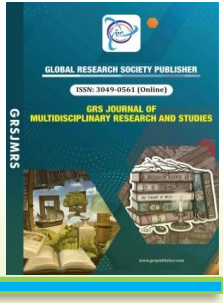
OPEN ACCESS

GRS Journal of Multidisciplinary Research and Studies
Abbreviate Tittle- GRS J Mul Res Stud
ISSN *(Online) - 3049-0561*
https://grspublisher.com/journal-details/GRSJMRS

Vol-3, Iss-2 (Feb- 2026)



Exploring the Emergence of Disruptive Technologies in Cognitive Warfare: Convergent Innovations in Neural and Neocortical Weaponry

Prof. Dr. Mohammad Ekram YAWAR [1], Prof. Dr. Erdal DURSUN [2], Muaiyid Rasooli [3], Abdul Jamil Sharify [4], Said Abdullah Sadat [5], SOROUSH RAHMANIBOUKANI [6], Jamshid Rasooli [7]

[1]Dean of the Faculty of Law, International Science and Technology University, Warsaw, Poland.

[2]Rector, International Science and Technology University, Warsaw / Poland.

[3]PhD Candidate, School of Law, Xi'an Jiao tong University, China.

[4]Head of Department of Management Information Systems, International Science and Technology University, Warsaw, Poland.

[5]International Science and Technology University, Warsaw, Poland.

[6]Secretary General at International Science and Technology University.

[7]Bachelor's degree, Faculty of Economics department of Banking and Finance, Jawzjan University.

Article History
Received: 17.01.2026
Accepted: 05.02.2026
Published: 14.02.2026

Corresponding Author: Prof. Dr. Mohammad Ekram YAWAR

Abstract: In the contemporary geopolitical landscape, nation-states increasingly compete to decode and manipulate the intricacies of the human brain. Technological advances have extended the scope of conflict beyond conventional physical engagements into the cognitive domain, where the neural substrates governing human behavior—particularly those of adversaries—are increasingly susceptible to modulation and control. This shift represents a paradigmatic evolution in warfare, enabled by cutting-edge neuroscientific innovations that provide unprecedented access to non-lethal interventions capable of influencing the human executive system.

Such interventions encompass neurotherapeutic agents engineered to alter behavioral dispositions, sophisticated remote monitoring technologies leveraging electromagnetic waveforms to track cerebral activity, acoustic systems that focus sonic energy on cranial structures, and holographic or multidimensional spatial constructs designed to challenge perceptual boundaries. This study argues that military strategy is progressively prioritizing psychological and cognitive effects, reducing reliance on kinetic engagement while simultaneously mitigating the material and ethical costs of conflict.

Using a descriptive-analytical approach, this inquiry examines the emergent field of cognitive warfare through the lens of convergent technologies, highlighting the synergistic interplay between neural and neocortical weaponry. The study further reflects on the ontological and epistemological implications of these developments, envisioning a future battlefield where mental sovereignty and influence are central to strategic advantage.

Keywords: *convergent technologies, cognitive warfare, neural and neocortical weapons, non-kinetic warfare.*

Cite this Article

Dr. M. E. Yawar, E. Dursun, M. Rasooli, A. J. Sharify, S. A. Sadat, S. Rahmaniboukani, J. Rasooli, (2026) Exploring the Emergence of Disruptive Technologies in Cognitive Warfare: Convergent Innovations in Neural and Neocortical Weaponry. *GRS Journal of Multidisciplinary Research and Studies, Vol-3(Iss-1). 16-25*

Introduction

The pursuit of dominion over the human mind transcends traditional notions of power, which historically relied on territorial control. The strategic value of cognitive sovereignty now surpasses that of physical dominion, as mastery over collective cognition can render territorial conquest unnecessary—populations may comply or submit under psychological influence alone. Consequently, the preservation of cerebral autonomy emerges as a critical imperative in safeguarding national integrity. This awareness is not unprecedented. Throughout history, civilizations have recognized threats that extend beyond overt aggression or environmental crises to include deception and manipulation. Ancient inscriptions, such as those on the Apadanas, beseech divine protection against enemies, drought, and falsehoods. Similarly, moral injunctions against deceit—deeply embedded in religious and cultural traditions, including Islamic thought, where dishonesty is viewed as a gateway to evil—reflect enduring concerns regarding social stability and collective cognition.

In the contemporary era of synthetic and cognitive warfare, deception has assumed a more complex and insidious form. The deliberate creation of false mental constructs—appearing outwardly plausible but intrinsically misleading—constitutes the core of modern cognitive conflict. The term "fake news," which

rapidly entered global discourse, exemplifies the epistemic weaponization of information. Empirical studies reveal widespread public uncertainty regarding media narratives, highlighting the vulnerability of collective cognition to manipulation.

The manipulation of cognitive processes extends beyond misinformation. Digital platforms have facilitated the mass dissemination of falsehoods, while advances in neuroscience offer emerging modalities for direct interference with neural function. As an inherently interdisciplinary field integrating computational science, biology, psychology, and philosophy, neuroscience carries transformative implications for national security. The potential militarization of neuroscientific research—including neuropharmacological agents and neural-targeting technologies—signals an emerging arms race centered on cognitive control, wherein "nerve powers" may rival or surpass nuclear deterrence as instruments of strategic leverage.

Central to this paradigm is the human cerebral cortex, the neural substrate of emotion, cognition, and behavior. Modulation of cortical activity to influence behavior constitutes the principal objective of emerging neuroweapons and neocortical warfare. Although some of these technologies may appear speculative, existing capabilities—including electromagnetic saturation of the central nervous system, disruption of neural signaling, and influence over motor control—substantiate their feasibility.

This study examines the novel mechanisms through which the brain and central nervous system may be influenced to reshape mental capacities, emotions, and decision-making. It further explores the philosophical and ethical ramifications of cognitive warfare, emphasizing the profound shift from traditional physical battlegrounds to cognitive and neural domains.

