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Anderson, J. R. (2002). *Instruction in Dynamic Tasks Based on a High-Fidelity Cognitive Architecture (Report No. TR-02-0300)*. Pittsburgh, PA: Carnegie Mellon University, Department of Psychology. (DTIC No. ADA406694)

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Abstract: Initial research was performed on the Brute synthetic task for manned flight (based on the Predator system). This research indicated that spatial orientation was a major difficulty that people had in performing this task. Many participants made many errors in their directional judgments. A series of experiments were performed systematically investigating the difficulties people had in integrating a map view of a terrain with a camera view available from a plane. Two strategies were identified for bringing the map view and the camera view into alignment. One strategy involved mentally rotating the camera view until it was in alignment with the map view. The second strategy involved calculating the offset of various targets in the camera view and adding that offset to the direction of orientation in the map. Cognitive models in ACT-R were developed that implemented both of these strategies and fit to eye movements of participants. Part of this effort involved developing an imagery module for ACT-R that can be used more generally to model navigation. The final report describes in more detail the nature of the experimentation, the results, and the ACT-R model.

Cooper, B. L.; Arabian, J. M. (2002). *Department of Defense Physical Strength and Job Performance Survey: Report on the Ability of First-Term Enlisted Personnel to Perform Physically Demanding Work (Report No NPRST-TN-03-4)*. San Diego, CA: Navy Personnel Research And Development Center. (DTIC No. ADA407563)

<http://handle.dtic.mil/100.2/ADA407563>

Abstract: In response to a report by the Government Accounting Office (GAO), the Department of Defense (DOD) conducted a mail survey of personnel in the Army, Navy, Air Force, and Marine Corps to determine the beliefs of first-term-of-enlistment personnel and their supervisors regarding the ability to perform physically demanding tasks. Within each service, 10 occupational specialties with moderate to high strength requirements were identified as the target populations for the DOD Physical Strength mid Job Performance Survey, consisting of about 30 items. There were two parallel survey formats, one for first-term incumbents and one for supervisors, with supervisor responses intended to confirm (or contradict) those of incumbents. Incumbents reported their own experiences regarding over-exertion injuries, physical strength, endurance, and physical

fitness. Supervisors were asked analogous questions about the first-term personnel they supervised.

Howse, C. E. (2002). *Human Disorientation as a Factor in Spacecraft Centrifuge Design*. Monterey, CA: Naval Postgraduate School. (DTIC No. ADA407032)

<http://handle.dtic.mil/100.2/ADA407032>

Abstract: Weightlessness is the major contributing factor behind the degradation of bone mass, muscle tone, and aerobic capacity during long-term space missions. With the loss of bone mass progressing at up to two percent per month, long duration and interplanetary missions shall remain the sole duty of robotic explorers until sufficient countermeasures are developed. Several countermeasures are either in use, or under development to alleviate this problem. Exercise is currently used to reduce the severity of bone loss and muscle atrophy. Exercise has proven ineffective despite the fact two hours of daily exercise together with elaborate apparatus have been devoted to simulating the load of Earth's gravity. Drug therapy and other, more exotic, countermeasures are also under consideration, but the side-effects of these other treatments and the fact that they do not directly address the root cause of the negative effects of weightlessness means that they may only reduce, not cure, those problems. Only artificial gravity addresses the root cause, weightlessness itself. This thesis addresses the need to balance the effects of Coriolis on human disorientation with the engineering costs of constructing a centrifuge for human occupation in space.

Martin, E. A. (2002). *Cognitive Probe Project: Development of a Testbed for Collecting Cognitive Model Parameterization and Validation Data*, (Report No. TR-2002-0156). Dayton, OH: Science Applications International Corporation. (DTIC No. ADA406707)

<http://handle.dtic.mil/100.2/ADA406707>

Abstract: The Air Force Research Laboratory's Human Performance Model Integration (HPMI) program is exploring the merit and feasibility of combining multiple human performance models possessing dissimilar architectures to create integrated representations of human behavior that address application-specific requirements for model fidelity while controlling cost. The first exploration of HPMI feasibility involves the integration of a task-network model of a strike fighter pilot with an Adaptive Control of Thought-Rational (ACT-R) cognitive model. The ACT-R cognitive model is to replace the strike fighter pilot model's implementation of shootlist management, which is a dynamic and cognitively-intensive target-prioritization task. The Cognitive Probe project described in this report developed a concept and a virtual simulation testbed for obtaining the

context-specific parameterization data needed to populate the ACT-R shootlist management model. One observation based on the data collection was that the earlier validation of the initial implementation of the strike fighter pilot model, which compared mission outcomes and task performance of the model against that of humans, was not sufficiently sensitive to cognitive aspects to pick up differences in shootlist management search strategies. Cognitive testbeds such as this may be beneficial for defining or verifying effective tactics and interface configuration before developing human performance models.

