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PROGRAMMING COUP D'OEIL:
The Impacts of Decision Making Technology in Operational Warfare

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

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Contents

Abstract

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Effective military leaders are able to make decisions under extreme pressure and in the face of imperfect information. They are also able to make assumptions and predictions regarding their opponent's potential actions. The lack of perfect information and uncertainty creates the fog and friction of war, and commanders use either the analytical or intuitive decision making methodologies during the planning process to see through the ambiguity of warfare. Given that both processes have shortcomings, this paper addresses the potential positives and negatives of using computer-based decision making technologies (DMT) to cut through the fog of war. It explores several of the common human cognitive biases that erode the effectiveness of the analytical and intuitive decision making processes, and it discusses how a DMT can overcome those shortcomings. It also examines the impact of the DMT upon the operational factors of time, space, and force. Finally, it addresses several problems that a DMT may introduce into the planning process.

Introduction

Military leadership is about being able to effectively make decisions, sometimes under extreme pressure, and doing so in the face of imperfect information. It also involves making predictions about an opponent's potential activities based on inadequate information and assumptions, and then directing decisive actions based upon those predictions. This lack of perfect information leads to friction and uncertainty in warfare, making war a nasty, messy business. Given these limitations, military commanders have traditionally employed two types of methodologies to arrive at decisions during military operations, each with their own unique characteristics.

The first methodology that a commander may employ is the analytical decision making process. It is a methodical procedure that relies heavily on staff work, and it is founded on the premise that decision making should be a rational and systematic process of analysis based on the comparison of multiple options. Staffs attempt to identify several possible courses of action (COAs) prior to beginning an operation, and then they analyze those COAs against a specified set of criteria set forth by the commander. A value is then assigned to each COA (either objectively or subjectively), and the staff recommends the COA with the highest value to the commander, based on their analysis.[1] This process, if done correctly and with good information, should ensure that the best possible COA is presented to the commander for consideration, since the staff attempts to optimize the available variables and options. Two drawbacks to this process are that it is time consuming and it requires a high degree of good information to yield accurate options for success. In warfare, tempo is vital and there is rarely enough time to move through long, deliberate

planning processes. Information is often unreliable, missing, or very time late. Failing to conduct a full analysis of each available COA and making assumptions about battlefield variables degrades the entire analytical process, and it may lead the staff into presenting the commander with a COA that has not been fully scrutinized.

The second methodology that a commander may use is the intuitive process. In this form, commanders may not rely heavily on their staffs; rather they rely on a combination of intuition, experience, and framing to recognize the essence of a given situation to tell them what their appropriate action should be. They study a situation, and then the problem and the solution come to them simultaneously. They then think through the implications to arrive at a COA, and then they commit to it, or reject it if they think it will not work.[2] Schmitt writes that the intuition of leaders tells them "what factors are important in any given situation, what goals are feasible, and what the outcomes of their actions are likely to be."[3] The commander then generates a workable first solution, rather than a longer list of options. Intuitive decision making emphasizes situational awareness, or, as it is oftentimes called in the military, *coup d'oeil*.[4] Clausewitz described *coup d'oeil* as "an intellect that, even in the darkest hour, retains some glimmerings of the inner light which leads to the truth…the concept merely refers to the quick recognition of a truth that the mind would ordinarily miss or would perceive only after long study and reflection."[5] He believed that the outstanding commanders in military history were able to see through the fog of war and seize opportunities from their opponents.