Several neuropharmacological agents—such as modafinil, oxytocin, and propranolol—demonstrate measurable effects on cognitive function and behavior and are being investigated for military applications. Remote monitoring and manipulation of cerebral activity may be achieved using technologies such as radiofrequency and microwave transmission, functional spectroscopy, near-infrared, or ultrasound pulses, all targeting precise neural regions. Forecasts suggest that neural weapons and neocortical warfare capabilities may become operational by 2025, given current investments in brain simulation, brain-computer interfaces, and neural mapping. The transformative potential of brain mapping and coding may surpass that of any prior technology, threatening individual autonomy and freedom of choice.

Following traditional theaters of warfare—land, sea, air, space, and cyberspace—human cognition has emerged as a new and highly vulnerable battleground, carrying potentially unprecedented consequences. The revolution in information and communication technology has also empowered small actors to wield disproportionate influence, using information platforms to execute cognitive operations. One critical domain of influence is the manipulation of public perception via information and communication networks (Backes et al., 2019).

Carl von Clausewitz defined war as the heroic exertion to compel an adversary to submit to one's will. In the age of information warfare, the battlefield has expanded to include psychological and cognitive dimensions, where data itself functions as a strategic weapon. Consequently, computers and digital networks are no longer mere tools but integral instruments of warfare. Information has become the most potent weapon in technological conflict, guiding societal behavior and reshaping decision-making processes. Indeed, the U.S. military has identified information, rather than nuclear arsenals, as its primary strategic asset.

Cognitive influence may be exerted through multiple modalities: information warfare on social networks via text, audio, images, and video; neuropharmacology; and direct neuroscientific interventions. Neuroscience is on the cusp of decoding the human brain, rendering it a battlefield in its own right. Neuroscientist James Giordano asserts that the brain constitutes the principal battlefield of the present and future. Emerging neuro-psychiatric and neocortical weapons will enable remote modulation of mental states, emotions, perception, cognition, and behavior.

According to Vladimir Putin, such weapons could rival nuclear arms in strategic impact, yet, unlike nuclear weapons, they may be more politically and legally palatable (Aftergood, 2009). The implications of these developments demand urgent ethical, legal, and strategic consideration, as the boundaries of warfare extend into the most intimate domain of human existence: the mind itself.

Statement of the Problem

Following humanity's engagement in warfare across the four traditional physical domains—land, sea, air, and space—attention has shifted to the fifth domain, cyberspace, and the sixth domain, cognition. Cognitive warfare leverages cyberspace and networked platforms, including the World Wide Web and satellite-based Internet, to conduct operations. However, its scope extends beyond digital networks. Cognitive warfare employs a range of tools—neuropharmacological agents, electromagnetic waves, acoustic systems, and other emerging modalities—to influence and potentially gain control over human cognition, behavior, and decision-making.

The cerebral cortex, as the seat of human emotions, perception, and executive function, is the primary target of such operations. Understanding this new dimension of warfare is essential for developing effective defensive measures; ignorance leaves populations and states vulnerable to strategic manipulation. Therefore, the central research problem of this study is to elucidate the mechanisms, functions, and strategic implications of cognitive warfare, particularly through convergent technologies, neural and neocortical weapons, and hybrid technological systems.

Theoretical Foundations

Humanity is already engaged in a knowledge-based war, the primary challenge of which is its invisibility. Only the effects of this conflict are observable, and often recognition occurs too late (Clavery & de Clausell). Cognitive warfare operates at the intersection of neuroscience, psychology, information technology, and social dynamics, aiming to manipulate perceptions, beliefs, and behaviors.

According to Clavery, the principles of cognitive warfare include exploiting cognitive biases, leveraging innate psychological tendencies, overloading attention and focus, inducing cognitive stress, and influencing decision-making processes. The ultimate objective is to achieve mental domination over adversaries and disrupt intellectual structures at both individual and societal levels.

In this context, knowledge warfare integrates information operations, psychological operations, and cyber operations into a cohesive strategy. Its foundation aligns with the principle of achieving strategic objectives without direct physical confrontation, focusing on shaping adversaries' cognition, beliefs, and mental frameworks. Cognitive warfare has the potential to

transform societies, influencing collective thought, perception, and behavior on a global scale.

Principles of Cognitive Warfare Based on Converged Force Technologies

Cognitive warfare, as conceptualized through the lens of Professor Bernard Clavery, operates on the principles derived from neuroscience theories of resilience and vulnerability. It leverages cognitive biases, innate predispositions to error, manipulation of cognitive processes, attention saturation (tunneling), and the induction of cognitive stress. The operational objective is to achieve intellectual dominance over adversaries by disrupting the structure and function of their mental frameworks, ultimately destabilizing societal cohesion (Giuseppe, 2018).

In knowledge warfare, all elements of information operations, psychological operations, and neuroscience-informed strategies, grounded in complexity theory, are mobilized to achieve strategic objectives. This form of warfare exists at the intersection of two operational domains: on one hand, psychological operations and intellectual influence campaigns (soft power), and on the other, cyber-enabled operations utilizing physical-information systems. Its foundation is not limited to the strategy of victory without direct conflict, as articulated by Sun Tzu, but extends to the systematic targeting of adversaries' cognitive frameworks—altering, manipulating, or distorting facts to influence their beliefs, reasoning, and perceptual processes.

The ultimate aim of cognitive warfare is the transformation of individual and collective belief systems. This transformative potential can extend to entire societies, shaping cognition on a scale comparable to global phenomena such as the COVID-19 pandemic, irrespective of the agent responsible for its propagation (Libicki, 2017). Cognitive operations draw on insights from behavioral psychology, social psychology, and cultural studies to influence decision-making, perception, imagination, and cognitive orientation. The scope of these operations now includes the application of soft power, cyber-psychology, human-machine collaboration, autonomous systems, robotics, drones, and artificial intelligence-driven automation.

Cyber technologies constitute a foundational element of intelligence and cognitive warfare. The OVADA cycle—Observe, Adapt, Decide, Act—illustrates this process, where adaptation is the critical determinant of operational success. Errors in the adaptation phase compromise overall effectiveness, regardless of performance in other stages. Understanding human behavior in technological contexts is essential, as the boundaries between the physical and digital realms are increasingly blurred (Mark, 2021).

