CREW DECISION MAKING UNDER STRESSS, J. Organg, NASA Ames Research Center, Moffett Field, CA 94035

INTRODUCTION: Flight crews must make decisions and take action when systems fail or emergency events 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 in response to abnormal events that occurred 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 airman.

RESULTS: Based on a median split of crew performance errors, analyses to date indicate a difference in general strategy between crews who made more or less errors. Higher performing crews showed greater situational awareness—they responded quickly to cues and interpreted them appropriately. They requested more decision-relevant information and took into account more constraints. Lower performing crews showed poorer 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. Captains 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. C. Carter
NASA Ames Research Center, Moffett Field, CA, USA

Models and modeling environments for human performance are becoming significant contributors to early system design and analysis procedures. Levels of system performance, physical environment, informational environment, and training requirements are being addressed by both man/machine analysis systems. 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 deconstruction of crew procedures that supports interaction with models of cognition on the basis of procedures observed; that serves to identify cockpit design/evaluation inform requirements and crew information requirements, and that provides the structure to support methods for function allocation among crew and aiding systems.

One approach is to develop an object-oriented, modular, executable software representation of the cockpit, the aircraft, and the procedural tasks into which flight-phase goals. We then encode the crew procedures into a frame-based language, the application of the conceptual, relational, and procedural constraints among the cockpit avionics and control systems and the aircraft. We have designed an interface that provides a general software representation that is adequate to describe the flow in the cockpit. We then execute the procedural representation in simulation software and calculate the values of the flight variables, aircraft state variables, and crew resources using the constraints available from the relationship taxonomy. The system provides a flexible, extensible, manipulable, and executable representation of aircraft and procedures that is generally applicable to complex system simulation. This approach facilitates a parallel processing simulation environment and a framework for cockpit decision support.

The representation supports distributed methods of spatial allocation, and is extensible to include issues of information requirements and functional allocation. We are also working to link the procedural representation to models of task sequence, task function, and task performance, several issues. Among these issues are the development of deterministic decision strategies that are consistent with the procedural context in which the values are being performed.


The use of cockpit elements to guide flight control is not always an option (e.g., low-level rotorcraft flight). Under such circumstances the pilot must use out-the-window information for control and navigation. 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 that are consistent with 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 issues.

Research results presented on: 1) the important visual scene information used in aircraft and cockpit control; 2) the utility of monocular, stereo, and hyperstereo cues for the control of flight; 3) perceptual effects due 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 altitude information on a virtual billboard located on the ground).

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


This panel will consist of five presentations on human factors 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. Army will review the trends and causes of Naval aviation accidents and the effect on recent training. The U.S. Air Force will present the problems of the mid-atlantic region and suggest 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.