How is *coup d'oeil* developed? Experience may be the most important factor in developing the ability to recognize a situation as typical, or as one that has been

seen before, in one way, shape, or form. Although battlefield problems range from well-structured to ill-structured to wicked, an experienced commander may recognize similarities of patterns within those problems and understand what they mean – the commander then does not have to reason a way through a problem (using an analytical process), and instead will know how to act appropriately. The factor of experience then lends itself to the development of pattern recognition, or *coup d'oeil*, which has traditionally been recognized among great military leaders.[6]

If experience forms the basis for pattern recognition and situational awareness, then it can be gained by commanders through practice and application. Opportunities to develop intuitive decision making skills may be limited due to operational commitments, and commanders and staffs may be insufficiently experienced to function effectively in an operational warfare environment. Given these constraints, could it be possible to augment this lack of experience among human decision makers? Could a computer program in the form of a decision making aid or expert system – which can store nearly infinite amounts of information, access it in seconds, do in-depth statistical analysis, and recognize patterns – enhance the effectiveness of commanders, their staffs, and their forces by bringing together the best of both decision making processes?

Thesis

If completed, programmed, and fielded effectively, the employment of computer-based decision making technologies (DMT) could provide a significant advantage for friendly forces at the operational level of war. Using a DMT could give operational

commanders an advantage in COA development and mission execution, and aid them with the rapid reorientation of forces as situations and variables change. Additionally, the employment of DMTs could help commanders and staffs overcome the inherent problems and time delays that are resident in human-based decision making processes, help them better maximize the operational factors of time, space, and force, and still allow for human interactions within the overall decision making process. Despite these potential advantages, DMTs will never fully eliminate the fog of war and they should be treated as another tool that can be utilized during the commander's decision making process.

Background

In 2007, the US Army announced that it was working with the Defense Advanced Research Projects Agency (DARPA) on an experimental DMT, titled DEEP GREEN. Kenyon writes that the goal of the software is to "help future commanders see through some of the fog of war by helping them plan operations, recognize when a plan is not working, and develop alternatives to keep ahead of the enemy,"[7] and that it "will also allow commanders to generate options rapidly and proactively to avoid any surprises, which… is the point in a battle where a commander has no options."[8] This software, once fully functional and ready, will shorten the Observe, Orient, Decide, Act (OODA) Loop of friendly forces, and it will allow the commander and staff to rapidly plan and make decisions based upon force interactions on the battlefields. Noah Shachtman, of *Wired.com*, writes that DARPA envisions DEEP GREEN as a system where "the Observe (execution monitoring) and Orient (options generation and analysis) phases run continuously and are constantly building options based on the current operation and making predictions as to the direction the operation is

taking... the OO part of the OODA (loop) is done many times prior to the time when the commander must decide,"[9] and that the DEEP GREEN system "will enable officers to out-hustle and out-think potential foes – and do all that planning and analysis with a quarter of the staff that it takes today."[10]

According to DARPA, the DEEP GREEN program will:

> aid in battle command and commander's visualization by creating technologies that make it easier for the commander to articulate options to consider and anticipate the possible futures that result from those options. This proactive analysis will help predict which possible futures are becoming more likely – before they occur. Given that information, the commander can make better decisions and focus planning efforts (the generation of future branches and sequels) on where they can be the most useful.[11]

Given a set of inputs, constrictions, restrictions, and desired end states, the DMT will be able to quickly generate a number of prospective COAs for the commander. Then, through the constant monitoring of interactions upon the battlefield, the DMT will be able to tell the operational commander if the chosen COA is in danger of failing. Finally, it will recommend other potential COAs to reach the same desired end state given the change in the situation.

Analysis

The first advantage that can be gained through the use of a DMT is that it will help commanders and staffs overcome the cognitive biases that influence their thoughts and actions. Humans see decisions through the lenses of their own experiences, which colors their perception of the factors and influences that make up a problem. These biases then become present in the decision making process, and they may hinder progress and slow down the overall effectiveness of a commander and the staff.

