AAR-100

Human Factors Newsletter # 03-08

May 1, 2003 – May 21, 2003

Recent Publications/Project Reports

- **Technical Note:** V. Ahlstrom, R. Muldoon. *Core Commands Across Airway Facilities Systems*. William J. Hughes Technical Center. **Abstract** This study takes a high-level approach at evaluating computer systems without regard to the specific method of interaction. This document analyzes the commands that Airway Facilities (AF) use across different systems and the meanings attributed to the different commands. Human factors researchers collected data on AF systems and equipment, identifying 25 different systems monitored and controlled by AF specialists. Different AF systems had different means of interfacing with the computer (e.g., graphical user interface, menus, and command line interface). The researchers summarized data on the interaction types across AF systems to find that most AF systems used menus as the primary means of interaction. Among the 25 systems monitored and controlled by AF, they uncovered more than 1500 options for accessing, interacting with, and controlling the equipment necessary to National Airspace System operations. The researchers analyzed the options for frequency of occurrence. They defined meanings for each of the 30 most frequently used options. The result of this analysis is a set of core commands that are common across a number of systems.

Excellence in Aviation Award Call for Nominations: The FAA has issued a call for nominations for its 2003 Excellence in Aviation Award. The Excellence in Aviation Award is a highly competitive, non-monetary award that is presented annually to individuals/institutions that clearly demonstrate the benefits of their research to the aviation community. This distinctive award allows the FAA to formally recognize superior significant accomplishments by its external research partners. The nomination period closes May 30, 2003. (T. Kraus, AAR-200) Note: for additional information on the award and/or to obtain a nomination form, please see http://research.faa.gov.

Symposium on Aviation Psychology: As mentioned in the last Newsletter, AAR-100 sponsored human factors research was showcased at the 12th International Symposium on Aviation Psychology held at the Dayton Convention Center in Dayton, Ohio, April 14 - 17. Additional presentations included:

NASA Ames:

- *What Makes Flight Situations Risky? Examining Commercial and General Aviation Pilots' Concepts of Risk.* J. Orasanu, J. Davison, NASA-Ames; U. Fischer, Georgia Institute of Technology. Despite its significance to aviation safety, surprisingly little empirical research has addressed how pilots conceptualize risk and how flight experience might influence their understanding. A sorting study was conducted in which expert (= commercial airline) and novice (= private) pilots were asked to categorize aviation incidents in terms of their risk levels. Analyses of their judgments revealed differences between more and less experienced pilots in their conceptualizations of risk. Private pilots classified incidents in terms of the magnitude of their consequences, analogous to the dread factor observed in studies of the general public's understanding of risk. Commercial pilots used two factors: the timeline of a threat and its controllability. These findings suggest that flight safety in the GA environment may be improved by instructing private pilots in the more complex and action-oriented risk concept of commercial pilots.

William J. Hughes Technical Center:

- *Communication and Coordination between AF Sites: Implications for OCCs*. V. Ingurgio. The Federal Aviation Administration's Airway Facilities (AF) organization developed a new operations concept focused on improving customer satisfaction in managing the National Airspace System (NAS) infrastructure services. The new model consolidated maintenance monitoring and management functions into three central Operations Control Centers (OCCs). Effective communication and coordination is critical to efficient organizational functioning. This report examined communication and coordination patterns, as well as task cohesion (a measure of teamwork effectiveness), between AF OCCs and other AF facilities, specifically between the General National Air Space Maintenance Control Centers (GMCCs) and Service Operations Centers (SOCs). The NAS Human Factors Group collected data from a representative sample of facilities via the Communication and Coordination Questionnaire. Researchers distributed 368 surveys to the three OCCs, a geographic sample of seven GMCCs, and nine SOCs. The response rate of 27% resulted in a +/- 7% sampling error. The responses indicated that telephone communications were still the most widely used mode of communication for a number of events. Phone communications could account for as much as 89% of an AF specialist's time. Task cohesion between facilities was above average. We found a significant, negative correlation between task cohesion scores and distance from a facility to its regional OCC ($r = -0.83$, $p < .05$). Thus, as the distance from the facility to its regional OCC increased, the level of task cohesion between those facilities decreased. The results baseline the transition to the new operations model in terms of the frequency and modes of communications used for coordinating management and maintenance events between these facilities. In addition, the report recommended management focus on facilitating communications with the more distant field offices.
- *A Field Study of Complexity in Air Traffic Control Towers*. A. Koros, P. S. Della Rocco, G. Panjwani,. J.F. D'Arcy, and V. Ingurgio. This study investigated sources of complexity and their incidence within Federal Aviation Administration (FAA)Air Traffic Control Towers (ATCTs). It was the second in a series of studies investigating ATC Specialist (ATCSs) decision-making processes and information requirements. A team of human factors specialists investigated the incidence and nature of 29 sources of ATC complexity. This

survey characterized the differences between facilities in terms of the key sources of complexity and their incidence. The relative contribution of each of the sources was site specific, but some were important across all sites.

