional-cognitive process, involving collaboration between emotional self-regulation networks, executive monitoring, and stress resilience.

In this sense, the use of the HALO Sport neurostimulator appears to have accelerated the synchronization of these networks, facilitating a smoother transition between states of alertness, effort, and precision under stress, with direct benefits on emotional state and operational performance.

The following analysis aims to highlight the activation of the key brain regions involved in emotional regulation by correlating the types of EEG waves recorded with the variations observed in the three experimental conditions, in order to outline a differentiated profile of emotional response based on the type of stimulation applied.

1. **Medial Prefrontal Cortex (mPFC)** – Actively involved in emotional self-control, planning, impulse inhibition, and self-regulation, predominantly beta waves were recorded, associated with intense cognitive effort, but also alpha and theta waves, reflecting moments of mental calm and internal processing of emotional states.

Day	EEG Activation	Emotional Interpretation
Day 1 (no stimulation)	Increased beta waves and slightly elevated theta	Emotional overload, effort of self-control
Day 2 (Halo)	Increased alpha and theta waves, decreased beta	Calm, emotional clarity, efficiency in regulation, with theta indicating a centered and reflective mental state
Day 3 (placebo)	Moderate beta and alpha activation	Relatively stable emotional state, but not optimized

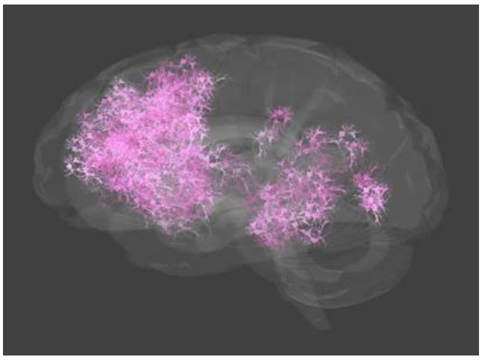

FIG. 10 Beta Waves Activated in the Prefrontal Cortex (Dorsolateral, Ventrolateral, Orbitofrontal, and Medial), as well as in the Auditory Cortex

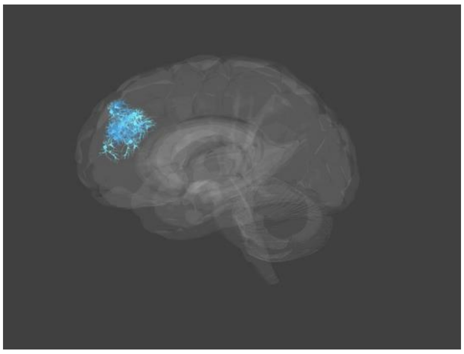

FIG. 11 Theta Waves Activated in the Prefrontal Cortex

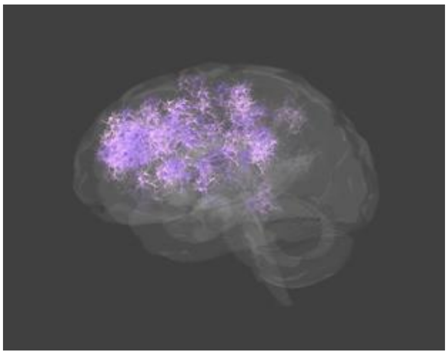

FIG. 12 Moderate Activation of Alpha and Beta Waves

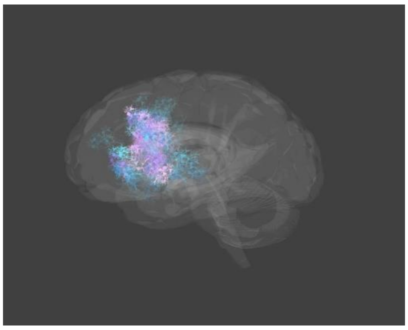

FIG. 13 Increased Alpha and Theta Waves and Decreased Beta Waves

2. Amygdala – A key structure in processing threat-related emotions, it was involved in triggering stress responses, being predominantly associated with high activation of Hi-Beta waves, typical of anxiety. However, this activation was significantly reduced on Day 2, suggesting a top-down emotional regulation process facilitated by prefrontal and medial cortical stimulation through alpha and theta waves.

