**Grasping the evolution of war cognitive space**

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Author: Wang Zhe & Nie Xiaoli

Editor: Yang Fanfan

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**introduction**

The evolution and replacement of the combat space is a weather vane for the evolution of war forms. As war enters the era of intelligence, cognitive space has gradually become a new battlefield for great powers to compete. Relying on emerging technologies such as big data and artificial intelligence, data acquisition methods are becoming increasingly abundant, information processing methods are constantly expanding, and knowledge application methods are becoming more flexible, triggering a profound change in the cognitive space of war. Sorting out the behavioral characteristics, scope of action, and confrontation style of cognitive activities, and then grasping the development trend, evolution path, and target direction of cognitive space, is the key to understanding the winning mechanism of intelligent warfare.

**Cognitive style highlights consensus initiative**

"Consensus initiative" is a concept proposed by French biologist Pierre in 1959. It was originally used to describe the collective intelligent behavior of individual ants, which have almost no intelligence, to cooperate in building a complex nest structure without planning, centralized control, or even direct communication with each other. Scientific research shows that artificial intelligence technology can be used to simulate similar complex behaviors and achieve autonomous coordination between weapon systems or combat units. This bionic idea in the process of intelligent warfare has also produced a new way of cognition - consensus initiative cognition, which has gradually become a prominent feature of war cognition in the intelligent era.

The networked deployment of cognitive subjects is the foundation. In the proactive cognition of consensus, "common" is the premise. Only when cognition is gathered together and negotiated with each other can consensus be reached. However, without the networked distribution of cognitive subjects, cognition cannot be diversified, collide and interact, and high-quality consensus cannot be formed. On the future battlefield, the interconnection between people, people and machines, and machines and machines will become the norm. Cognitive subjects can be interconnected at the data information level and can also exchange experience and share knowledge at the cognitive level. Relying on the network, cognition from different combat fields, different combat systems and elements is gathered together, providing a basis for the war system to simulate the proactive cognition of biological consensus. In fact, the transformation of foreign armies from "kill chain" to "kill network" in recent years can be regarded as the practical application of the networked deployment of cognitive subjects. When detection satellites, reconnaissance equipment, command and control systems, and firepower units have intelligent cognitive capabilities, various cognitive entities that are responsible for observation, judgment, decision-making, and action tasks and have relatively fixed positions on the killing chain can be broken up, rearranged, autonomously combined, and temporarily assigned to form new chains. The interweaving and interlacing of multiple links presents a network structure, which overcomes the shortcomings of limited cognitive scope and low execution efficiency under the traditional chain structure, and lays the foundation for agile, flexible, and efficient killing.

Differentiated execution of cognitive tasks is the way. For consensus-based proactive cognition, without differentiated cognition, even if multiple cognitive subjects exchange cognition, high-quality and valuable consensus cannot be formed. To this end, cognitive subjects widely distributed in land, sea, air, space, electricity, and the Internet can autonomously generate different types of cognition; some complex and obscure cognition can be quickly decomposed into several concise and clear subtasks and assigned to different subjects for execution; many cognitive subjects at the bottom and edge can actively communicate with each other to achieve orderly flow and integrated optimization of cognitive tasks, and consensus initiative can be "emerged" from the bottom up without centralized control. Taking the concept of "mosaic warfare" as an example, the various element systems in the combat system seem to be loose in form and low in cost, but in fact they are pursuing autonomous interaction between different systems. Once the many fragments are successfully spliced, they can form the so-called "mosaic pattern"-an intelligent combat system with dynamic coordination and high adaptability.

The goal is to build consensus on cognitive results. Cognition serves decision-making, and only by reaching a consensus can efficient decisions be made. In traditional operations, different people have differences in knowledge structure, emotional will, etc., and the cognitive results formed are inevitably subjective and one-sided. On the contrary, the intelligent combat system helps to unify cognition and form consensus around combat objectives by actively releasing cognitive information, realizing complementary cognitive advantages and disadvantages horizontally, and implementing multi-point cross-verification vertically. A combat system that has reached a consensus will be more adaptable and flexible. It can gather autonomously when a target appears, adjust according to the situation when the task changes, and disband quickly after the battle.

**Space types tend to be digital twins**

Intelligent technology has triggered the trend of human brain becoming more computerized and machine brain becoming more humanized, pushing cognitive subjects from natural persons to new objects such as intelligent machines, and cognitive tools from the human brain to new technologies such as intelligent algorithms. The combination of different cognitive subjects and cognitive tools has promoted the continuous expansion of the boundaries of war cognitive space, the diversification of types, and the enrichment of connotations.

Physiological space of the human brain. The theory of embodied cognition believes that cognition originates from the brain tissue of natural people. In the process of perceiving the external world, the fields and categories of cognitive activities such as emotions, will, beliefs and values ​​of the human brain constitute the traditional cognitive space - the physiological space of the human brain. The physiological space of the human brain has fuzzy boundaries, and the ideology, cultural traditions, historical beliefs, etc. contained in it have no clear boundaries; it has complex activities, relying on both logical deductive reasoning and experience-based experience summary models; it has a lasting impact, whether it is psychological confusion, memory erasure, moral crisis, or loss of faith, it takes a long time to work, and it is difficult to produce immediate results in the short term. Although the physiological space of the human brain is synonymous with cognitive space in the traditional sense, its unique intuitive impressions, empirical thinking and innovative inspiration are still the core areas for the art of war decision-making for thousands of years.