- *Relationship Between Age, Flight Strip Usage Preferences, and Strip Marking*. C.A. Manning, F.T. Durso, P. Batsakes, T.R. Truitt, J.M. Crutchfield. To accommodate new technologies, U.S. air traffic controllers must eventually convert from paper flight progress strips to Electronic Flight Data Replacements (EFDRs). It is anticipated that controllers may be reluctant to accept DSTs and EFDRs. It would be useful to identify factors predicting EFDR resistance, because failure to use these tools would reduce projected capacity gains. We analyzed data from 2 studies to determine if age and preferences for strips would predict strip marking and the ability to use a procedure that allowed removing strips early. In the first study, we found that older controllers said they preferred strips more than younger controllers, and controllers who preferred strips made two types of strip markings more often. However, age did not predict strip marking. In the second study, we found that older controllers used an experimental strip reduction procedure effectively. We expected that age would predict strip usage. However, the results suggest that a combination of age and preference for strips may better predict EFDR transition problems.

- *Planning Aviation Human Factors Research in the 21st Century*. E.S. Stein. Good research requires effective planning so that all the resources necessary are available when needed. In aviation, change is constant and not invariably predictable. There are many stakeholders with varied agendas. Economics can be a driving force for change or the status quo. Many factors come into play that influence what research should be done and which projects actually move forward. The challenge in research planning and management is maintaining the resources and expertise, so that there is sufficient flexibility to meet current and projected requirements for human factors research that ranges from the very conceptual to the highly applied.

- *High Fidelity Test of New Air Traffic Control Concepts*. T.R. Truitt, D.M. McAnulty. Researchers examined an Air Traffic Control concept that collocates Terminal Radar Approach Control (TRACON) and Air Route Traffic Control Center (ARTCC) operations while expanding the terminal airspace. The concept may provide benefits for inter-sector coordination, traffic sequencing and spacing, holding, and overall traffic flow. By simulating arrival flows through two en route and two terminal sectors simultaneously, the researchers tested the effects of collocation and an expanded terminal airspace on system efficiency and Certified Professional Controller performance, workload, and communication behavior.

ECG: Human Factors researchers from ACB-220 supported the En Route Communications Gateway (ECG) Operational Capabilities Demonstration. The activity was held at the Integration and Interoperability Facility at the FAA William J. Hughes Technical Center from April 30 – May 8, 2003. Participants from the field completed scripted as well as *ad hoc* scenarios exercising various aspects of the ECG. Researchers collected user comments and worked with the participants to categorize and prioritize the issues. (T. Yuditsky, ACB-220)

Terminal Controller Displays: The NAS Human Factors Group (ACB-220) supported the Air Traffic Terminal Enhancement and Modernization team (ATEAM) using iterative rapid

prototyping techniques and tools. The ATEAM sought to develop a user interface for the Area Navigation (R-NAV) Status Indicator (RSI) on terminal controller displays such as STARS, ACD/ARTS3E, FDAD/ARTS3E, DEDS/ARTS3A, and RADS/ARTS2E. RNAV is a method of navigation that allows aircraft to fly routes based on geographic points rather than ground-based fixes. The RSI is a relatively simple indication of which aircraft are flying RNAV routes. The user interface design process, however, is complicated by the number of displays and systems (some of which are over 20 years old) that must be accommodated. Many coding options that are available on modern display systems, such as colors and icons, are simply impossible on the older display systems. ACB-220 demonstrated 12 different options for displaying the RSI, using the Distributed Environment for Simulation Rapid Engineering and Experimentation (DESIREE). These options included various letters and symbols in the data block with numerous characteristics. The ATEAM members were able to view the options on a realistic ATC display, request modifications, and see the results of the modifications very rapidly. ACB-220 has used this iterative rapid prototyping process numerous times to develop effective user interfaces in the terminal, en route, flight service, traffic management, and airway facilities domains. (K. Allendoerfer, ACB-220).

Aerospace Medical Association Meeting: Human factors researchers from CAMI attended the 74th Annual Scientific Meeting of the Aerospace Medical Association, San Antonio, TX in May 2003. In this Newsletter and the next, we'll provide a summary of the presentations.