Day	EEG Activation	Emotional Interpretation
Day 1	Indirect activation through Beta in the prefrontal cortex	Intense emotional reactions, heightened stress, anxiety
Day 2	Indirect inhibition through dlPFC and mPFC activation via alpha waves	Superior emotional control, reduced reactivity through top-down inhibition (dlPFC and mPFC)
Day 3	Partial activation	Present emotions, but better controlled than on Day 1

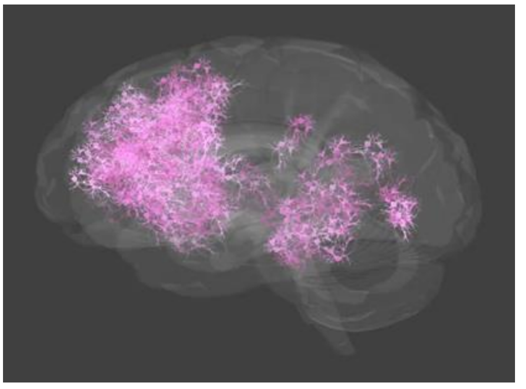

FIG. 14 Beta Waves Activated in the Prefrontal Cortex, Cingulate Cortex, Auditory Cortex, and Amygdala on Day 1

3. Anterior Cingulate Cortex (ACC) – Involved in integrating emotions into decision-making processes, detecting emotional conflicts, processing threats, and triggering rapid emotional responses, the ACC showed predominant activation in the Gamma, Beta, and Theta bands, suggesting heightened emotional attention, active monitoring of internal states, and efficient adaptive regulation, particularly on the day of active stimulation. However, it is inherently active under conditions of acute stress, and the Halo Sport indirectly contributed to top-down regulation of the amygdala through stimulation of the dorsolateral prefrontal cortex (dlPFC), which inhibits excessive emotional reactivity.

Day	EEG Activation	Emotional Interpretation
Day 1	High Beta Activation	Intense effort of emotional integration, emotional overload
Day 2	Balanced Gamma + Theta Activation	Emotional flow state, decision-making clarity, and active monitoring of internal states
Day 3	Intermediate Alpha Wave Activation	Partially controlled emotional response

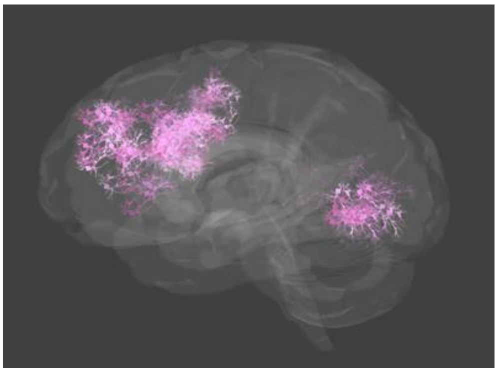

FIG. 15 Beta Waves Activated

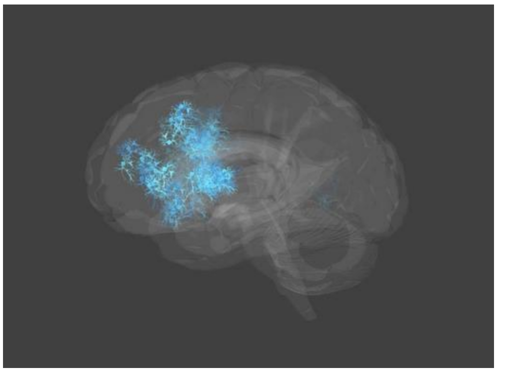

FIG. 16 Theta Waves in the Anterior Cingulate Cortex

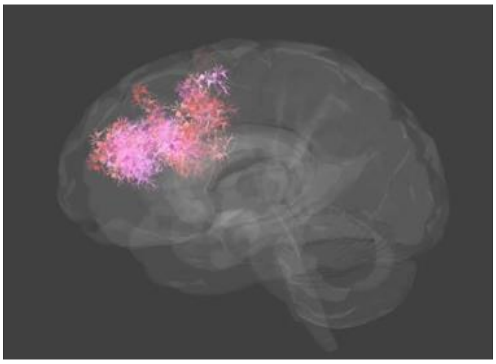

FIG. 17 Gamma and Beta Waves Activated

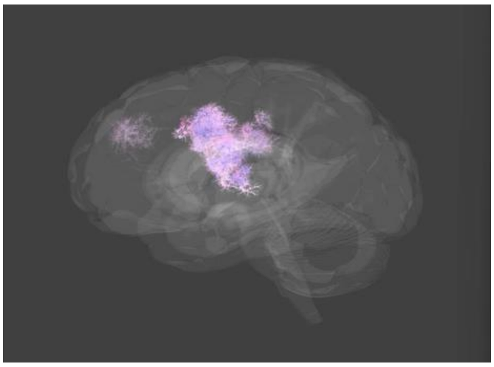

FIG. 18 Alpha Waves Activated

4. Insula – Responsible for awareness of bodily sensations and perceived stress, emotional adaptation, and specifically for integrating emotion and decision-making, the insula was activated primarily in the Gamma, Beta, and Theta bands, reflecting a balance between interoceptive monitoring, stress response, and emotional awareness without overload.