Disruptive technologies are characterized by their capacity to fundamentally alter existing systems or behavioral paradigms, replacing them with superior alternatives. Coined by Harvard professor Clayton Christensen in 1995, the term exemplifies innovations such as the advent of computers during the information age, which reshaped human behavior and societal norms. Contemporary examples include blockchain, 5G networks, virtual and augmented reality, artificial intelligence and machine learning, quantum computing, cloud computing, nanotechnology, big data analytics, 3D printing, autonomous drones (quad-bots), and computational chemistry (Smith, 2022).

The weaponization of neuroscience and the military application of converged technologies have positioned the human brain as a central battlefield of the twenty-first century (Giordano, 2018). Modern conflicts increasingly prioritize cognitive over attrition-based strategies, exploiting the constant flow of information and technological advances to manipulate thought processes. Emerging tools—including neural networks, augmented and virtual reality, artificial intelligence, edge computing, brain-machine interfaces, neurotherapeutics, remote brain monitoring via electromagnetic waves, acoustic weapons, and holographic projections—have rendered the brain a primary operational target. Consequently, understanding the human brain's functions represents one of the most critical challenges for the future of humanity.

In sum, cognitive warfare harnesses insights into individual and collective psychology, cultural influence, and technological integration to achieve strategic objectives. Its execution relies on advanced cyber capabilities, human-machine interaction, and disruptive technologies, emphasizing the manipulation and transformation of perception, cognition, and societal beliefs at unprecedented scales.

Weaponization of Neuroscience and Military Applications of Converged Technologies

Dr. James Giordano identifies the human brain as the new battlefield of the twenty-first century. Scholars increasingly assert that warfare has transitioned from attrition-based strategies to cognitive warfare. The continuous intellectual interaction of individuals in cyberspace, coupled with a relentless flow of information and technological advances in neuroscience, has created unprecedented opportunities for manipulating human cognition.

Emerging tools and technologies—including neural networks, augmented and virtual reality, artificial intelligence and edge computing, voice recognition, brain-computer interfaces, neurotherapeutics, remote monitoring of brain activity via electromagnetic waves, acoustic weapons targeting neural responses, and holographic projections—have positioned the brain as a primary strategic target in modern conflicts. Consequently, understanding the functions and vulnerabilities of the human brain constitutes one of the most critical challenges for humanity's future.

The convergence of cyber-psychology, nanotechnology, information technology, and cognitive science has catalyzed the integration of four previously distinct domains:

1. **Nanotechnology**: Nanorobotics, nanosensors, nanostructures, and energy systems.
2. **Biotechnology**: Biogenomics, neuropharmacology, and related fields.
3. **Information Technology**: Communications, microelectronics, and computational systems.
4. **Cognitive Science**: Psychology, neuroscience, and neurology.

Since 2002, the U.S. Department of Defense has invested in Convergent Technologies initiatives, with other nations pursuing similar programs. The convergence of these disciplines facilitates the development of technologies that enhance human-machine integration and improve capabilities in defense, security, and health domains. Practical manifestations include nanotechnology-driven cognitive enhancement, electronic brain implants, and chemical or pharmacological interventions to augment mental performance. The overarching goal is the creation of "super soldiers" with

superior informational and operational capacities (Technology Trends, 2020; Science, 2020).

As battlefield operations evolve, the integration of connected brains, advanced sensor systems, and cognitive enhancement tools has expanded the scope of intelligence warfare and defense measures. Although some aspects of these technologies may appear speculative, ongoing research demonstrates that projects aimed at cognitive augmentation—such as genome editing, sensory enhancements, and neural implants—are progressing systematically (NATO StratCom COE, 2017).

Neuroscience and convergent technologies have become critical for ensuring national security in the information age. The U.S. Army, for example, has emphasized the operational, defensive, and informational applications of these capabilities (Moreno, 2017). Such technologies offer unprecedented potential to influence cognition, perception, emotions, and behavior in adversaries, thereby enhancing strategic effectiveness in security, intelligence, and warfare contexts.

Four primary approaches characterize the military application of neuroscience and integrated technologies (Moreno, 2019):

1. Employing neuroscience to enhance insight, situational awareness, and influence.
2. Utilizing convergent technologies to provide strategic advantages.
3. Integrating military programs with dual-use applications across multiple nations.
4. Driving competitive development of offensive and defensive cognitive capabilities.

Key applications include:

- **Neural modeling and human-machine interactive networks** for operations, training, and intelligence collection.
- **Neuroscience-based optimization** of performance, resilience, and cognitive capacity in military personnel.
- **Direct weaponization of neuroscience and neurotechnology**, aimed at influencing the collective psyche of populations through soft-power operations, information campaigns, or chemical interventions targeting cognition.

Non-lethal neuroweapons, including biochemical agents, have historically demonstrated operational efficacy. For instance, the 2002 Moscow theater hostage crisis involved chemical incapacitation of terrorists, resulting in unintended civilian casualties. Neuroactive compounds, such as oxytocin, can temporarily modulate trust and compliance among adversaries, while speculative concepts—e.g., “sex bombs” or scopolamine-based incapacitating devices—illustrate potential non-lethal applications of cognitive manipulation. Advances in genetic engineering and microbiology further suggest that human behavior can be influenced by altering gene expression, enabling non-destructive control over host behavior.

Information-based neuroweapons are also emerging. The DARPA Narrator Network Project, for example, studies how narrative framing influences cognition and behavior, enhancing the effectiveness of propaganda and public deception campaigns. Neural devices and brain-computer interfaces offer additional avenues for influencing personality, cognition, emotions, and behavior, including inducing actions otherwise contrary to an individual’s volition. Brain hacking and subliminal messaging have thus been empirically validated as effective tools for cognitive influence (Pasternak, 2019).

Collectively, these developments signify a profound transformation in the nature of warfare. Modern conflicts increasingly emphasize cognitive dominance, leveraging neuroscience, convergent technologies, and information operations to shape adversaries’ decision-making, perceptions, and societal cohesion—underscoring that the battles of the future will be fought as much in the mind as on the physical battlefield.