- *Intra-team Communication and Consistency of Performance: An Air Traffic Control Simulation Study*. L.L.Bailey, B. Willems, and C. Hackworth.
  PURPOSE. In between airports, the National Airspace System (NAS) is divided into sectors, each of which is managed by a radar controller. When the task load becomes too high, a radar associate is assigned to assist the radar controller. Studies suggest that the benefit derived by adding an additional controller is not as great as one might expect. To better understand this phenomena, we conducted a study that examined how air traffic control (ATC) teams differed based on their levels of workload, situation awareness, and intra-team communication. **METHOD**. Using a high-fidelity ATC simulator, ten 2-person certified ATC teams (one radar controller and one assistant), performed routine ATC tasks within a single factor, lower (88 aircraft) and higher (107 aircraft) task load repeated measure design. Controller interactions were videotaped and the frequency of intra-team task-related communications was counted. The radar controller's subjective workload (WL) and situation awareness (SA) were assessed every three minutes. **RESULTS.** Two chi-square distance matrices (lower and higher task load) of SA, WL, and intra-team communications were computed and submitted to multidimensional scaling. In both lower and higher task load conditions, the best solution was a two-dimensional plane. SA and WL accounted for one axis and intra-team communications accounted for the other. In both task load conditions, the radar controller in teams with a higher frequency of communication were more similar and moderate in their SA/WL, as compared to teams with a lower frequency of communication. **CONCLUSION.** Assistance provided through intra-team communication appears to come with a cost. Although help is provided, communication also competes for a radar controller's attention (i.e., increases mental workload) and focuses his/her attention on a specific situation (i.e., narrows situation awareness). This may be one reason why additional staffing of the radar position does not always produce the expected benefits.

- *The Bathyphase Value of the Temperature is Related to Improved Performance on the Midnight Shift*. A. Boquet., C.E. Cruz, and T. Nesthus.
  Introduction. A significant percentage of shift-working populations such as air traffic control specialists (ATCs) must deal with the issue of maintaining performance across rapidly rotating shift schedules. Significant and steady declines across the night shift in certain cognitive tasks have been demonstrated repeatedly in the laboratory. One physiological measure that has shown a relationship between performance and circadian rhythms is core body temperature. This investigation reports data indicating that the bathyphase value (the value of the lowest temperature) and the variability of the temperature curve may serve as markers for the hardiness of the individual to performance decrements on the midnight shift. **Method.** Participants (n=28) worked a week of day shifts (0800-1600) followed by two weeks of either a clockwise (n=14) or counter-clockwise (n=14) shift work schedule. Performance data were collected using the Multiple Task Performance Battery (MTPB), a synthetic work environment that assesses abilities similar to those required in air traffic control. Core body temperature was obtained using a flexible rectal temperature sensor for the duration of the study. Participants were grouped into low (LBV) or high bathyphase value (HBV) groups via a median split following adjustment of the temperature curve with cosinor analysis. **Results.** The results indicated that the LBV group performed significantly better on the midnight shift than the HBV group on both the active and passive MTPB composite scores. Furthermore, the LBV group had a significantly greater range in temperature compared with the HBV group. **Discussion.** Although the results are limited by the use of intact groups, the effects noted for performance were stable across all tasks. The observation of a greater range in the temperature rhythm for the LBV group coupled with significantly better performance supports the hypothesis that greater variability in the temperature rhythm may be associated with enhanced hardiness on the midnight shift.

- *The Effect of Short Duration Countermeasures on the Night Shift. C.E.* Cruz, A. Boquet, T. Nesthus, K. Holcomb, and S. Shappell. **Introduction**. A number of studies regarding shift work in air traffic control have identified the need for countermeasures to sleepiness and fatigue on the night shift. The purpose of this study was to examine the effectiveness of two short-duration countermeasures on performance during the night shift: two 20-minute naps and two 20-minute periods of mild activity (i.e., pedaling a stationary bike at 20% of Vo_2 max). **Methodology**. Two experiments were conducted (experiment 1, n=11; experiment 2, n=12). Both protocols included two training days followed by three rapid rotations from early morning (0600-1400) to midnight shifts (2200-0600 in Experiment 1; 2200-0700 in Experiment 2) with 48 hours off between. Participants were not allowed to sleep between the morning and midnight shift, resulting in approximately 17.5 hours of prior wakefulness at the beginning of the midnight shift. Each treatment (nap, activity, and control) was administered twice during the night shift, and each participant served in all three, randomly ordered treatment conditions. Performance was assessed using the Bakan Vigilance Task. Subjective and physiological measures were also collected. **Results**. Both experiments indicate a potential benefit for napping, but not for mild activity, when performance was measured 40 minutes after the nap to control for sleep inertia. **Discussion.** These data represent a "worst case scenario" where a controller works a rapidly rotating shift schedule with no opportunity

for rest prior to the midnight shift. Nevertheless, two 20-minute naps appear to have been effective at mitigating performance decrements on the night shift.