Day	EEG Activation	Emotional Interpretation
Day 1	Increased Gamma + Beta	Internal tension, high physiological stress
Day 2	Balanced Alpha	Calm bodily awareness, without overload
Day 3	Intermediate Activation	More stable emotional state, but without clear optimization

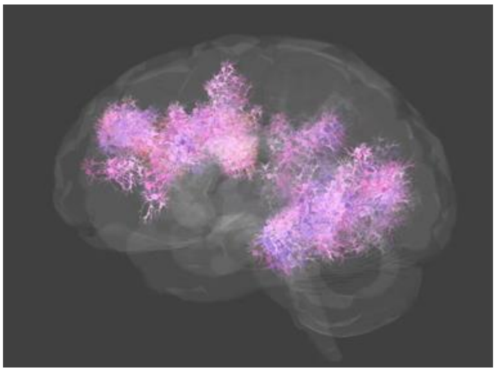

FIG. 19 Alpha and Beta Waves Activated in the Limbic Area, as well as the Insula

5. Dorsolateral Prefrontal Cortex (dlPFC) – Plays a crucial role in executive control, attentional focus, and "top-down" emotional regulation of subcortical structures (such as the amygdala). It is involved in maintaining concentration under pressure and inhibiting automatic emotional reactivity. In EEG activity, its involvement is reflected by the presence of Beta waves (cognitive vigilance) and Gamma waves (real-time integration of emotional-cognitive information).

Day	EEG Activation	Emotional Interpretation
Day 1 (no stimulation)	Fluctuating activation in Beta band, low in Gamma	Unstable emotional control, difficulties in maintaining emotional and cognitive focus
Day 2 (Halo)	Significant increase in Gamma waves and balanced Beta	Sustained emotional focus, effective inhibition of stress, and clear decisions under pressure
Day 3 (placebo)	Moderate Beta activation, decreased Gamma compared to Day 2	Partial emotional control, but lack of optimal integration of emotional responses

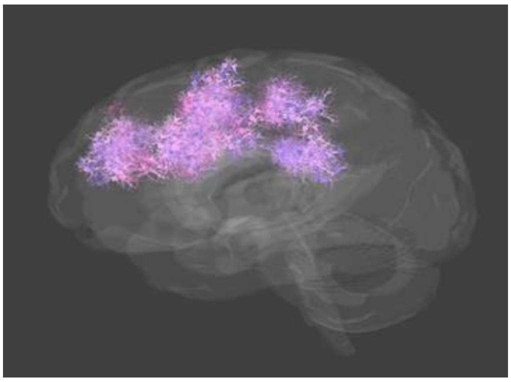

FIG. 20 Alpha and Beta Waves Activated in the Dorsolateral Prefrontal Cortex

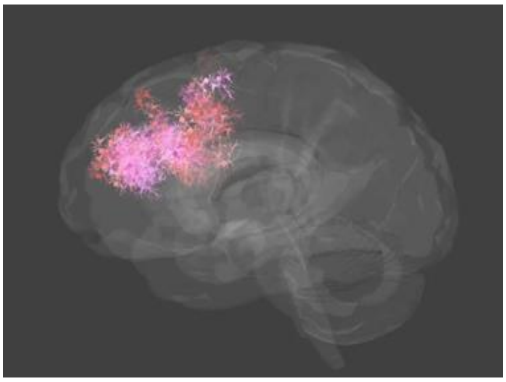

FIG. 21 Gamma and Beta Waves Activated in the Dorsolateral Prefrontal Cortex

The activation of brain waves does not occur sequentially but rather in a rapid and often simultaneous manner, reflecting the complexity of integrating cognitive and emotional functions. In demanding contexts, the brain mobilizes different neural networks simultaneously, represented by alpha, beta, theta, and gamma waves. This synchronous activation allows for efficient adaptation, rapid response, and fine regulation of behavior in real-time. Thus, emotional regulation, attention, and decision-making are not separate processes, but part of a unified and rapid brain response to the external context. In other words, the brain simultaneously processes emotions, thoughts, and actions.