Information Applications of Neuroscience and Technology in the Twenty-First Century

With the intensification of geopolitical conflicts over resources and strategic territories, and the growing demand to meet the basic needs of human societies, the emergence of advanced cognitive warfare tools—particularly in neuroscience—is inevitable. These tools are designed to manipulate human cognition, perception, and decision-making.

Advancements in neuroscience and convergent technologies have expanded the battlefield to the human brain, conferring operational, informational, and security significance at the national level. The brain’s irreplaceable role in emotional regulation, information storage and processing, problem-solving, and decision-making underscores its critical importance in the age of information and communication technology (ICT) and cognitive warfare.

Convergent technologies—including nanotechnology, biotechnology, information technology, cognitive sciences, as well as advances in genetics, genomics, and neuro- and neocortical weapons—possess dual-use potential, applicable for both military and civilian purposes. Humanity has already achieved milestones such as enhanced soldier performance and the development of energy-guided weapons systems. The operational deployment of neuroscience and neurotechnology by military forces is now an established reality.

Key applications of these technologies include:

- Enhancement of memory, learning, and cognition.
- Regulation of sleep-wake cycles, fatigue, and alertness.
- Impulse control and emotional modulation.
- Management of behavioral states, mental health, and self-perception.
- Optimization of decision-making processes.
- Augmentation of physical performance, including speed, strength, agility, and motor learning.

In military operations, these capabilities can be employed both to strengthen the mental and physical capacities of friendly forces and to degrade the same capacities in adversaries (Marks, 2019).

The Quest to Conquer the Human Brain

China offers a concise conceptualization of intelligence warfare, defining it as the systematic application of scientific and biotechnological tools to achieve “mental superiority.” Under this framework, territorial warfare is reconceived as a battlefield for ideological influence, aimed at undermining enemy morale, cohesion, and operational capabilities.

China's approach delineates six key technologies organized across two layers:

1. **Cognitive Layer**: Technologies influencing an individual's capacity for thought and action.
2. **Sub-Cognitive Layer**: Technologies affecting emotions, knowledge, beliefs, and will.

By integrating cognitive science, artificial intelligence, and biotechnology, China aims to enhance future military and national competitiveness (Lynch, 2019). The ultimate objective of cognitive warfare is to achieve mental superiority by shaping the cognitive performance of adversaries, including decision-makers and public opinion.

As warfare evolves, so too does the complexity and tempo of cognitive operations. China's military is actively exploring the challenges commanders will face in future tactical environments, particularly regarding human-machine interactions. For example, cognitive warfare technologies may cause operators to misinterpret or misidentify targets, influencing both perception and action in operational contexts.

China is particularly focused on research in artificial intelligence, neuroscience, brain science, and associated biotechnologies—including biosensing and advanced biomaterials—to enhance soldier capabilities. The shift from computerization to informationization has become essential to optimizing human performance in complex conflict scenarios. Developments in cognitive science have precipitated the emergence of "brain warfare," fundamentally redefining traditional concepts of military engagement. Disciplines spanning the humanities, medicine, anthropology, and psychology now intersect with military neuroscience to advance this domain (Cohen, 2020).

Redefining Knowledge Warfare

Synthesizing definitions from China and NATO, knowledge warfare can be defined as: *"A domain encompassing information warfare, cyber warfare, psychological operations, and the convergence of nanotechnology, biotechnology, information technology, cognitive science, and neuroscience, applied for military purposes. This redefinition underscores the urgent need for the development of cognitive defense strategies in the evolving battlefield."* (Marks, 2020)

The Rise of Military Neuroscience

Military neuroscience has become a strategic priority for leading nations. In 2013, President Obama launched the **BRAIN Initiative**, allocating an additional $100 million to advance research despite the United States facing a significant budget deficit. This initiative is comparable in scope and ambition to the Human Genome Project, with the potential to impact not millions but billions of people globally.

Similar programs were initiated in Europe and Canada in 2013 and in Japan in 2014 under the banner of the **Human Brain Project**. These initiatives have explored applications such as brain implants to remotely influence subjects and the use of pharmacological agents to elicit truthful responses. Broadly, military neuroscience research focuses on two complementary objectives: **enhancing and suppressing human behavioral performance**.

The enhancement of behavioral performance aims to optimize soldiers' capabilities. This includes stress reduction, heightened alertness, and improved cognitive endurance. Techniques such as **electroencephalographic (EEG) monitoring embedded within soldiers' helmets** allow commanders to assess brain activity in real-time, providing continuous insight into soldiers' levels of consciousness. Furthermore, **brain-computer interfaces** facilitate neural prostheses, enabling soldiers to operate weapons or control systems directly through thought.

Efforts to weaken adversary brain function remain largely opaque, with limited information publicly available. The secrecy surrounding such programs stems from ethical and legal concerns, as nations possessing these technologies may face moral scrutiny and reputational risks. Additionally, disclosure of these capabilities could reduce their effectiveness by enabling countermeasures (Canna, 2022).

From the perspective of military technologists, **humans are often considered the weakest link in the "chain of destruction"**, constrained by physiological and cognitive limitations such as the need for sleep, food, and water. Addressing these vulnerabilities has led to three principal approaches to human neuroenhancement: **neuropharmacology, neurostimulation, and brain-computer interfaces** (Bland, 2021).

Neuropharmacology

Recent advances in neuroscience have revealed critical insights into brain chemistry, resulting in the development of psychotropic and cognitive-enhancing drugs. For example, **fluoxetine (Prozac)** was initially developed to treat depression, and emerging research now explores **nootropic drugs** designed to enhance cognitive performance. Nanotechnology offers the potential to improve drug delivery across the blood-brain barrier, augmenting both efficacy and precision.

Among the most studied cognitive enhancers in military contexts is **modafinil**, approved by the U.S. Food and Drug Administration for treating narcolepsy and sleep disorders. Its primary appeal lies in promoting sustained wakefulness and alertness rather than merely suppressing fatigue, making it highly valuable in operational settings. Other pharmacological agents aim to reduce stress, mitigate anxiety, and prevent post-traumatic stress disorder (PTSD) among soldiers. Some Western militaries administer these compounds pre-deployment to reduce the psychological impact of combat exposure and enhance soldiers' resilience and operational effectiveness (Armstrong et al., 2022).