- *Personality Factors as Predictors of Performance on the Air Traffic – Selection and Training (AT-SAT) Test*. C.A. Detwiler, C. Williams, A. Boquet, C.E. Cruz, and R.E. King. **Introduction.** The FAA recently implemented a new selection procedure, the Air Traffic-Selection and Training (AT-SAT) test battery for hiring Air Traffic Controllers (ATCs). Recent research has shown a relationship between selected personality traits and subsequent performance in certain occupations. As part of an ongoing longitudinal study, CAMI scientists have collected personality and other demographic data along with scores on AT-SAT from students entering ATC training at the FAA Academy in Oklahoma City. The hypotheses of this study were (1) there would be no significant gender differences in AT-SAT scores, and (2) higher scores on the *Self-Efficacy (SE), Instrumental Competence (IC)*, and *Belief in a Just World (JW)* measures, an internal *Locus of Control (LOC)*, and lower *Cynicism* would be significantly related to higher performance on AT-SAT. **Methods.** Data were collected on 128 students (110 males, 18 females). Correlations for all students were computed comparing personality measures to the AT-SAT composite score. A tertile split on AT-SAT was computed to identify low- (n=42) and high-scoring students (n=43). The dependent measures included *SE, JW, LOC, Cynicism*, and *IC*. Analyses included MANOVA and univariate analysis. **Results.** No significant gender differences were found for any of the measures. A MANOVA revealed that the dependent measures were significantly related to high and low AT-SAT scores, $F(5, 79) = 2.6$, $p < .05$, but univariate comparisons were not significant. Correlations of the personality measures with the AT-SAT score showed that *SE* and *JW* were significantly correlated to the composite score. **Discussion.** Hypothesis one was supported. Results show mixed support for the second hypothesis, indicating a complex relationship of AT-SAT performance to the personality traits measured. The positive correlation between *SE* and the composite score supports prior research showing that a positive self-assessment of one's future performance was significantly related to FAA Academy success.

- *Personality Characteristics of Air Traffic Control Specialists as Predictors of Disability.* C.S. Dollar, D. Broach, and D.J. Schroeder. **Introduction.** Federal employees can apply for disability retirement once an agency has exhausted all reasonable attempts to retain the employee in a productive capacity through accommodation or re-assignment. The average age for federal disability retirement is 49, with about 17 years of service (OPM, 2002). The FAA's air traffic control specialist (ATCS) workforce is aging (Schroeder, Broach, & Farmer, 1998), and may soon start experiencing a greater number of disability retirements. Little information is available describing individual and situational characteristics associated with disability retirements from the ATCS workforce. The purpose of this exploratory study was to determine if personality characteristics were related to disability retirement. **Method.** A search of data extracted from the FAA's Consolidated Personnel Management Information System found records for 52 disability retirements from the terminal and en route controller workforce between FY1996 and FY2001. These 52 cases were matched on five factors with 104 controls who did not retire: (a) age at entry, (b) gender, (c) race, (d) air traffic option (e.g., en route or terminal), and (e) scores on the competitive ATCS aptitude test battery. Cattell's 16PF test had been collected for the subjects and controls as part of the pre-hire

medical examination. A discriminant analysis was conducted using standardized 16PF scale scores to predict group membership. **Results.** The canonical discriminant function included three 16PF scales: Sensitivity (I), Suspiciousness (L), and Tension (Q4) (Wilk's $\Lambda = .807$, $\chi^2(3) = 32.8$, $p < .001$). Overall, 69.2 of the cases were correctly classified by the function. **Discussion.** These results suggest that personality factors have limited utility in predicting disability retirement. Controllers that left the agency as disability retirements were more sensitive, suspicious, and insecure than the control group of working controllers. While the literature suggests that psychological factors may play some role in disability retirement, these results suggest that other factors may play larger roles. Consideration should be given to gaining a better understanding of the interaction between characteristics of the individual, aspects of the working conditions, and the overall task demands as they relate to the etiology of medically disabling conditions. Understanding the history and etiology of disability retirements might lead to workplace interventions to reduce the incidence of medically disabling conditions.

