CREW DECISION MAKING UNDER STRESSSS. J. Orasanu. NASA Ames Research Center, Moffett Field, CA 94035

INTRODUCTION. Flight crews must make decisions and take action when systems fail or emergencies arise during flight. These situations may involve high levels of risk, information uncertainty, and time pressure, factors that contribute to stress. Full-mission flight simulation studies have shown that crews differ in how effectively they cope in these circumstances, judged by operational errors and crew coordination. The present study analyzed the problem solving and decision making strategies used by crews led by astronautical environments. The study included 120 abnormal events that, required decisions during high workload periods. Transcripts of videotapes were analyzed to describe decision making strategies. Crew performance (errors and coordination) was judged on-line and from videotapes by check airmen.

RESULTS. Based on a median split of crew performance errors, analyses to date identify a difference in general strategy between lower-performing crews who make more or less errors. Higher-performing crews showed greater situational awareness—they responded quickly to cues and interpreted them appropriately. They requested more decision-related information and took into account flight plans. Lower-performing crews showed higher situational awareness, planning, constraint sensitivity, and coordination. The major difference between higher and lower performing crews was that poorer crews made quick decisions and then collected information to confirm their decision.

CONCLUSION. Differences in overall crew performance were associated with differences in situational awareness, information management, and decision strategy. Captain personality profiles were associated with these differences, a finding with implications for crew selection and training.

COGNITION AND PROCEDURE REPRESENTATIONAL REQUIREMENTS FOR PREDICTIVE HUMAN PERFORMANCE MODELS. K. K. Carter
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Models and modeling environments for human performance are becoming significant contributors to early system design and analysis procedures. Issues of levels of automation, physical environments, information displays, and reasoning requirements are being addressed by such models. The research reported here investigates the close interaction between models of human cognition and models that describe procedural performance. We describe a methodology for the incorporation of awareness procedures that supports interaction with models of cognition on the basis of procedures observed; that serves to identify cockpit/avionics information requirements and crew information requirements, and that provides the structure to support methods for function allocation among crew and aiding systems. Our approach is to develop an object-oriented, modular, executable software representation of the aware, the aircraft, and the procedures that take into account flight plans. We then encode, in a frame-based language, taxonomies of the conceptual, relational, and procedural constraints among the cockpit avionics and control systems and the aircraft. We have designed implemented a goldilocks procedure hierarchic representation sufficient to describe procedural flow in the cockpit. We then execute the procedural representation in simulation software and calculate the values of the flight instrument, aircraft state variables and crew resources using the constraints available from the relationship taxonomies. The system provides a flexible, extensible, and executable representation of awareness that is generally applicable to cockpit environment task-analysis. The representation supports developed methods of intent inference, and is extensible to include issues of information requirements and functional allocation. We are currently using the approach to link the procedural representation to models that incorporate several issues inference methods including procedural backtracking with concurrent search, temporal reasoning, and course checking for partial ordering of procedures. Visually the representation is provided by modeling of human decision making processes that include heuristic, propositional and prescriptive judgement processes that are sensitive to the procedural content in which the value functions are being performed.

USING AND DESIGNING PROCEDURES; LESSONS LEARNED FROM AVIATION. A. Decker. San Jose State University Foundation, San Jose, CA 95106.

-536- 11035

The modern, highly automated transport cockpit has brought a new era of highly efficient flight. But it has also introduced new problems of situational awareness, remoteness from the basic airplane, and concerns about possible loss of manual flying proficiency. This paper will discuss the "good news/bad news" of cockpit automation.

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The use of cockpit instruments to guide flight control is not always an option (e.g., low-level/low-speed flight). Under such circumstances the pilot must use out-the-window information for control and navigation. Thus it is important to determine the basis of visually guided flight for several reasons: 1) to guide the design and construction of the visual displays used in training simulators; 2) to allow modeling of visibility restrictions brought about by weather, cockpit constraints, or distortions introduced by sensor systems; and 3) to aid in the development of displays and visual cues that augment the cockpit window scene and are compatible with the pilot's visual extraction of information from the visual scene. The authors are actively pursuing these questions. We have ongoing studies using both low-cost, lower fidelity flight simulators, and state-of-the-art helicopter simulation research facilities. Research results will be presented on: 1) the important visual scene information used in altitude and speed control; 2) the utility of monocular, stereo, and hyperstereo cues for the control of flight; 3) perceptual effects that arise to the differences between normal unaided daylight vision, and that made available by various night vision devices (e.g., light-intensifying goggles and infra-red sensor displays); and 4) the utility of advanced contact displays in which instrument information is made part of the visual scene, as on a "scene-linked" head-up display (e.g., displaying altimeter information on a virtual billboard located on the ground).


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This panel will consist of five presentations on human factor (operator) issues in military aircraft accidents, focusing on immediate and future concerns. The U.S. Army will discuss the underlying causes of aircraft accidents during Desert Shield/Storm compared to the non-combat environment. The U.S. Navy will review the trends and causes of naval aviation accidents and the effect on current training. The U.S. Air Force will present the problems of military aircraft accidents and potential solutions. The Canadian Forces will discuss their proposed system to collect and analyze human error data from aircraft accidents. The Royal Air Force will describe recent studies concerning emergency egress equipment.