Brain Stimulation and Computer Connectivity in Military Applications

The use of electrical brain stimulation for therapeutic purposes dates back to the late 19th century, with **electroconvulsive therapy (ECT)** widely adopted by the 1940s and 1950s to treat depression, schizophrenia, and bipolar disorder. The American Psychiatric Association considers ECT a safe and effective treatment modality. Since the early 1980s, psychiatrists and neuroscientists have developed more advanced techniques for targeted brain stimulation, including helmet-like devices capable of delivering strong electromagnetic fields to specific brain regions.

Recent advances have extended beyond therapy to experimental brain-to-brain communication. In 2013, researchers at the University of Washington successfully used electrical stimulation of the motor cortex to remotely control another individual's hand movements—a proof-of-concept for **brain-computer communication**. Current approaches to brain stimulation include **transcranial electrical stimulation (TES)** and **transcranial magnetic stimulation (TMS)**, which can be integrated into soldiers' helmets to deliver weak currents aimed at enhancing concentration and cognitive performance. Ongoing projects focus

on monitoring mental states, enhancing alertness, reducing pain, and optimizing decision-making under operational conditions (RAND Corporation, 2020).

The ultimate objective is to establish **brain-computer interfaces (BCIs)**, enabling soldiers to receive information directly from computers and control systems via neural input. Early EEG-based BCIs demonstrate the potential for neural control of weapons, unmanned aerial vehicles, and real-time battlefield operations. By integrating cognitive technologies, soldiers could achieve unprecedented situational awareness, respond rapidly to threats, and communicate directly with each other through thought alone (Ottewell, 2020).

Foundations and Players of Cognitive Warfare

Significant research on cognitive warfare has emerged in recent years. Notable contributions include the NATO-affiliated HALL organization's report, *Cognitive Warfare: Creating a Concept of Knowledge in the Field of Wars* (June 21, 2021), sponsored by the French Army. Other studies, including Pukhpatsov's *The First World War* (2016) and Pradhan's analysis of psychological operations in the Russia-Ukraine conflict (2022), provide insights into information and psychological operations, although few explicitly address **cognitive warfare using neocortical and neural weapons**. Similarly, analyses of Chinese military intelligence, such as Tzu Chi-hong and Tzu Wei-hong's 2021 study on Taiwan, provide operational context but rarely discuss neural or neocortical technologies (National Research Council, 2019).

Francois Declare's NATO report, *Scientific Warfare: The Battle for Brains*, emphasizes that there is no universally accepted definition of scientific warfare, often conflated with information or cyber warfare. Historically, however, scientific warfare has been recognized as a method to exploit the self-awareness and cognitive mechanisms of adversaries or populations, enabling subtle, gradual, and strategic influence or subjugation. This approach integrates cyber-based information techniques with soft power, often manifested as **psychological operations**, digital manipulation, and the redefinition of reality through virtual and digital tools (ETL, 2018; Rogers, 2018).

Cognitive Warfare in Cyberspace

Cyberspace provides both unprecedented opportunity and strategic vulnerability. Its ubiquity and constant human engagement make it an ideal medium for cognitive influence. Operations conducted in cyberspace leave minimal trace, allowing actors to penetrate adversarial systems and intellectual infrastructures silently—earning the description of **"termite warfare"**, wherein influence spreads imperceptibly until significant disruption occurs. Social networks and digital platforms amplify the collection of behavioral data, enabling precise targeting of individuals and groups. The integration of systems engineering and social sciences enhances the effectiveness of these operations (Narula, 2004).

Cognitive warfare seeks to manipulate habitual and involuntary mental processes, exploiting cognitive biases to distort perception, influence decisions, and inhibit actions with potentially catastrophic consequences at individual and societal levels (Dunn, 2020). Unlike conventional cyber warfare, which primarily targets information, cognitive warfare focuses on **the processing and interpretation of information by the human mind**, using engineered digital environments, robotics, and automated systems as instruments to achieve these ends (Fruhlinger, 2020).

Players and Actors in Cognitive Warfare

Cognitive warfare involves a diverse array of actors, including states, non-governmental organizations, corporations, ideological and political movements, and terrorist groups. Operations are often executed by specialized intelligence units with advanced digital and cognitive expertise. While information and communication technologies are central, they constitute only one component of a broader set of tools, including neurotechnologies, convergent science, and psychological operations, which together define the modern cognitive battlespace.

Research Objective

The primary objective of this study is to elucidate the functions of **cognitive warfare** through the application of **convergent technologies**, **neocortical**, and **neural weapons** as integrated instruments of modern military and strategic operations.

Research Question

What are the functions and operational mechanisms of cognitive warfare when leveraging convergent technologies, neocortical, and neural weapons as integrated technological tools?

Research Methods and Tools

This research is applied in scope and adopts a **descriptive-analytical methodology**. The primary research tools include **library research** and **documentary analysis**, with data interpreted using **comparative rational analysis**.

Research Area

The study focuses on documents and materials published between **2017 and 2022**. Spatially, the research centers on the domain of cognitive warfare with a particular emphasis on **neocortical and neural weapons**, while the temporal horizon extends to **the next five years**, considering potential applications and technological trajectories.

Data Processing and Research Findings

Cognitive warfare is driving radical transformations in the management of battlefields, shifting the focus from traditional physical confrontations to mental and psychological arenas. Competitors now increasingly engage based on cognitive assumptions, perceptions, and decision-making processes rather than merely conventional force.

Convergent technologies—including nanotechnology, biotechnology, information and communication technology, and cognitive sciences—play a pivotal role in determining the outcomes of modern conflicts. While concepts such as flying drones using thought may seem fantastical, neuroscience and psychology have demonstrated the feasibility of connecting soldiers' brains to computers to enhance operational capabilities. Neuroleptics reduce the psychological impacts of war, bolstering courage and resilience among troops, while neural devices—microscale sensors operating wirelessly within the brain—enable novel battlefield functions. DARPA, for instance, is researching salt-sized neural implants capable of digitally transmitting activity from a million neurons to external computational systems.