- *Decision Errors and General Aviation Accidents: A Fine-Grained Analysis using HFACS.*
  T. Faaborg, D. Wiegmann, and S.A. Shappell.
  Purpose. Over the past several years, the Human Factors Analysis and Classification System (HFACS) has been used to analyze nearly a decade of accidents involving U.S. general aviation (GA) aircraft. These analyses have focused on a more global level to identify trends in the types of unsafe acts that cause these events. However, investigations to identify particular error forms, such as specific types of decision errors that lead to accidents, have yet to be performed. The purpose of this paper is to provide a fine-grained analysis of specific decision-errors associated with fatal GA airplane accidents. **Method.** A review of the Federal Aviation Administration's HFACS database for fatal accidents involving U.S. GA airplanes (14 CFR Part 91) that occurred between January 1990 and December 1998 was conducted. **Results.** This review identified a total of 2,716 accidents, of which more than 89% were associated with aircrew factors. Of these aircrew-related accidents, approximately 26% were associated with at least one decision error. Decision-errors were the first error in the accident sequence (i.e., seminal error) in 16% of all aircrew-related accidents, but more than 60% of those accidents were associated with decision errors. The majority of decision errors were considered erroneous (86%) versus delayed decisions (7.4%) or otherwise unspecified (6.6%). The most frequent seminal decision errors included improper pre-flight and in-flight-planning and inadequate weather evaluation. **Discussion.** The study provides the first ever, comprehensive analysis of the specific form and contribution of decision errors within the context of fatal GA accidents. These findings have direct implications for the development of safety programs that focus on improving aeronautical decision-making within the GA environment.

- *Examining Hypoxia: A Survey of Pilots' Experiences and Perspectives on Altitude Training.*
  C.A. Hackworth, L.M. Peterson, D.G. Jack, C.A. Williams, and B.E. Hodges.
  Introduction: Federal Aviation Regulations and Advisory Circulars provide requirements and guidance for high-altitude physiology training for pilots and crewmembers. Pilots and crewmembers on flights exceeding 25,000 feet/msl are required to complete ground training in high altitude physiology including hypoxia training; however, regulations do not require altitude chamber training. The present research examined the training experiences and

perceptions of pilots about the need for hypoxia training and altitude chamber training. **Method:** Sixty-seven male pilots attending a meeting on aviation safety completed a survey assessing their experiences and perceptions of hypoxia training. All pilots indicated that they flew professionally and had logged hours flying for business during the six months prior to the survey date. **Results:** Sixty-two pilots reported receiving hypoxia training and approximately two-thirds of the sample reported having initial altitude chamber training. Pilots reported that their training was informative (97%) and that they would benefit from more hypoxia training (90%). Pilots endorsed (agreed or strongly agreed) a proposal that all pilots should receive: introductory hypoxia training (92%), recurrent hypoxia training (86%), initial altitude chamber training (85%), and recurrent altitude chamber training (70%). However, when asked specifically if general aviation pilots flying unpressurized aircraft should receive initial altitude chamber training, only 31% perceived this as being necessary. Further, when asked if altitude chamber training should be based on the altitude capability of an aircraft, 59% responded affirmatively. When asked if the current regulations (i.e., not requiring altitude chamber training) addressing high altitude flying (above 25,000 feet/msl) are sufficient, 52% disagreed or strongly disagreed. **Conclusions:** Generally, these professional pilots perceived that all pilot training should include introductory hypoxia training, recurrent hypoxia training, and altitude chamber training. A noted exception was initial altitude chamber training for general aviation pilots flying unpressurized aircraft. Finally, slightly over half (52%) of respondents indicated that the current Federal Aviation Regulations regarding high-altitude training may require revision.

- *The Armstrong Laboratory Aviator Personality Survey (ALPS) and Air Traffic Control Students*. R.E. King, and P.D. Retzlaff.
  Introduction. For a personality test to be useful as part of a screening process, it requires a demonstration that its scores are psychometrically sound and, moreover, that its scores are related to employee performance. The Armstrong Laboratory Aviation Personality Survey (ALAPS) is a 240-item test with a true/false format, composed of 15 scales. ALAPS extends the traditional limits of many psychological tests by including scales gauging crew/team interaction potential in addition to personality and psychopathology. The purpose of the present work was to provide initial psychometric evidence of the quality and potential utility of the ALAPS for selecting air traffic controllers. **Methods.** One hundred twenty-one (102 male, 19 female) air traffic control students voluntarily took the ALAPS. **Results.** The scale scores appear to be well behaved. Score ranges run from 11 points (Anxiety) to 16 points (Alcohol Abuse) with a median of 15 points. Further, means run from 1.0 (Depression) to 13.0 (Team Orientation) with a median of 7.6. As such, few scales have a "ceiling" or "floor" effect. The scales appear to be reliable with Cronbach Alphas (KR-20s) ranging from a low of .64 (Dogmatism) to a high of .86 (Team Oriented). Only two of the 15 scales had reliabilities below .69. Indeed, five of the scales were above .80. Initial validity estimates are likewise promising. The scale Depression correlates with overall Air Traffic Selection and Training (AT-SAT) scores at -.264 ($p,<05$), suggesting that more depressed applicants do less well than others. Additionally, Organization correlates with AT-SAT at .179 ($p<.05$), indicating that individuals with a more structured approach to life perform better on AT-SAT and may have greater potential to do well on the job. **Conclusion.** The value of the ALAPS in air traffic control selection is promising. It remains to be validated against training outcomes and workplace performance.