One of the most common cognitive biases that may influence decision makers and planners is ethnocentrism. Dong, Day, and Collaço defined ethnocentrism as the "belief that

one's ethnic or cultural group is the center of everything, and all other things are related to or dependent on it."[12] Ethnocentrism plays a role in shaping stereotypes, which is one way the human mind categorizes information, in the hope of predicting experiences. Although stereotypes are not intrinsically bad, they do provide individuals with specific expectations about members of a group, which can unfavorably influence perceptions and behaviors.[13] Ethnocentrism plays a large role in coalition military operations, and it creates friction between planners who (consciously or subconsciously) may discount the feelings, opinions, and judgments of planners and decision makers from other nations. Varying perceptions of risk and preferences associated with cultural differences may also introduce tension and complications into the decision making process.[14] Ethnocentrism can also influence joint operational decision making, since staff members have different preconceptions about the cultures and effectiveness of their sister services. Members of joint staffs may discount the abilities of their sister services while overestimating the capabilities and potential contributions of their own service, and this may lead to tensions and friction developing among staff members and planners. Conversely, a computer system is free from ethnocentrism and biases. It bases its calculations upon the macro level physical capabilities and limitations of platforms and their associated weapons systems, rather than at the micro level and the human operators working each system.

A second cognitive problem that a DMT can overcome is the human tendency to keep all options open for as long as possible, even when a particular course of action quickly, and clearly, becomes evident as the best possible choice in a particular situation. The analytical decision making process requires that staffs thoroughly evaluate a number of available COAs, and this consumes time. This process, however, has a significant opportunity cost

attached to it: as planners examine other possible COAs, they are expending time and energy on tasks that could be better spent on defining and preparing for the already-known best COA. Planners may also become emotionally attached to a particular COA after developing it, and they may continue to advocate for it even after better COAs are recognized. This results from the human tendency to persistently fit new information to a poor image until the contradiction becomes painfully obvious.[15] A DMT offers two distinct advantages over human decision makers in this area, in that 1) it has no emotional attachments to any particular COA, and 2) the speed at which it can push through the analytical and statistical analysis of the available COAs – using the exact same information that is available to human decision makers – is limited only by the processing power of the system. It is feasible that a DMT could recognize and recommend the best available COA to a commander, based on sound historical analysis and statistical reasoning, before its human counterparts have finished identifying all of the COAs that they want to analyze. The time saved in planning by the DMT could then be used to maneuver subordinate forces during mission execution.

Another human cognitive shortcoming that a DMT overcomes is overconfidence. According to Mauboussin, decision makers tend to consider problems by "focusing on a specific task, using information that is close at hand, and making predictions based on that narrow and unique set of inputs. This approach is common for all forms of planning and almost always paints too optimistic of a picture."[16] The factor of overconfidence then influences three other illusions, each of which can impact the decision making process: the illusion of superiority, the illusion of optimism, and the illusion of control.

The illusion of superiority stems from the physiological perception that humans, regardless of their backgrounds, tend to have an unrealistically positive view of themselves

and their mental and physical capabilities in any given situation.[17] This overestimation of skills leads to a second dilemma: not only do people tend to be incompetent in the strategies they utilize and make unfortunate choices, their incompetence robs them of the ability to realize it. Instead, decision makers and planners may be left with the impression that they are doing just fine.[18] Research also shows that the least-capable performers often have the largest gaps between what they think they can do and what they actually achieve, which further illustrates the hazards of the illusion of superiority.[19] The influence of the illusion of superiority upon commanders may lead them to believe that they are better decision makers than they actually are, which may cause them to believe that they can discount some steps of the decision making process because of their own perceived abilities. A DMT will not overestimate or underestimate any single factor in warfare; rather, it will spend the same amount of power and time analyzing each known variable that goes into a military decision.

The illusion of optimism states that most people see their future as brighter than that of others, and that individuals tend to believe that they will experience more luck than their peers or their opponents.[20] The illusion of optimism may influence staffs and commanders to pursue losing or riskier COAs longer than they should, only because they fundamentally believe that at some point their luck will change through some extraordinary set of circumstances. A DMT will not suffer from optimism, and it will view a situation rationally and immediately recognize when a desired end state is no longer possible. Luck will not factor into its equations.