Globally, convergent and neural technologies are advancing rapidly, with strategic ambitions reflected in doctrines such as those of the Chinese military. China's approach encompasses:

1. **Belief-based warfare**
2. **Psychological operations**
3. **Legal or normative warfare**

Through these strategies, China aims to achieve **cognitive and technological superiority** by leveraging convergent technologies across scales, from nanoscale interventions to global influence campaigns.

Cognitive Warfare and Modern Conflict

The rules of war have fundamentally changed. Many countries and societies now experience cognitive defeats without awareness, as adversaries manipulate perceptions, beliefs, and decision-making processes. Cognitive warfare complements physical conflict, enabling strategic control over populations with minimal resistance.

A defining characteristic of convergent technologies is their ability to influence human minds and psyches. Information and communication technologies in cyberspace have created digital dependencies, making societies increasingly susceptible to cognitive manipulation. These technologies, functioning as double-edged swords, enable adversaries to redirect public attention, distort collective reasoning, and manipulate social memory.

The art of cognitive attacks lies in the unawareness of the targeted populations, allowing objectives to be achieved silently while minimizing military expenditure. Consequently, social resilience and public awareness become critical; citizens must be information-literate, capable of recognizing and mitigating cognitive threats. Analytical frameworks, such as S.W.O.T. models, can guide systematic promotion of media and information literacy, particularly among youth at educational centers and universities.

Applications of Convergent Technologies in Warfare

Convergent technologies serve dual purposes:

1. **Enhancing soldiers' cognitive and physical capabilities**—producing "super soldiers" through neuroenhancement, genetic manipulation, or advanced neurotechnology.
2. **Weakening adversaries' cognitive functions**—via chemical, biological, or informational interventions.

Cyber and information technologies are instrumental in **urban influence operations**, while biotechnology may target genetic predispositions or intellectual tendencies within populations. Vaccination programs, for instance, could hypothetically be employed for **long-term cognitive or genetic effects**, particularly among children.

In modern strategic initiatives, cognitive warfare underpins political, economic, socio-cultural, and legal efforts. Examples include:

- **China's Belt and Road Initiative (2013–2049)**, leveraging cognitive insights to manage cooperation among 70 nations and numerous international organizations.
- **Turkey's geopolitical strategies**, combining infrastructural projects with **cultural diplomacy** via satellites and educational networks to propagate Pan-Turkic identity.

General Jiang Shibo of China's National Defense University emphasizes that **biotechnology may emerge as a dominant force**, capable of influencing genetic and cognitive traits within targeted populations.

Conclusions and Recommendations

Emerging technologies in the 21st century are advancing at a pace that may soon rival or even surpass the strategic impact of nuclear weapons. **Convergent (or "prophetic") technologies**—combining nanotechnology, biotechnology, information and communication technology, and cognitive sciences—are reshaping human thought, both individually and collectively, with profound societal and even racial implications. Consequently, many contemporary social science theories may become obsolete, and a **new generation of threats** could emerge, potentially endangering societies, nations, and specific populations if left unaddressed.

Technological Convergence and Human Enhancement

- **Nanotechnology** enables manipulation and construction at the scale of 10^{-9} meters.
- **Biotechnology** allows modification and utilization of living organisms.
- **Information technology** provides computational and networking capabilities.
- **Cognitive science** studies the human mind as an information-processing system.

At the nanoscale, the **distinction between living and non-living systems becomes blurred**, enabling reconstruction of the body and brain, implantable medical devices, and targeted drug delivery. This allows the creation of **supercomputers the size of a cell**, capable of predicting and influencing biological functions. Furthermore, convergent technologies facilitate **self-repairing and self-designing organisms**, transforming the principles of natural selection and evolution.

Cognitive Warfare and Its Scope

Cognitive warfare is now recognized as a **strategic tool** by which states or influential actors can access and manipulate the cognitive mechanisms of adversaries, gradually undermining and subjugating them. Its scope encompasses:

- Decision-making and cognitive orientation
- Perception and imagination
- Soft power influence
- Cyber-psychology and social engineering
- Human-machine teamwork and robotic systems
- AI-based automation

The convergence of nanotechnology, biotechnology, information technology, and cognitive science enables **integrated applications**, including:

- Nanorobotics, nanosensors, nanostructures, and energy devices
- Biogenomics and neuropharmacology

- Advanced computing, microelectronics, and communications
- Neuroscience, psychology, and neurology

The **human brain** should now be considered the **sixth operational domain**, alongside land, air, sea, space, and cyberspace. Protecting this domain requires dedicated doctrines, monitoring systems, and adaptive strategies focused on the mind and cognition.

Functions of Cognitive Warfare Using Convergent Technologies

1. **Information Loading into the Brain**
    - Using nanotechnology and biotechnology, information can be transmitted into the brain at speeds comparable to computer processing.
2. **Neuroleptics and Neocortical Weapons**
    - These tools enhance cognitive functions for soldiers while enabling manipulation of adversary populations via medicine, vaccines, or food.
3. **Knowledge Integration and Backup**
    - Individual knowledge can be digitized, creating a permanent, accessible cognitive repository.
4. **Acceleration of Thought and Decision-Making**
    - Implanted devices allow neurons to transmit information rapidly, enhancing command, control, and situational awareness.
5. **Reduction of Biological Demands**
    - Soldiers' physical requirements, such as sleep and nutrition, can be reduced, enabling prolonged deployment in demanding environments.
6. **Mental Networking and Collective Intelligence**
    - Communication between commanders and soldiers can occur mentally, potentially replacing conventional communication systems.
7. **Non-Destructive Strategic Operations**
    - Strategic objectives can be achieved without conventional weapons, influencing adversaries' cognition rather than engaging physically.
8. **Enhanced Learning and Cognition**
    - Soldiers' retention, learning speed, and analytical abilities are improved.
9. **Fatigue and Emotional Regulation**
    - Reduced fatigue and controlled emotions enhance focus, alertness, and battlefield performance.
10. **Optimized Decision-Making**
    - Accurate cognition and emotional regulation support superior command and control.
11. **Improved Physical Performance**
    - Cognitive and mental enhancements translate into superior physical capabilities, agility, and resilience.