- *Comparing Task Load Measures Obtained from Different Air Traffic Control Facilities.* C. Manning, and E. Pfleiderer. **Purpose.** Performance and Objective Workload Evaluation Research (POWER) software computes numerical measures from routinely recorded air traffic control (ATC) data that describe aircraft and controller activity in a given airspace. The development of such measures is important to describe how ATC activity varies as a function of changes to ATC systems or procedures. Previous studies found positive relationships between principal components based on the measures and subjective workload estimates, but were based on small samples. This study utilized larger samples, allowing examination of variables that might influence ATC activity such as facility, sector strata, staffing levels, and time of day. **Methods.** System Analysis Recording (SAR) files were collected from the Washington, Kansas City, and Los Angeles en route centers. Data were recorded between 8:30 a.m. and 5:30 p.m. on three days, either in December 1999 or January 2000. The POWER measures were compared across the three facilities, two sector strata (high/low), two staffing levels (1/2 person sector), and three times of day (morning/midday/afternoon). Analyses to reduce the number of variables were also conducted. **Results.** Seventeen hundred and seventy 45-minute observations were analyzed. Multivariate Analysis of Variance indicated that the POWER measures were significantly related to facility, sector stratum, and staffing (and interactions between these variables), but were not significantly related to time of day. Principal components analyses conducted for each facility produced a strong activity factor and secondary factors related to sector strata (e.g., more heading, speed, and altitude changes occurred in arrival sectors). **Conclusions.** The results suggest that POWER data should be analyzed separately for each facility to account for differences in traffic, procedures, and operational constraints. Furthermore, some of the POWER measures are highly correlated and should be condensed to form a more parsimonious set.

- *Comparison of Performance between Screening and Work-Sample Color Vision Tests for Air Traffic Control Specialists*. N.J. Milburn and H.W. Mertens.
  Introduction. The FAA requires that all applicants for air traffic control specialist (ATCS) positions demonstrate their color discrimination ability. This is necessary because several ATCS tasks involve critical, non-redundant, color-coded information. Currently, the Dvorine is the initial color vision screening test used for all ATCS work options. Work sample color vision tests have been developed for secondary testing of terminal and en route ATCS applicants who fail the Dvorine. During development of these tests, results revealed that some individuals who failed the Dvorine may be able to perform ATCS color tasks as well as people with normal color vision. **Method.** This study compared performance between (a) a prototype work-sample color vision test for Automated Flight Service Station (AFSS) ATCSs that work with color weather radar displays, (b) the Dvorine, and (c) the terminal and en route work-sample tests. The participants were 112 people with normal color vision and 60 with varying degrees of red-green types of color vision deficiency. In addition to the Dvorine, participants received the Aviation Lights Test (ALT), the Flight Progress Strips Test (FPST), and the Color Weather Radar Test (CWRT), which are the work sample tests for terminal, en route, and AFSS work options, respectively. The ALT used a Farnsworth Lantern modified to present aviation red, green, and white lights. The FPST consisted of lithographed copies of actual flight strips on which examinees must identify red and black

printing and handwriting. The participants also identified colors on the CWRT that consisted of 50 actual, archived color weather radar images presented on accurately color-calibrated CRTs. **Results.** In general, errors were rare among participants with normal color vision and those with mild color abnormalities. Kappa between the Dvorine and the ALT, k (171) = .90, was the highest of the work-sample tests, followed by the FPST and the CWRT, k (171) = .75, and .69, respectively. **Conclusion.** The range of Kappa scores indicates that different levels of color discrimination ability may be needed to perform the various ATCS color tasks.

R&D Review: The spring issue of FAA's R&D Review and the FAA's Research Laboratories and Research Facilities brochure are currently being distributed. The newsletter is also available on-line http://research.faa.gov/newsletters.asp; the brochure is on-line at http://research.faa.gov/labs.asp.

