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# Extending Cognitive Assistance with AI Courses of Action

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# EXTENDING COGNITIVE ASSISTANCE WITH AI COURSES OF ACTION FOR WARGAMING

## EXECUTIVE SUMMARY

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**Additional Researcher(s):** No additional researchers participated in this research project.

**Student Participation:** No students participated in this research project.

**Prepared for:**
Topic Sponsor Lead Organization: HQMC Plans, Policies & Operations (PP&O)
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## Project Summary

In the United States Marine Corps (USMC) Fire Support Coordination Unit (FSCU), the FSCU officer often does not have the correct, optimal information for situational awareness (SA) and, as a result, can make poor decisions in the battlefield. This is a problem because it leads to fratricide and unintended civilian casualties. The working research question is, to what degree will situational awareness and decision quality improve by using a cognitive agent that reduces friction factors in knowledge flows? A factorial, quasi-experimental design will be implemented as described by Kerlinger and Lee (2000). Quantitative methods will be used to analyze data collected on the variables to show a corollary relationship between the use of a cognitive agent and the resulting improved situational awareness and decision quality versus without the use of a cognitive agent. This research explored the availability of potentially existing cognitive agents that could provide situational awareness and context to an operator in an operational military environment. While there is active research ongoing in this area, a cognitive agent has yet to be designed and developed to meet this need. Since such a tool does not yet exist, it is recommended that this line of research continue so that the described discovery experiment plan can be executed. By continuing this research, a baseline of experimentation can provide insights into how a technology may be designed and developed with various artificial intelligence/machine learning (AI/ML) algorithms. Future research beyond the exploratory and discovery phases could look at how a cognitive agent could provide courses of action based on all data sources available. Further, a cognitive assistant (CA) with the ability to provide courses of action would shift from 'human-in-the-loop' to 'human-on-the-loop,' thereby reducing cognitive load.

**Keywords:** *human-machine teaming, HMT, mission workflows, automation, machine learning, ML, artificial intelligence, AI, courses of action, COA, wargaming, decision making, naturalistic decision making, NDM.*

## Background

This research examined automating tactical workflow tasks optimized in complex, interdependent missions and joint activities. In 2012, the Defense Science Board Task Force Report: The Role of Autonomy in DOD Systems, stated, "the true value of [autonomous systems] is not to provide a direct human replacement, but rather to extend and complement human capability by providing potentially unlimited persistent capabilities, reducing human exposure to life threatening tasks, and with proper design, reducing the high cognitive load currently placed on operators/supervisors" (p. 1). Furthermore, the 2018 DOD Artificial Intelligence Strategy identifies delivery of AI-enabled capabilities that includes "improving situational awareness and decision-making…by offloading tedious cognitive or physical tasks and introducing new ways of working" (p. 7).

Several United States Marine Corps (USMC) thesis students studied how to design interdependent human-machine teaming (HMT) for military applications (Beierl & Tschirley, 2017; Clarke & Knudson, 2018). In Capt. Ben Herbold's thesis (2020), he continued this research and studied interdependence analysis matrix using the approach developed by Dr. Matt Johnson at IHMC (2014). The current research was based on the Plans, Policy, & Operations (PP&O) United States Marine Corps, Headquarters (USMC HQ). Studies from PP&O USMC HQ have laid the groundwork that directly supports the mission of the Headquarters Marine Corps (HQMC) PP&O for "coordinating the development and execution of service plans and policies" for joint and service functions (Headquarters Marine Corps, n.d.).

Previous research has been computationally intensive and unavailable at the tactical edge. Currently, humans drive intelligent tasks, and the machine performs simple, programmable, mundane tasks. While programming improves task efficiencies at the margin, HMT activities need to be extended to reduce the cognitive load of operators in a complex and dynamic operational environment. An HMT cognitive assistant should reflect realistic environments such as multiple agents, human and/or computer. As noted by Stilman (2000), "None of the conventional approaches … allow us to scale up to the real-world concurrent systems with respect to the number of agents, dynamic change of their capabilities, size, shape, and dimension of the operational district, concurrent actions, real time requirements, etc." (p. 8). As AI advances, machine intelligence grows, resulting in humans realizing that machines may become true peers to humans in conducting enriching dialogue via an HMT interface.

We studied the HMT interface with an AI tool, providing SA. We believe humans should learn from intelligent AI agents. Learning from AI agents results in reduced decision-making errors, due to humans progressing in a temporal dimension by learning tacit knowledge of SA from intelligent AI agents. Our research results expect to support that bringing congruency into the HMT interface translates into decision superiority as human decision making is aligned with a superior, AI enabled decision support system.

This research aids the USMC PP&O in accomplishing the "development and articulation of concepts, plans, and policies to support the Joint Strategic Planning System" by laying the groundwork for AI decision support in reducing cognitive load on operators (Headquarters Marine Corps, n.d., Functions section).

## Findings and Conclusions

This research explored the availability of potentially existing cognitive agents that could provide situational awareness and context to an operator in an operational military environment. While there is active research ongoing in this area, a cognitive agent has yet to be designed and developed to meet this need.

A factorial, discovery, quasi-experimental design will be implemented as described by Kerlinger and Lee (2000). As discussed by Runde (2016), discovery experiments can be very economical because they do not employ large amounts of infrastructure and resources (p. 27). Discovery experiments are an important element in the experimentation process as some ideas may fail early on. These failures, however, provide a rich learning source prior to investing resources.

Discovery experiments may be successful, yet further discovery testing may continue to be explored to validate findings, refine concepts, and determine the best fit for implementation (Alberts, 2009). Quantitative methods will be used to analyze data collected on the variables to show a relationship between the use of a cognitive agent and improved situational awareness and decision quality versus without the use of a cognitive agent. The design will be 'quasi-experimental' because it may not be possible to have more than one group that receives the experimental treatment, and the other group would not receive the experimental treatment (Kerlinger & Lee, 2000). The training scenario will be provided by the Army through an existing program called Scarlet Dragon. Todd South cites Lt. Gen. Erik Kurilla, XVIII Airborne Corps commander, who describes Scarlet Dragon as a series "designed to increase our joint warfighting capability and how

AI-augmented decision making significantly increases the scale, speed and accuracy of our targeting process" (South, 2021, para. 15). The availability of this training series is an ideal match for this research study due to its focus on AI within the Navy and joint forces.

**Recommendations for Further Research**

Since an artificial intelligence (AI) tool does not yet exist, it is recommended that this line of research continue so that the described discovery experiment plan can be executed. By continuing this research, a baseline of experimentation can provide insights into how a technology may be designed and developed with various AI/machine learning algorithms. Future research beyond the exploratory and discovery phases could look at how a cognitive agent could provide courses of action based on all data sources available. Further, a cognitive assistant with the ability to provide courses of action would shift from 'human-in-the-loop' to 'human-on-the-loop' thereby, reducing cognitive load.

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**Acronyms**

| | |
|---|---|
| AI | artificial intelligence |
| CA | cognitive assistant |
| D-UNS | Deliberate Universal Needs Statement |
| DOD | Department of Defense |
| FSCU | Fire Support Coordination Unit |
| HMT | human-machine teaming |
| HQMC | Headquarters Marine Corps |
| ML | machine learning |
| PP&O | Plan, Policy, & Operations |
| SA | situational awareness |
| USMC | United States Marine Corps |