The third illusion is that of control. People who believe that they have some degree of control over a given situation tend to have the perception that their odds of success are better than they actually are.[21] Also, detailed planning may reduce the perception of risk

among planners as they become more familiar with the problem at hand, its associated risks, and the possible COAs that could be adopted. This familiarity may generate a feeling of control, and this may reduce the commander's perception of risk and effectively increase the propensity to take risks.[22] Conversely, the DMT will not account for certain events happening based upon the feeling of control. The DMT will use historical analysis and pattern matching to generate a statistical probability of success and allow the commander to avoid taking potential unnecessary risks with valuable assets. If the probabilities for success are too low based on previously established constraints, the commander will be able to avoid that particular COA and pursue another sequence of options.

Allowing overconfidence and its three related cognitive illusions into the decision making process may cause operational commanders and their staffs to take unnecessary risks with their forces, and in extreme cases it may place an entire operation, and possibly a strategic goal, at risk. The analytical military planning process overcomes cognitive biases through the use of rigorous threat assessments, planning sessions, and deliberations over COAs, but these necessary steps consume time. Once a conflict has begun, time becomes the one commodity that a commander can never have enough of and, once spent, can never get back. A DMT, on the other hand, will rapidly generate a COA that is free of these cognitive biases and has a certain probability of success, based upon a historical analysis of a situation.

Commanders and planners may also become overwhelmed with information and intelligence reports during an operation. This poses a dilemma for commanders and their staffs, since they must first find the information that is most relevant to their current battlefield situation and then fuse it into a coherent picture before making a decision. The capacity of planners and commanders to deal with the complexity of the operational problem

and the amount of information received is critical to execution, and oftentimes they are forced to construct simplified representations of what is actually occurring because they can only process a limited amount of information about a situation.[23] Although this problem may be mitigated by guidance regarding critical and priority intelligence requirements, the possibility of missing vital information is high due to the massive volume of data that is received over time. A DMT may help commanders overcome these cognitive limitations, since computers are able to rapidly analyze massive amounts of data. Every single data point that comes into the DMT will be analyzed against the current situation and against history, and then used to further refine and perfect the COA recommendation.

One advantage of the intuitive decision making process over the analytical process is that the commander uses it to rapidly formulate a "good enough" solution to a problem and promptly put it into action. The commander may arrive at a decision by evaluating what information is available and matching the scenario they face to one previously experienced. If the solution to the problem is plausible, it can be quickly adopted and put into action, even if it is not fully optimized.[24] Conversely, a DMT will use its version of the analytical process and arrive at the best possible COA in a given situation, provided it has the most up-to-date information from the operational environment. It will produce a solution that is optimized and based on the consideration of all available intelligence, whereas the human commander may provide a solution that is only "good enough" in the same amount of time.

The DMT will help the commander combine and balance the operational factors of time, space, and force for maximum effectiveness. It may also allow them to tailor their guidance to the DMT, based upon the nine principles of war.[25] The DMT will leverage the operational factor of force by constantly analyzing the interactions of friendly and enemy

forces, and then generating updated COAs that reflect changes in the operational environment. DEEP GREEN is being designed by DARPA and the US Army to continually monitor the progress of friendly forces and to recommend certain actions be taken based on the inputs that it receives from the operational theater. If there is good intelligence on the location of enemy forces, a DMT will analyze their movements in conjunction with those of friendly forces, and it will recommend subsequent COAs to the operational commander that are in line with guidance. As the operation continues to play out, the DMT will continually monitor incoming data and recommend changes to the commander and staff. Kenyon writes that DEEP GREEN is being designed so "that if a particularly good future is becoming eclipsed by a bad outcome, the system will detect this shift and alert commanders to generate options that may move the mission back to the desired outcome."[26]

The DMT will also work to maximize the utilization of space, since it will know and consider the geographical size and shape of the operational theater as it develops its COA recommendations. It will work to optimize routes for movements for friendly forces, given the terrain, maneuverability, and potential for surprise. In regards to time, the DMT will think and react faster than humans to changes in the operational environment, and that time can be spent to better posture friendly forces for follow on actions. The DMT could perform OODA Loop calculations millions of times per second, which could make the friendly decision cycle faster than that of the opponent and force them to continually react. Once the DMT knows what forces are involved, the physical limits of the terrain, and the amount of time allotted to reach a certain objective, the DMT can work to generate recommendations that have the highest statistical probability of achieving the objective as efficiently and as effectively as possible.