More information on human factors research can be found at the FAA Human Factors (AAR-100) web site: http://www.hf.faa.gov

Mark D. Rodgers
FAA (AAR-100)

CALENDAR

June 2003 – SAE Digital Human Modeling for Design and Engineering, Location TDB
http://www/sae.org/calendar/aeromtgs.htm

June 2-3, 2003 - The National Center of Excellence for Aviation Operations Research (NEXTOR) Conference on Air Traffic Management and Control, hosted by NEXTOR - Virginia Tech, Virginia Tech Graduate Center, Falls Church, VA

June 4-6, 2003 - Institute of Electrical and Electronics Engineers (IEEE) American Control Conference, Denver, CO *http://acc2003.me.berkeley.edu/*

June 9 – July 4, 2002 – World Radio Communication Conference, Geneva, Switzerland
http://www.itu.int/ITU-R/conferences/wrc/wrc-03/index.asp

June 9-13, 2003 - Institute of Electrical and Electronics Engineers (IEEE) Intelligent Vehicles Symposium (IV 2003), Columbus, OH *http://www.eleceng.ohio-state.edu/~umit/IV2003/*

June 14-17, 2003 - Association for the Advancement of Medical Instrumentation (AAMI) 2003 Annual Conference and Expo, Long Beach, CA
http://www.aami.org/meetings/aami2003/index.html

June 15-22, 2003 – 45th Paris Air Show le bourget http://www.paris-air-show.com/index3.htm

June 16-19, 2003 –SAE Digital Human Modeling for Design and Engineering, Montreal, Canada http://www.sae.org/calendar/dhm/index.htm

June 18-19, 2003 – 6th GAIN World Conference, Alitalia Auditorium, Rome, Italy http://www.gainweb.org/whatsnew.html

June 19-20, 2003 – 31st Annual Meeting of the FAA/NASA Joint University Program, Ohio University, Athens, OH http://www.aec.ohiou.edu.

June 22-27, 2003 – 10th International Conference on Human-Computer Interaction, Institute of Computer Science Foundation, Research and Technology, Science and Technology Park of Crete, Heraklion, Crete, Greece mailto:info@hcii2003.gr

June 23-25, 2003 – Human Systems Integration Symposium "Enhancing Human Performance in Naval and Joint Environments", Sheraton Premier Hotel, Tyson's Corner, VA http://www.navalengineers.org/Events/HSIS2003/HSIS.html

June 23-26, 2003 – Electronic Industries Alliance SSTC & G33/G47 Quarterly Meeting, Charleston, SC *mpetitt@eia.org*

July 7-10, 2003 – SAE 33rd International Conference on Environmental Systems, The Westin Bayshore Resort and Marina, Vancouver, Canada http://www/sae.org/calendar/aeromtgs.htm

July 14-17, 2003 – AIAA/ICAS International Air & Space Symposium and Exposition, Dayton Convention Center, Dayton, OH http://www.flight100.org/

July 20-24, 2003 - 2003 International Symposium on Performance Evaluation of Computer and Telecommunication Systems (SPECTS '03*)*
http://www.scs.org/confernc/coninfo.html#spects2003

July 21 – 23, 2003 - 4th Australian Pacific Vertiflite Conference on Helicopter Technology, Melbourne, Victoria, Australia. Contacts: Dr. Arvind K. Sinha and Mr. Raden Kusumo

July 29-August 4, 2003 – 51st Annual AirVenture, Oshkosh, WI http://airventure.org/

August 7-10, 2003 – 111th Convention of the American Psychological Association, Toronto, Ontario, Canada http://www.apa.org/convention

September 8-12, 2003 – SAE Aerospace Congress and Exhibition, Palais des Congrès, Montreal, Quebec, Canada http://www/sae.org/calendar/aeromtgs.htm

September 15-17, 2003 – FAA/TCA/CAA Safety Management in Aviation Maintenance Symposium, Toronto, Canada

September 16 – 18, 2003 - 29th European Rotorcraft Forum, Friedrichshafen, Germany. Contact B. Gmelin at bernd.gmelin@dir.de

September 16-18, 2003 – MRO Europe, Cardiff International Arena, Cardiff, Wales http://www.awgnet.com/conferences/meumain.htm

September 16-19, 2003 – Investigation and Reporting of Incidents and Accidents (IRIA), Williamsburg, VA *http://shemesh.larc.nasa.gov/iria03/*

September 17-21, 2003 - Institute of Electrical and Electronics Engineers (IEEE) 25th Annual Engineering in Medical and Biology Society International Conference, Cancun, Mexico *http://itzamna.uam.mx/cancun/*

September 18-19, 2003 – National Academy of Engineering 2003 Frontiers of Engineering Symposium, Irvine, CA *Welcome to the National Academy of Engineering (NAE)*

September 22-24, 2003 - 41st Annual SAFE Symposium, Jacksonville, FL *http://www.safeassociation.org/2003symposium1.htm*

September 22 – October 3, 2003 – ICAO 11th Air Navigation Conference, Montreal, Canada *http://www.icao.int/icao/en/anb/meetings/anconf11/index.html*

September 24-25, 2003 –IATA/ICAO/Flight Safety Foundation ICARUS Committee/University of Texas LOSA Meeting, Montreal, Canada mailto:helmreich@mail.utexas.edu

