Current Research Projects

Understanding Conflict with a Socio-Cognitive Computational Approach
Funding Source: Defense Threat Reduction Agency.
External Collaborators: Christian Lebiere, Carnegie Mellon University & Ion Juvina, Carnegie Mellon University

Training Dynamic Decision Making in Mine Emergency Situations
Funding Source: National Institute of Occupational Safety and Health.

Hypothesis Generation & Reasoning in Dynamic Cyber SA Decision Making
Funding Source: Army Research Office, Multidisciplinary University Research Initiative.
External Collaborators: Peng Liu, Penn State University, Nancy Cooke, Arizona State University, Sushil Jajodia, George Mason University, Peng Ning, North Carolina State University, Michael Young, North Carolina State University, & V. S. Subrahmanian, University of Maryland

Training Decision Making Skills
Funding Source: *Training Knowledge and Skills for the Networked Battlefield*. Army Research Office, Multidisciplinary University Research Initiative.
External Collaborators: Alice Healy, University of Colorado at Boulder, Lyle Bourne, University of Colorado at Boulder, & Robert Proctor, Purdue University.

Cognitive Process Modeling and Measurement in Dynamic Decision Making
Funding Source: U.S. Army Research Laboratory.
External Collaborators: Mica Endsley, SA Technologies

Hypothesis Generation & Feedback in Dynamic Decision Making
Funding Source: National Science Foundation, Human and Social Dynamics Priority Area.
External Collaborators: Rickey Thomas, University of Oklahoma, Robert Hamm, University of Oklahoma Health Sciences Center, John Sterman, Massachusetts Institute of Technology, & Matt Cronin, George Mason University

Neural Basis of Dynamic Decision Making

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Dynamic Decision Making Laboratory

The Dynamic Decision Making Laboratory (DDMLab) was founded in 2002 by Dr. Cleotilde Gonzalez to investigate decision making in complex dynamic environments. Such environments are characterized by the need for people to make multiple, interdependent, real-time decisions in reaction to both external changes, as well as the effects of their past decisions.

We ask the general question of how decision makers adapt and learn in dynamic situations. This question naturally leads to a focus on the match between decision processes and the dynamic situations in which those decisions are made. DDM theory and methods, therefore, are particularly suited to programs concerned with the integration of humans and complex systems.

Practical applications of our research extend from front-end system design activities to back-end training and decision-support. On the front-end, we can provide principled guidance and empirical support for the design of systems that exploit DDM strengths. On the back-end, we can help decision makers exploit system strengths. In this respect, DDM theory and methods are particularly suited for the design of training interventions. But the closely related activity of decision support design is no stretch for the skill set our multidisciplinary team provides.

The laboratory consists of post-doctoral fellows, research-programmers, doctoral students and research assistants. Lab members come from different fields, including Behavioral Decision Research, Psychology, and Computer Science.

The DDMLab is part of the Social and Decision Sciences Department at Carnegie Mellon University.

http://www.cmu.edu/ddmlab

Theory and Research

Our research aims at understanding learning in DDM. We seek to build models and develop methods that will help explain and predict decision making in dynamic situations. We address questions such as: How does experience influence our decisions? What kinds of and how much experience would produce better performance and better adaptation?

We use multiple research methods including laboratory experiments and cognitive modeling. For example, we collect behavioral data using complex, dynamic simulations (called DMGames) and involving extended practice to understand how experience develops, changes, and transfers. Also, we create ACT-R cognitive computational models that reproduce human behavior.

Research Tools

Our main research tools are simulations of DMGames. We are not limited by a particular task domain. DMGames we use are: dynamic resource allocation, medical diagnosis, supply chain management, and generic dynamic control accumulations. DMGames represent a compromise between the experimental control of the laboratory and the realism from real-life decision making.

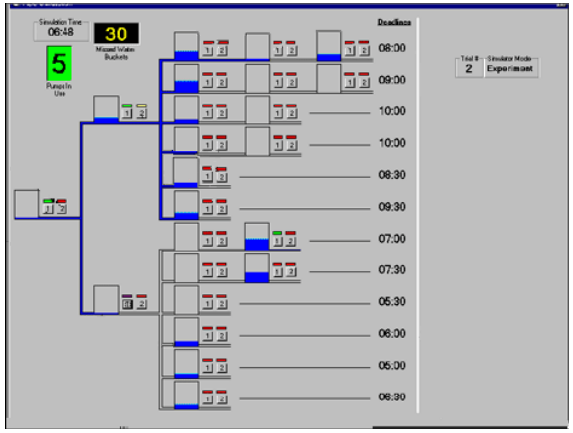
Dynamic Stocks & Flows (DSF)

DSF is a generic representation of the basic building blocks of every dynamic system: a single stock that represents accumulation; inflows, which increase the level of stock, and outflows, which decrease the level of stock. A user must maintain the stock at a particular level or at least within an acceptable range by counteracting the effects of the environmental flows.

Examples of Simulations and Decision Making Tasks

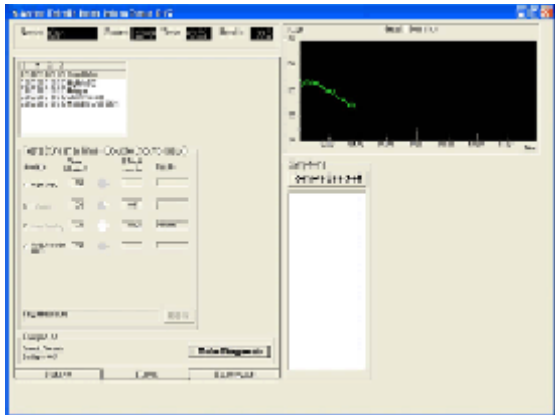
Water Purification Plant (WPP)

WPP has been used extensively to study automaticity development, situation awareness, learning, and adaptation. In addition, we developed an ACT-R cognitive model that reproduces human learning in this task.



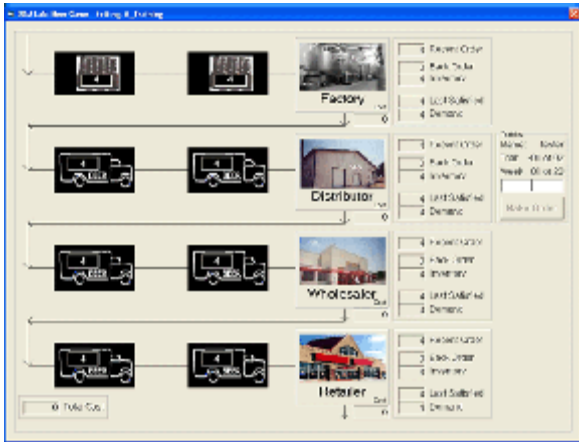
MEDIC

MEDIC allows one to study several crucial facets of complex medical decision making while also being well controlled for experimental purposes. Using MEDIC, there is a correct diagnosis for the patient, which provides both outcome and process measures of good performance. MEDIC also allows us to calculate cue diagnosticity and probability functions over the set of hypotheses that participants are explicitly considering, based on assumptions of local (bounded) rationality.



Beer Game

Beer game is used extensively to study the way decision makers perform when confronted by dynamic complexity. We use the beer game to study learning and adaptation in DDM. In addition, we have developed an ACT-R cognitive model that reproduces initial data collected on human learning.



FIRECHIEF

This simulation was developed by Omodei and Wearing (1995). The simulation can be used to study a range of time-pressured, high stakes, dynamic decision-making settings: military operations, transport control, plant operations and of course, fire fighting.