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Symposium: Dynamic Decisions, Conflict Resolution, and Real-Time Diagnosis in Complex Domains

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Studies of cognition beyond laboratory walls have flourished in recent years. These developments have been enabled by both methodological and theoretical advances that have facilitated investigations of "cognition in the wild". These endeavors promise to profoundly impact the discipline of cognitive science. This symposium presents research pertaining to the development of decision-making expertise in complex and diverse environments.

An emerging area of research concerns investigations of cognition in dynamic "real-world" work environments. Dynamic environments are characterized by high levels of urgency, uncertainty, and shifting, ill-defined, and competing goals. Decisions are often part of an ongoing process, embedded in the flow of work, and jointly determined by teams of individuals with complementary spheres of expertise. Emergency and intensive care medicine are two exemplar disciplines characterized by high velocity decision making. Vimla Patel and David Kaufman present work related to understanding dynamic decision making in high velocity medical environments, namely intensive care and medical emergency units. This presentation focuses on a series of studies conducted by Patel and colleagues in these dynamic medical environments. The presentation examines the differential and selective use of evidence and conflict resolution in negotiating decisions in situations of varying urgency. Guy Boy discusses sources and models of conflict resolution between agents, including humans and machines, in airplane cockpits. This presentation focuses on major causes of conflict in an aircraft cockpit, such as lack of knowledge, lack of training, forgetting, role confusion, workload, human errors, inability to delegate, imprecise or incomplete perception, quid pro quo, lack of power sharing,

or misunderstanding. An example of accident analysis is presented to highlight how a conflict between a human and a machine is generated and evolves toward an unrecoverable situation. Boy provides some recommendations in the form of usability criteria for human-centered design of artificial agents. Kim Vicente and colleagues similarly address conflict resolution by nuclear power plant (NPP) operators. They present findings into how operators deal with these conflict situations, drawing on a number of field studies. Conflicts arise in some cases because their expectations are inconsistent with one or more indications provided by the control room displays and other times because the control room indications themselves contradict each other. Our final speaker, Alan Lesgold, presents studies related to the development of expertise in the diagnosis and repair of complex equipment in microchip manufacturing. Many areas of technical expertise involve complex mixtures of partial conceptual knowledge and rules of thumb that are often not well anchored in basic scientific principles. Existing theories have not adequately addressed this. This research draws on recent work on building coached apprenticeship environments. Their experience has been that carefully designed intermediate representations that are grounded in science but not necessarily fully explained or understood, can be very useful in promoting technical expertise, even when the technicians do not have much science background.

There is a gap between decision making research and education in the professions. In addition, technical skill domains have not adequately addressed the role that conceptual knowledge plays in supporting acquisition of expertise. The presentations in this symposium address some of these common concerns in diverse everyday work environments, using different methodological and theoretical approaches.