September 24-26, 2003 - Institute of Electrical and Electronics Engineers (IEEE) International Symposium on Technology and Society, Amsterdam, The Netherlands *http://radburn.rutgers.edu/andrews/projects/ssit/istas03.pdf*

October 5-8, 2003 - Institute of Electrical and Electronics Engineers (IEEE) International Conference on Intelligent Control, Houston, TX *http://vlab.ee.nus.edu.sg/~isic2003/*

October 5-8, 2003 - 2003 IEEE International Conference on Systems, Man, and Cybernetics, Washington, DC *http://becat.engr.uconn.edu/IEEE_CSMC_2003/*

October 6 – 9, 2003 - NATO Research and Technology Agency, Applied Vehicle Technology Panel (AVT) will present "The Vehicle Propulsion Integration Symposium" in Poland. For more information contact cheynes@rta.nato.int

October 7 – 9, 2003 - National Business Aviation Association Annual Meeting & Convention, Orlando, Florida. Contact: www.nbaa.org

September 24-26, 2003 - International Symposium on Technology and Society, Amsterdam, The Netherlands *http://radburn.rutgers.edu/andrews/projects/ssit/istas03.pdf*

October 13-17, 2003 – Human Factors and Ergonomics Society 47th Annual Meeting, Adams Mark Denver Hotel, Denver, CO http://www.hfes.org/

October 26-30, 2003 – ATCA 48th Annual International Technical Program and Exhibits, Marriott Wardman Park Hotel, Wash, DC http://www.atca.org/static2_item.asp?item_ID=19

October 27-28, 2003 – National Academies Institute of Medicine Annual Meeting, National Academy of Sciences, Washington, DC http://wwwsearch.nationalacademies.org/

October 27-30, 2003 – SAE DoD Maintenance Symposium and Exposition, Valley Forge Convention Center, King of Prussia, PA http://www.sae.org/calendar/aeromtgs.htm

November, 2003(tentative) – DOD TAG-50, Fall 2003, Phoenix, AZ http://hfetag.dtic.mil/meetschl.html

November 17-20, 2003 – 56th Annual Air Safety Seminar, A Joint Meeting of Flight Safety Foundation, International Federation of Airworthiness, and International Air Transport Association, Bangkok, Thailand http://www.flightsafety.org/seminars.html

December 2-4, 2003: National Training Systems Association Inter-Service/Industry Training, Simulation and Education Conference (I/ITSEC), Orlando, FL *http://www.trainingsystems.org*

December 9-12, 2003 - Institute of Electrical and Electronics Engineers (IEEE) Decision and Control Conference, Maui, HI *http://www2.acae.cuhk.edu.hk/~ycliu/cdc03/*

January 11-15, 2004 – Transportation Research Board Annual Meeting, Washington, DC http://www4.trb.org/trb/annual.nsf

January 21 – 23, 2004 - AHS 4th Decennial Specialists' Meeting on Aeromechanics, Fisherman's Wharf, San Francisco, CA. For more information contact the Technical Chairman, Tom Maier at tmaier@mail.acr.nasa.gov

April, 2004 – SAE General Aviation Technology Conference and Exhibition, Century II Convention Center, Wichita*, KS* http://www/sae.org/calendar/aeromtgs.htm

May 3-6, 2004 – 75th Annual Scientific Meeting of the Aerospace Medical Association, Egan Convention Center, Anchorage, AK http://www.asma.org/

May 6-8, 2004 - AHS International 60th Annual Forum and Technology Display, Virginia Beach, VA. Contact Staff@vtol.org
July 27-August 2, 2004 – 52nd Annual AirVenture, Oshkosh, WI http://airventure.org/

July 28 – August 1, 2004 – 112th Convention of the American Psychological Association. Honolulu, Hawaii http://www.apa.org/convention

September 20-24, 2004 – Human Factors and Ergonomics Society 48th Annual Meeting, Sheraton New Orleans Hotel, New Orleans, LA http://www.hfes.org/

October 18-19, 2004 – National Academies Institute of Medicine Annual Meeting, National Academy of Sciences, Washington, DC *http://wwwsearch.nationalacademies.org/*

May 9-12, 2005 - 76th Annual Scientific Meeting of the Aerospace Medical Association, Kansas City, MO *http://www.asma.org/*

October 24-25, 2005 – National Academies Institute of Medicine Annual Meeting, National Academy of Sciences, Washington*, DC http://wwwsearch.nationalacademies.org/*

Note: Calendar events in Italics are new since the last Newsletter

Comments or questions regarding this newsletter?
Please contact Bill Berger at (334) 271-2928
or via e-mail at bill.ctr.berger @faa.gov