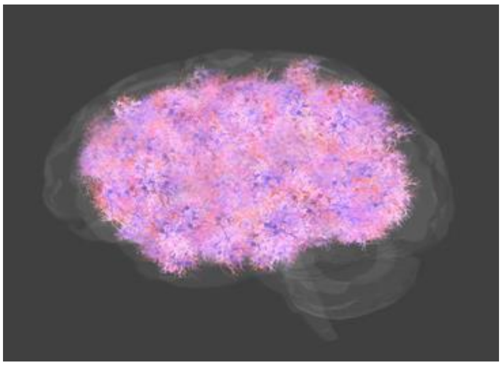

FIG. 22 Alpha, Beta, and Gamma Waves Activated in the Human Brain

Thus, on the first day (no stimulation), increased brain activation was observed in the prefrontal cortex and the limbic system, associated with emotional overload and acute mental stress. The EEG showed an increase in high Beta waves (Hi-Beta), which are correlated with anxiety and hypervigilance. On the second day (with Halo Sport), a significant decrease in negative emotional activation was recorded, along with an increase in alpha and theta waves, associated with states of calm, mental flow, and emotional self-regulation. The subjects reported improved emotional clarity, focus, and greater control. On the third day (placebo effect), the emotional response was intermediate, suggesting that the effect of Halo cannot be attributed to mere suggestion. The EEG confirmed moderate brain activation, but without the optimization observed on day two.

On the day of active stimulation, the EEG suggested a functional regulation of the limbic system, directly involved in emotional control (hippocampus, amygdala). This indicates that Halo Sport may facilitate an adaptive stress response through top-down modulation of limbic activity by the frontal cortex. Thus, emotional brain activity was significantly optimized on day 2 (Halo Sport stimulation), with:

• Reduced anticipatory stress (reduced Beta, increased Alpha)
• Emotional adaptation during effort (balanced insula and ACC)
• Effective emotional inhibition during shooting (increased Gamma in dlPFC)

Here's the comparison of neurophysiological and emotional responses based on daily stimulation:

Component	Day 1 – No Stimulation	Day 2 – With Halo Sport	Day 3 – Placebo
Emotional Activation	Intense, reactive, high stress	Controlled, calm, relaxed	Fluctuating, uncertain
Dominant EEG Waves	High Beta (Hi-Beta) – anxiety	Alpha/Theta – active relaxation	Mixed (Low Beta/Alpha)
Attention Focus	Dispersed, fluctuating	Focused, sustained	Partially sustained
Emotional Control	Low – frequent frustrations	High – efficient self-regulation	Medium – variable between subjects

CONCLUSIONS

The results of the study show that emotional regulation in operational stress contexts is not a simple adaptive reaction, but a high-level neurocognitive function that can be influenced by precise interventions such as neurotechnological stimulation (Halo Sport).

EEG observations and subjective feedback indicate that optimal performance occurs when emotions are not suppressed but actively integrated into the decision-making and action processes. Balanced activation of alpha, theta, beta, and gamma waves allows access to lucid calm, stable focus, and effective emotional self-regulation, which are essential for rapid, clear decisions and behavioral control in high-risk situations.

In the military environment, where pressure-induced reactions can make the difference between success and failure, training and optimizing emotional responses become critical components of tactical and mental performance. An emotionally balanced brain not only reacts but does so with intention, clarity, and adaptability traits essential for an operator prepared to face uncertainty and operational stress.

Halo Sport, through transcranial stimulation applied to the frontal regions, provided a stable neurophysiological framework conducive to the operational flow state a balance between challenge and internal emotional resources. Thus, the study demonstrates that non-invasive neurocognitive stimulation not only improves cognitive and motor performance but also facilitates emotional homeostasis, which is essential under tactical pressure conditions.

This study, initially conducted as part of my dissertation, aimed to analyze the impact of neurostimulation on cognitive and motor performance in simulated operational stress conditions. The results clearly show that using a neurostimulator, particularly the Halo Sport system, generated significant differences, leading to visible improvements in concentration, coordination, and reaction capabilities compared to states without stimulation or with placebo effects.

Based on this initial experimental core, I extended the analysis into a crucial but often neglected direction: the emotional component. Although less visible, the emotional aspect plays a critical role in military performance, as emotional responses determine how a soldier reacts, makes decisions, and maintains control in high-stakes situations. From this perspective, EEG results showed not only cognitive and motor optimizations but also evident emotional regulation, with reduced anxiety levels, improved affective clarity, and increased mental resilience. Therefore, the Halo Sport neurostimulator demonstrated beneficial effects not only in cognitive and motor domains but also in the emotional domain, highlighting its integrative potential in the psychophysiological preparation of military personnel.