Recommendations

- States should **recognize cognitive domains as critical operational theaters** and develop dedicated doctrines, defense strategies, and monitoring systems.
- **Public awareness and information literacy** must be strengthened to enhance social resilience against cognitive attacks.
- **Youth-focused educational programs** should include digital, media, and cognitive literacy to mitigate susceptibility to manipulation.
- Governments should **invest in ethical research and regulation** of convergent technologies to prevent misuse and ensure societal protection.
- Military planners should **integrate convergent technologies responsibly** to enhance soldier performance while considering the moral, legal, and societal implications of cognitive warfare.

References

1. Aftergood, Steven,(2009), 'The Soft-Kill Fallacy', The Bulletin of Atomic Scientists, 40-45.Bienvenue,
2. Armstrong, Doree, etl, (2022), 'Researcher Control Colleague's Motions in 1st Brain-toBrain
3. Backes, Oliver etl. ,(2019), Cognitive Warfare. The Russian Threat to Election Integrity in the Baltic States. Belfer Center for Science and International Affairs.
4. Bland, Eric, (2021), 'Army Developing "Synthetic Telepathy", NBC News, Blank, Robert H., Intervention in the Brain: Politics, Policy, and Ethics (Cambridge, MA: MIT Press).
5. Canna, Sarah, (2022), 'Leveraging Neuroscientific and Neurotechnological Developments with a Focus on Influence and Deterrence in a Networked World', Carnegie Endowment
6. Cohen, Fred, (2020), 'Influence Operations', 'In Colombia, the Drug Burundanga Is Street Thugs' Weapon of Choice', Wall Street Journal.
7. Dr. Mehmet Uçkaç, PhD, & Prof, Dr. Mohammad Ekram YAWAR. (2025). Systematic Literature Review - Talent Management, Succession Planning and Organizational Sustainability. Içinde GRS Journal of Multidisciplinary Research and Studies (C. 2, Sayı 1, ss. 1-7). GRS Publisher. https://doi.org/10.5281/zenodo.16886511
8. Dunn Cavelty, M. (2020), 'Cyber-security'. In Collins, A. (ed.) Contemporary Security Studies (pp. 400-416). Oxford: Oxford University Press.
9. Dursun, E., Jamil Sharify, A. ., Abdullah Sadat, S., Qurban Hakimi, M., & Ekram Yawar, M. (2025). The Role of New Technologies in the Development of E-Learning (With a View to the Opportunities and Challenges Facing Universities and Higher Education Centers). *Global Spectrum of Research and Humanities* , *2*(2), 99-112. https://doi.org/10.69760/gsrh.010120250020
10. Ekram Yawar, M. (2025). The Impact of Artificial Intelligence on the International Human Rights System. *Acta Globalis Humanitatis Et Linguarum*, *2*(2), 62-78. https://doi.org/10.69760/aghel.02500206
11. Ekram Yawar, M., & Jamil Sharıfy , A. (2025). Exploring Rational Reflections in Artificial

Intelligence. *EuroGlobal Journal of Linguistics and Language Education*, *2*(2), 4-31. https://doi.org/10.69760/egjlle.2500011