Murphy-Sweet, P. A. (2002). *Analysis of General Accounting Office, Armed Services Board of Contract Appeals and Federal Court of Claims Decisions on Protests Disputes Involving Performance Specifications*. Monterey, CA: Naval Postgraduate School. (DTIC No. ADA407087)

<http://handle.dtic.mil/100.2/ADA407087>

Abstract: This thesis analyzes rulings and court cases from the General Accounting Office, Armed Services Board of Contract Appeals and Federal Court of Claims with respect to contract protests and disputes involving Performance Specifications. Performance Specifications generally leave the contractor open to decide the best means to accomplish the work of a contract and deliver the product called for in the contract. As compared with Design Specifications, which tell the contractor exactly the processes and materials that must be used to accomplish the task, Performance Specifications only specify the final product to be delivered and the parameters it will fulfill or operate within, and thus leave the contractor open to decide the best processes and procedures to accomplish the task. The use of Performance Specifications in the Defense acquisition process has been mandated from the Secretary of Defense since 1994. The intent in using Performance Specifications was to provide incentive to the contractor to become innovative and resourceful in performing the contract and result in cost avoidances and savings to the Federal Government. This thesis examines protests and disputes from the above sources to evaluate the use of Performance Specifications to date and compiles any patterns of success or failure that can then be passed on to today's acquisition workforce.

Nguyen, J. L. (2002). *The Effects of Reversing Sleep-Wake Cycles on Sleep and Fatigue on the Crew of USS John C. Stennis*. Monterey, CA: Naval Postgraduate School. (DTIC No. ADA407035)

<http://handle.dtic.mil/100.2/ADA407035>

Abstract: This study explores the effects of reversing the work-sleep schedules of the crew aboard the USS JOHN C STENNIS. It also reviews current research in the field

of sleep deprivation and the resultant performance decrements in humans. The results of the study indicate that a significant number of sailors have difficulty adjusting to working nights and sleeping days. Additionally, the study finds that individuals working topside have greater difficulty adjusting to the reversed schedule than do their counterparts who work belowdecks. Using a validated model of human performance and fatigue, we demonstrate that the level of fatigue and sleep deprivation observed in this study population significantly reduces individual effectiveness. The recommendations address the need for educating military personnel on the subject of fatigue and sleep logistics, possible fatigue countermeasures, and the need for further research on this topic.

Olson, W. A. (2001). *Identifying and Mitigating the Risks of Cockpit Automation*. Maxwell AFB, AL: Air Command and Staff College. (DTIC No. ADA406899)

<http://handle.dtic.mil/100.2/ADA406899>

Abstract: Cockpit automation has delivered many promised benefits, such as improved system safety and efficiency; however, at the same time it has imposed system costs that are often manifest in the forms of mode confusion, errors of omission, and automation surprises. An understanding of the nature of these costs as well as associated influencing factors is necessary to design adequately the future automated systems that will be required for Air Mobility Command aircraft to operate in the future air traffic environment. This paper reviews and synthesizes human factors research on the costs of cockpit automation. These results are interpreted by modeling the automated cockpit as a supervisory control system in which the pilot works with, but is not replaced by, automated systems. From this viewpoint, pilot roles in the automated cockpit provide new opportunities for error in instructing, monitoring, and intervening in automated systems behavior. These opportunities for error are exacerbated by the limited machine coordination capabilities, limits on human coordination capabilities, and properties of machine systems that place new attention and knowledge demands on the human operator. In order to mitigate the risks posed by these known opportunities for error and associated influencing factors, a system of defenses in depth is required involving integrated innovations in design, procedures, and training. The issues raised in this paper are not specific to transport aircraft or the broader aviation domain but apply to all current and future highly automated military systems.

Young, R. M., Cox, A. L. (2002). *Comparing Human Concept Acquisition to Models in a Cognitive Architecture*. United Kingdom: University of Hertfordshire, Department of Psychology. (DTIC No. ADA406924)

<http://handle.dtic.mil/100.2/ADA406924>

Abstract: A study funded by UK DERA at the University of Nottingham in the mid-1990s examined performance on a concept formation task, where subjects had to classify schematic aeroplanes as being either USA' or Australian'. Subjects displayed poor performance, but more intriguingly exhibited a wide range of variability. A simple model of the same task, constructed in ACT-R, also displayed great variability from run to run. The present project aimed to investigate the reasons for the variability in the model, and if possible also in human subjects; and also to understand better the nature of concept representation in this class of model. This report, (a) explains the model, (b) contents critically on aspects of the original studies, (c) analyses components of the variability, (d) offers an account for the variability in terms of random walk processes within the ACT-R learning mechanism, and (e) outlines a graphical depiction of the representation and gradual acquisition of the concept within the model.

Zieleck, K. (2002). *USMC KC-130J Crew Composition (Report No. AU/ACSC/130/2001-04)*. Maxwell AFB, AL: Air Command and Staff College. (DTIC No. ADA407158)

<http://handle.dtic.mil/100.2/ADA407158>

Abstract: With the advent of the "glass cockpit" in the KC-130J, the Marine Corps faces tough decisions about reducing the crew complement. Designed for three crewmembers, the KC-130J potentially reduces the crew complement in half. This paper looks at the negative impacts that drastic crew reductions would have on the safety and efficiency of the KC-130 community. The analysis begins with a look at the extraordinary safety record of the KC-130 community and the training regimen. Next, the analysis looks at the capabilities, limitations, and the Cockpit Resource Management issues of glass technology. Finally, an analysis of a closely related aircraft, the C-17, is conducted to assess KC-130J training resource deficiencies. The analysis shows lack of training resources significantly degrades the safe operations of the KC-130J. The arrival of this new aircraft will not bring any substantial increase in training sortie opportunities. With a drastic reduction in crew complement, the KC-130 community will be severely strained to keep aircrews proficient. With relatively young aircrew and minimal training opportunities, the risk to safety of flight increases substantially without the contributions of the crew positions eliminated from the KC-130J. The Marine Corps would be well served to take a long-term transition strategy of maintaining the relative same crew complement until such time that appropriate training resources are available and the crew can be gradually reduced.