Even though a DMT may offer numerous advantages to operational commanders and planners, there are several challenges inherent to using DMTs at the operational level of war. Commanders and staffs must weigh the potential hazards of using a DMT carefully prior to following its recommendations during combat.

First, there will always be a necessity for humans to be in the decision chain. War is first and foremost a human endeavor with lives and property at risk. A DMT, despite its apparent rational view of a situation, will never understand that wars involve irrational acts and that random events of extreme unfortunate magnitude, and incredible positive consequence, will occur. The DMT will make recommendations using a process that is devoid of emotion or feelings. It may see no harm in recommending that a brigade be sacrificed if it means saving a division. While an action like this may be logical from a computer's standpoint, it may be callous from a leadership standpoint – and the commander may chose to order actions that are contrary to the advice of the DMT in the hope that they increase the chances of the brigade surviving.

Additionally, the human terrain of a conflict is significant. Because a DMT is a computer, it will not know human feelings and it may be tough for programmers to quantify those types of emotional qualities into a program. Simply overlooking this factor is not a trivial matter; in war, the morale and willingness of soldiers to fight and die for a cause is an incredibly powerful force multiplier. If possible, the DMT should somehow consider human factors that are present in a battle at the at the individual level, such as training, weapons proficiency, and skill, since these factors, once added up among large groups of combatants, may have a significant influence on the overall outcome of a battle.

Humans may also be unable to keep up with the speed of the DMT and its decision making process – it will make recommendations at a rapid pace as real-world events unfold, and by the time operational leaders issue orders down to the tactical level, the situation may have changed and the set of suggested maneuvers may be supplanted by an entirely new set of required actions. This problem was illustrated in 2002, when Joint Forces Command (JFCOM) executed Millennium Challenge '02. Armed with the Operational Net Assessment (ONA) tool, JFCOM hoped to show that, given the right technology and equipment, friendly forces could lift the fog of war from the battlefield. The outcome of the exercise was a disaster and the military's first attempt at pulling back the fog of war through technology ended in failure.[27] Some point to this exercise as justification enough for abandoning the idea of DMTs, but one of the primary reasons the Red Forces won was a combination of their speed of action and the lack of speed in decision making by Blue Forces.[28] JFCOM's defeat illustrated the hazards of waiting too long between receiving recommendations from computerized systems and issuing orders to the field. Using a DMT to generate orders for tactical units may also introduce a second dilemma, in that the ability of lower echelon commanders to have a significant say in operational decision making may be eroded. Having input to planning staffs on possible COAs for upcoming operations tends to improve morale and buy in, but a DMT may not afford tactical commanders that opportunity and frustrate their ability to motivate their troops.[29]

The ability of the DMT to generate valid COAs for future actions will be contingent upon its ability to obtain accurate location data on both friendly and enemy forces, and their positions relative to the operational objective. If the DMT does not have a valid picture of the objective and the forces interacting upon the battlefield, it will generate COAs for

operational commanders that are based on false data and on false probabilities of success. This will make a DMT vulnerable to exploitation by an enemy that utilizes a robust deception plan, and it may cause the DMT to generate recommendations that ultimately place friendly forces dangerous situations. Because of this potential weakness, commanders must always be able to make quick decisions based on experience and judgment, and make the best possible use of whatever flawed information is available.[30]

Physically, the DMT may also reside on an interconnected, distributed computer network system, with nodes that are spread over a large area. The will make the DMT vulnerable to malicious computer programs, hackers, and other types of computer network attack (CNA), which could each be employed to render the DMT useless to commanders. A worst-case scenario could involve a hacker infiltrating the DMT and falsifying the positions of units, which could then cause the DMT to make flawed recommendations to operational commanders and put friendly forces at risk.