12. Ekram Yawar, M., & Qurban Hakimi, M. (2025). Artificial Intelligence, Management and Organizations. *Global Spectrum of Research and Humanities* , *2*(1), 98-108. https://doi.org/10.69760/gsrh.010120250024
13. Ekram Yawar, M., & Qurban Hakimi, M. (2025). Explaining the Digital Health Marketing Model in Gaining Health Welfare Support from Nonprofits. *Acta Globalis Humanitatis Et Linguarum*, *2*(2), 4-28. https://doi.org/10.69760/aghel.02500201
14. Ekram Yawar, M., & Qurban Hakimi, M. (2025). The Impact of Artificial Intelligence Technology on Human Resources Performance in Organizations . *EuroGlobal Journal of Linguistics and Language Education*, *2*(1), 96-108. https://doi.org/10.69760/egjlle.2500013
15. Ekram Yawar, M., & Qurban Hakimi, M. (2025). The Impact of Robots and Artificial Intelligence on Human Resources in the Future. *Global Spectrum of Research and Humanities* , *2*(1), 87-97. https://doi.org/10.69760/gsrh.010120250014
16. Ekram Yawar, M., & Qurban Hakimi, M. (2025). The role and importance of ethics in the use of artificial intelligence in medical education and in the diagnosis of chronic diseases. *Acta Globalis Humanitatis Et Linguarum*, *2*(1), 308-314. https://doi.org/10.69760/aghel.02500139
17. Ekram Yawar, M., Abdul Sharify, J., & Abdullah Sadat, S. (2025). A Review of International Policymaking in the Field of Artificial Intelligence. *Global Spectrum of Research and Humanities* , *2*(2), 30-39. https://doi.org/10.69760/gsrh.010120250013
18. Ekram Yawar, M., Abdul Sharify, J., & Abdullah Sadat, S. (2025). Artificial Intelligence and International Peace and Security. *Acta Globalis Humanitatis Et Linguarum*, *2*(2), 49-61. https://doi.org/10.69760/aghel.02500205
19. Ekram Yawar, M., Abdul Sharify, J., & Abdullah Sadat, S. (2025). A Review of International Policymaking in the Field of Artificial Intelligence. *Global Spectrum of Research and Humanities* , *2*(2), 30-39. https://doi.org/10.69760/gsrh.010120250013
20. Ekram Yawar, M., Abdul Sharify, J., & Abdullah Sadat, S. (2025). Artificial Intelligence and International Peace and Security. *Acta Globalis Humanitatis Et Linguarum*, *2*(2), 49-61. https://doi.org/10.69760/aghel.02500205
21. Fruhlinger, Josh, (2020), Ransomware explained: How it works and how to remove it. CSO. URL: https://www.csoonline.com/article/3236183/what-is-ransomware-how-itworks-andhow-to-remove-it.htmlGiuseppe, G. (2018), The cognitive warfare: Aspects of new strategic thinking. Retrieved from: https://moderndiplomacy.eu/2018/03/05/cognitive-warfare-aspectsnewstrategic-thinking/.
22. Interface', UW Todayhttp://www.washington.edu/news/2013/08/27/researcher-controlscolleagues-motions-in1st-human-brain-to-brain-interface/, accessed 6 November 2014.
23. Jamil Sharify, A., Amany, S., & Ekram Yawar, M. (2025). Knowledge Management Approach to Data Mining Process in Smart Business. *Global Spectrum of Research and Humanities* , *2*(2), 128-140. https://doi.org/10.69760/gsrh.010120250041
24. Libicki, M. L. (2017), 'The Convergence of Information Warfare'. Strategic Studies Quarterly (11):1, pp. 49-65.
25. Lynch, Zach, (2019), The Neuro Revolution: How Brain Science is Changing Our World (New York: St. Martin's Press).
26. Mark, Joshua, (2021), the battle of Pelusium: A victory decided by cats, World History Encyclopedia.
27. Marks, John, (2020), The Search for the 'Manchurian Candidate': The CIA and Mind Control: The Secret History of the Behavioral Sciences.
28. Marks, Jonathan (2019), 'A Neuroskeptic's Guide to Neuroethics and National Security', AJOB Neuroscience.
29. Moreno, Jonathan (2017), Mind Wars: Brain Research and National Defense (New York: Bellevue Literary Press).
30. Moreno, Jonathan (2019), Undue Risk: Secret State Experiments on Humans (New York: W.H. Freeman and Co.).
31. Narula, Sunil, (2004), 'Psychological Operations (PSYOPS): A Conceptual Overview', Strategic Analysis 28/1, 177-192.
32. National Research Council, (2019), Emerging Cognitive Neuroscience and Related Technologies (Washington, DC.
33. NATO Strat Com Centre of Excellence (2017), Digital Hydra: Security Implications of False Information Online. Retrieved from: https://www.stratcomcoe.org/digital-hydra securityimplications-false-information-onlineNeurodeterrence Workshop.
34. Ottewell. Paul. (2020), Defining the Cognitive Domain. OTH. Defining the Cognitive Domain – OTH (othjournal.com)
35. Pasternak, Douglas, (2019), 'Wonder Weapons', U.S. News and World Report 123/1, 38-44.
36. Prof, Dr. Mohammad Ekram YAWAR, Dr. Ramazan Ahmadi, Muaiyid Rasooli PhD, & Lec. Abdul Jamil Sharify, Examining Diplomacy for Environmental Sustainability in Interaction with Artificial Intelligence (2025) GRS Journal of Multidisciplinary Research and Studies, Vol-2(Iss-8).88-92
37. Prof. Dr. M. Ekram. YAWAR, Dr. Muhammed. K., Examining the Legal Status of Clouds in International Law (2025) GRS Journal ofMultidisciplinary Research and Studies, Vol-2(Iss-8).101-106 *(PDF) Examining the Legal Status of Clouds in International Law*. Available from: https://www.researchgate.net/publication/394847292_Examining_the_Legal_Status_of_Clouds_in_International_Law [accessed Sep 11 2025].
38. Rahmaniboukani, S., Qurban Hakimi, M., & Ekram Yawar, M. (2025). Medical Artificial Intelligence and the Need for Comprehensive Policymaking. *Global Spectrum of Research and Humanities* , *2*(2), 60-70. https://doi.org/10.69760/gsrh.010120250018
39. RAND Corporation (2020), Information Operations. Retrieved from: https://www.rand.org/topics/information-operations.html.
40. Resnik, David B., 'Neuroethics, National Security and Secrecy', The American Journal of Bioethics.

41. Rogers E., &, etl. (2018), Cognitive Warfare. Retrieved from: https://cove.army.gov.au/article/cognitive-warfare
42. Science & Technology Trends (2020):Exploring the S&T Edge. Retrieved from: https://www.nato.int/nato_static_fl2014/assets/pdf/2020/4/pdf/190422ST_Tech_Trends_Report_2020-2040.pdf
43. Sharıfy, A. J. (2024). Positive and Negative Effects of Technology on Organization Culture. Akademik Tarih ve Düşünce Dergisi, 11(1), 137-147. https://doi.org/10.46868/atdd.2024.653
44. Sharıfy, A. J., & Yawar, M. E. (2024). The Position and Influence of Transformational Leadership on Organizational Culture and Strategies. Akademik Tarih ve Düşünce Dergisi, 11(5), 3737-3748. https://doi.org/10.46868/atdd.2024.842
45. Sharıfy, A. J., & Yawar, M. E. (2025). Examining the Impact of Transformational Leadership in the Development of Organizational Voice "An Analysis of the Mediating Impact of Information and Communication Technology". Akademik Tarih ve Düşünce Dergisi, 12(4), 215-231.
46. Smith, Tim, (2022), Disruptive Technology: Definition, Example, and How to Invest, Available at: https://www.investopedia.com/terms/d/disruptive-technology.asp
47. Van Gordon, William, (2022), True or false? How much is fake news influencing our lives? Available at: https://www.derby.ac.uk/magazine/issue-12/influence-of-fake-news/
    Yawar, M. E., & Amany, S. (2025). Impact and Role of Information Technology Application on the Success of Leadership, Organization, Society and Individual. Akademik Tarih ve Düşünce Dergisi, 12(1), 352-364. https://doi.org/10.5281/zenodo.15618840
48. Yawar, M. E., & Amany, S. (2025). The Use of Artificial Intelligence in Teaching History and its Effects on Community Leadership. Akademik Tarih ve Düşünce Dergisi, 12(1), 319-332. https://doi.org/10.5281/zenodo.15618802
49. Yawar, M. E., & Hakımı, M. Q. (2025). A Review of the Ethical and Legal Challenges of
50. Using Artificial Intelligence in the Health System. Akademik Tarih ve Düşünce Dergisi, 12(1), 307-318. https://doi.org/10.5281/zenodo.15618771
51. Yawar, M. E., & Sadat, S. A. (2025). Problems of Using Artificial Intelligence as a Judge in Legal Proceedings. Akademik Tarih ve Düşünce Dergisi, 12(1), 403-420. https://doi.org/10.5281/zenodo.15627539.