Toward The Development of a Predictive Computer Model of Decision Making Under Uncertainty for Use in Simulations of U.S. Army Command and Control Systems

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ABSTRACT:

In today's increasingly complex world of digital command and control it is seldom obvious or intuitive how the introduction of new automation systems will affect the overall performance of battlefield command and control systems. Field observations can account for performance factors that are directly observable such as rates of communication flows, rates of flow and quality of incoming intelligence information and factors leading to battlefield situational awareness. However, what the human mind does with all these factors is highly speculative and not directly observable.

This research addresses this limitation through the development of a predictive quantitative model of human decision making under conditions of uncertainty such as exist in many aspects of human performance and certainly in battle-space management. Utilizing Bayesian statistical approaches implemented through Partially Observable Markov Decision Processes (POMDP) that describes experiential decision processes moderated by Monte Carlo effects to account for interpersonal differences, a series of computer models is being developed that can predict the quality of decisions possible from a given set of input conditions.

Although these models are being developed through a series of empirical studies that investigate human performance in a sequential decision making with uncertainty task using human subjects, the results of these studies are being applied at each stage of the research to predictive computer simulations of Army battlefield performance as controlled by battlefield automated command and control systems. These simulations, when operational, will allow cognitive effects, such as predictive levels of effective decisions possible from a given set of circumstances, to be assessed as a battlefield metric. The usefulness of these simulations will be realized in their ability to predict potential effective decisions possible from changes to the overall command and control system through the projected introduction of such things as new system components, organizational changes, and training levels of team members.

KEYWORDS: partially observable Markov decision processes, decision making under uncertainty, command and control systems, computer simulation.

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