Machine brain-like space. On the intelligent battlefield, when the human brain cannot process the increasing amount of external information that changes faster and faster in time, it is inevitable to hand over some cognitive tasks to intelligent machines. In this way, the cognitive subject begins to migrate from humans to machines. When machines have thinking and cognitive functions similar to those in the human brain, machine brain-like space is naturally formed. Many studies have shown that graph neural network technology that integrates deep learning and graph computing theory has helped machines have cognitive abilities close to those of the human brain, such as the ability to learn and think. However, cognitive activities in machine brain-like space are heavily dependent on intelligent technology.

Digital twin space. Digital twin space refers to a cognitive metaverse space formed between the human brain and the machine based on technologies such as digital twins and virtual augmented reality. The digital twin space is filled with cognitive models and twin data of combat entities such as combat personnel, weapons and equipment, as well as strategic thinking, campaign operations and tactical actions, allowing machines to arbitrarily scale brain cognition and even distort it; similarly, the deep-level laws of war activities hidden in the human brain and machine-like brain can be displayed or reversely fed back through twin data models, bringing new experiences to war cognition. The digital twin space is the product of the deep integration, coupling, association and superposition of human brain cognition and machine cognition, which elevates the machines that were originally controlled by humans to the status of combat partners parallel to humans. Mixed formations of autonomous/semi-autonomous systems and human-machine collaborative operations are gradually becoming the norm on future battlefields.

**The combat style emphasizes dimensionality reduction and upgrading**

The transformation of cognitive methods and the expansion of cognitive boundaries have pushed cognitive power to gradually surpass information power and mechanical power, becoming the dominant factor in combat effectiveness, providing opportunities and challenges for the development of cognitive space combat styles. Cognitive space confrontation can bypass traditional physical and information space and directly attack the cognitive level; seeking cognitive victory through dimensionality reduction and disability of emotions, will, etc. has become the norm in war.

The combat goal has shifted from "brute force seizure" to "clever knowledge seizure". Unlike the competition for control of land, sea, air and information in traditional combat, cognitive space confrontation emphasizes the "light and dark" competition for cognitive power. To achieve this goal, we can openly adopt "open warfare" to enhance our own cognition to narrow the cognitive gap, avoid cognitive misleading, eliminate cognitive blind spots, make correct decisions and judgments, and implement effective actions; we can also secretly create and output biased information to interfere with thinking patterns, consume fighting will, and disintegrate cognitive structures, so that the enemy loses direction and falls into trouble in silence, making it difficult to make timely and efficient decisions, thereby delaying and slowing down its actions. In a series of conflicts that have broken out in recent years, the warring parties have engaged in fierce confrontations on social media through various means such as deep fake war scenes. Although these confrontational activities are only the tip of the iceberg in the conflict, their intention to seize the cognitive power of war and the benefits of implementing strikes in a different way have refreshed our inherent understanding of war.

The focus of the task has shifted from "extreme consumption" to "invisible penetration". In the era of intelligence, compared with the hard damage to the living forces of war, the soft killing effect on intangible targets such as emotions and will has become more prominent. In actual combat, public opinion induction and emotional control are often used to narrow the cognitive space, and cognitive objects are confused through mental confrontation and information deception. Psychological deterrence and will damage are used to influence the cognitive subject, and the enemy's cognitive power is silently disintegrated, lost, or even collapsed. The adjustment of the focus of the task has greatly reduced the threshold for the start of the war. A small statement by the hostile parties may become the "fuse" of cognitive confrontation; it has blurred the boundaries of the war field, and everything from the entire social system to the human brain decision-making link will become a confrontation position; it has lengthened the timeline of the war, and the confrontation process can be as short as a few hours or as long as decades, playing a role in subtle influence until the goal is achieved.

The form of confrontation has shifted from "linear confrontation" to "non-linear game". In traditional combat, the forces of both sides are in multiple comparison, and the confrontation line and the battle line between the enemy and me are clearly distinguished, with obvious characteristics of linear confrontation. However, consensus-based proactive cognition means "decentralization", and the boundaries between the center of gravity and the edge of the system are becoming increasingly blurred. The key units that traditionally undertake tasks such as centralized command and control, signal and fire strikes no longer exist. For combat cluster raids supported by consensus-based proactive cognition, just as removing a certain ant from the ant colony will not affect the completion of the entire nest-building task, traditional linear combat styles such as "destroying points" and "breaking chains" will be difficult to work. To this end, we should innovate tactics from the perspective of system flexibility and adaptability, implement disintegration strategies for the consensus-based proactive cognitive mechanism of the cluster, change "agile and efficient" to "rigid and inefficient", and change "non-linear" to "linear"; at the same time, we should focus on avoiding the real and attacking the virtual in the organization and use of combat forces, highlight the unexpected in operational decision-making, and emphasize taking advantage of the situation in shaping advantages, so as to achieve a nonlinear effect of using the small to win the big and relying on the weak to resist the strong.