At the same time, the role of simulators proved to be fundamental. Only through realistic simulations in controlled conditions can we observe and analyze authentic brain and behavioral responses specific to tactical contexts. The military biathlon simulator in the COMIND laboratory provided the ideal framework for conducting such an applied study, faithfully replicating the real operational environment and allowing for a deep investigation of human reactions under pressure. The Emotiv Epoc+ EEG headset played an essential role in recording and interpreting brain activity in real-time, while Halo Sport demonstrated, by comparison, that neurostimulation can bring not just subtle but measurable improvements in an individual's overall performance.

Of course, like any scientific endeavor, this study has certain limitations. These include:

- The small sample size, which limits the generalizability of the conclusions;
- The variability of individual responses to stimulation, due to neurophysiological differences between participants;
- The lack of a long-term evaluation to confirm the persistence of observed effects beyond the immediate testing context;
- Methodological limitations of EEG;
- Uncontrolled external factors.

Despite these limitations, the study opens valuable perspectives for applied research in the field of military performance, laying the foundation for integrated interventions where EEG technology and neurostimulation combine with simulated training to support the development of a soldier who is not only physically prepared but also mentally and emotionally resilient. In an era where the complexity of the operational field is continuously growing, the ability to maintain emotional balance becomes as important as shooting accuracy or reaction speed. This study unequivocally highlights the potential of modern technology in achieving this ideal.

REFERENCES

[1] ***, Broca`s area, wernicke`s area and other language-processing areas in the brain. *The brain from top to bottom.* [online]. URL: https://thebrain.mcgill.ca/flash /d/d_10/d_10_cr/d_10_cr_lan/ d_10_cr_lan.html, 2022 ;

[2] Alice Ferng B.S., MD, PhD, Brodmann areas. *Kenhub.* [online]. URL: https://www.kenhub.com/ en/ library/anatomy/brodmann-areas, 2022;

[3] K. J. Blacker, J. Hamilton, G. Roush, K.A. Pettijohn & A.T. Biggs, *Cognitive Training for Military Application: a Review of the Literature and Practical Guide*. *Journal of Cognitive Enhancement*. Online URL: https://www.researchgate.net/publication/324857630_Cognitive_Training_for_ Military_ Application_a_Review_of_the_Literature_and_Practical_Guide, 2018;

[4] L. Dănăilă, M. Golu, *Tratat de neuropsihologie vol. 1 și vol. 2*, București, Editura Medicală, 2021;

[5] C.D. Dugan, Neuroargumentarea în epoca cognitizării, între competiție și sinergie. Optimizarea performanțelor umane pentru personalul de securitate națională și profesii de elită. Foreword by Cristian Barna. Bucharest: Military Publishing House, 2020;

[6] A. Flood & R.J. Keegan, *Cognitive Resilience to Psychological Stress in Military Personnel*. *Frontiers in Psychology*, Online URL: https://www.frontiersin.org/journals/psychology/articles/10.3389/ fpsyg.2022.809003/full , 2022;

[7] L. Huang, Y. Deng, X. Zheng & Y. Liu, Transcranial Direct Current Stimulation With Halo Sport Enhances Repeated Sprint Cycling and Cognitive Performance. *Frontiers in Physiology*, Online URL: https://doi.org/10.3389/fphys.2019.00118, 2019;

[8] A. Lesenciuc & I.G. Sauciuc, Conștiință și identitate a militarului în executarea mișcărilor de instrucție de front. De la protoself la conștiință extinsă. Paradigma Conștiinței– abordări interdisciplinare Symposium. 4th Edition. Iași: The Romanian Academy. "Gheorghe Zane" Institute of Economic and Social Research, 2022;

[9] A. Lesenciuc, I.G. Sauciuc, Combat Mindset as a Communication Process: Task Awareness, Preparation and Execution. *Redefining Community in Intercultural Context.* Vol.11, no.1. 15-25 2023;

[10] A. Rusu, *Domeniul cognitiv al confruntării. Operațiile psihologice.* MA Thesis. Brașov: Academia Forțelor Aeriene „Henri Coandă, 2024;

[11] I.G. Sauciuc, *Neuroștiința comunicării: Abordări contemporane în studiul și înțelegerea proceselor de semnificare.* MA Thesis. Brașov: Academia Forțelor Aeriene „Henri Coandă", 2023;

[12] E.Yanilov & O. Boe, Combat Mindset and Mental Conditioning. Instructor Course (MCIC) Manual. KMG, 2014.