The type of conflict may also limit the effectiveness of a DMT, and it may best contribute to a war that is fought on conventional terms between state actors. State armies and their associated forces are much easier to track and their capabilities are more easily known and assessed, and they operate conventionally within the physical environment. Both factors would make it easier for a DMT to monitor and assess the effects of friendly and enemy actions upon the battlefield, and if the DMT can effectively monitor movements, actions, and reactions between forces, it can better inform commanders whenever the preferred COA is in jeopardy and recommend possible actions to salvage the situation. The system may be significantly more limited against an insurgency since the insurgent environment is much more fluid and nebulous. The locations of insurgent strongholds are

never known with a high degree of certainty, and the size of enemy forces may fluctuate over short periods of time as candidates join and leave the insurgency. A DMT may not understand the underlying factors that are driving a conflict, and it may recommend actions that could further incite a rebellious populace.

Recommendations

There is a future for decision making technology in warfare, but commanders and planners must be prudent in its use. Vego describes war as "an art, not a science,"[31] and this statement may be one of the strongest reasons for why any type of computer-aided decision system will never be a complete substitute for the personal judgment of the operational commander. Computers exist wholly in the scientific realm, in a binary world that is defined through mathematical, logical, and scientific terms, and where everything is represented through the lenses of an equation. War, on the other hand, is a messy and unpredictable business, where events happen for no reason despite giving every scientific indication for a different outcome. The positives that can be gained through the use of a DMT are promising, but there are also significant challenges to using such systems. Operational commanders, and their staffs, must recognize the limits of DMTs when they utilize them during contingency planning and during crisis action planning. They must be judicious with the use of DMTs and recognize the inherent traps and dangers of using such systems. They must never come to believe that a DMT is anything more than a planning tool that can better help friendly forces stay ahead of their opponents. Commanders and planners should never blindly follow the advice of a DMT; instead, they should always weigh its recommendations against the real-world political and military environment and against their instincts. The

existence of DMTs will never completely substitute the need for planning or for being versed in operational art. Regardless, the development of computer-based decision making tools – such as DEEP GREEN and the Operational Net Assessment – represent a significant step in the continual evolution of warfare.

Conclusions

Technology is always advancing, and it is constantly changing the ways humans think and compete. Gary Kasparov, recognized as the greatest chess player of all time, represents an interesting case in the history of the human mind versus computers. In 1997, Kasparov, who had a long and unblemished history of chess victories against computer technologies, faced IBM's Deep Blue chess supercomputer and lost in an event that made headlines around the world. Deep Blue was a not a computer that thought and played chess like a human, with creativity and intuition; rather, Deep Blue won through sheer power and its ability to calculate over 200 million moves per second.[32] It analyzed the positions of chess pieces on the board and then compared them against every possible chess layout combination before determining its next move. It matched patterns and won through situational awareness. In 2005, an online chess tournament hosted by Playchess.com illustrated the possibilities of using computers to augment human decision making processes. Three classes of competitors participated in the tournament: humans, chess computers, and hybrid teams (humans augmented by chess computers). The tournament was not won by a human Grand Master or by a chess supercomputer, but rather by a pair of twentysomething amateur chess players and their computer laptop, which had an off-the-shelf chess program loaded onto it that was used for situational analysis and advice.[33]

The results are telling, not because of the structure and outcome of the event itself, but because of the way the winners won – as a combination of man and machine. The winners persevered because they consulted the computer for advice on every move and followed its advice if it made sense to them. If it did not, they went with their own instincts. Although the interactions of two opponents on a chessboard is not completely analogous to the chaos, fog, and friction of war, the lessons from the online tournament may portend what a successful man/machine partnership could one day look like. The relationship among the operational commander, the staff, and the DMT may someday evolve along the lines of hybrid chess players. It is possible that in the future, military operations may be planned and executed by leadership teams that combine the perceptive and intuitive qualities of the human mind with the rapid, analytical, and unemotional qualities of the computer.

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[33] Ibid.

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