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EXPERIMENTAL DESIGN AND AUTOMATED ANALYSIS OF GROUND LEVEL AND RAPID DECOMPRESSION PPB STUDIES. T. Gee, W.D. Fraser*, L.S. Goodman*, K.N. Ackles*, S. Bainwohl, D. Eastman. Defence and Civil Institute of Environmental Medicine, North York, Ontario, Canada. M3M 3B9.

INTRODUCTION. Effective experimental design, automated data analysis, and statistical modelling can maximize the information collected during comparison of TLSS and CE. METHODS. 6 males and 1 female subject underwent 8 ten minute ground level exposures to PPB (TLSS & CE ensembles, 60, 70, 80, and 88 mm Hg PPB). Data was collected during the PPB exposures, 3 minute pre-control and 5 minute post control periods. 6 subjects were also exposed to 3 minutes of 60,000 ft simulated altitude and 60 mm Hg PPB following rapid decompression (RD) from 22,500 ft. wearing the two systems. Custom software coordinated all data processing, identified significant experimental events such as PPB onset, and performed error and out-of-bounds checking on all data. Multivariate analysis of covariance (MANCOVA) was used to analyze all collected data for the PPB and RD trials. RESULTS. Comparisons of the changes in cardiovascular and performance function with garment type, exposure duration and PPB levels were possible with this experimental design. CONCLUSION. The experimental and statistical designs of both the ground level and altitude experiments allow for subject by subject comparison of the cardiovascular effects of TLSS and CE systems and their effectiveness in protection against rapid decompression

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THE EFFECT OF INCREASED G-SUIT COVERAGE ON THE CARDIOVASCULAR EFFECTS OF POSITIVE PRESSURE BREATHING AT 60,000 FT. W.D. Fraser*, L.S. Goodman*, K.N. Ackles*. Defence and Civil Institute of Environmental Medicine, North York, Ontario, Canada. M3M 3B9.

INTRODUCTION. The ground level PPB study discussed previously showed that 3 minute exposures to 60 mmHg PPB with either TLSS and CE systems would not lead to cardiovascular collapse. This study compared the cardiopulmonary responses of subjects wearing the two systems to 60,000 ft. rapid decompressions. METHODS. HR, SV, CO, and oxygen saturation (SaO_2) of 6 subjects were measured during 3 minutes of exposure to 60,000 ft as described earlier. RESULTS. There were significant effects due to garment type on SV ($P < 0.004$) and CO ($P < 0.04$) with a greater decrement using CE. There was a significant effect of time at altitude on SaO_2 ($P < 0.02$) with a rapid fall SaO_2 over the three minutes but no differences between the garments. CONCLUSIONS. Both TLSS and CE provided sufficient physiological support to maintain oxygen saturations above 65%. during the three minute exposures to 60,000 ft altitude. As in the ground level studies, increased G-suit coverage resulted in improved cardiovascular function. Short term physiological support at higher altitudes with greater PPB levels or longer duration excursions at 60,000 ft may not be possible without the greater g-suit bladder coverage provided by TLSS type garments.

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CARDIOVASCULAR FUNCTION DURING POSITIVE PRESSURE BREATHING AT GROUND LEVEL. L.S. Goodman*, W.D. Fraser*, K.N. Ackles*. Defence and Civil Institute of Environmental Medicine, North York, Ontario, Canada. M3M 3B9.

INTRODUCTION. The use of positive pressure breathing (PPB) is limited in part by the cardiovascular collapse that eventually occurs with sustained PPB. The effects of prolonged exposure to high levels of PPB were compared in subjects wearing the TLSS and CE g-suit/jerkin/mask ensembles. METHODS. Heart rate (HR), stroke volume (SV), and mean arterial pressure (MAP) were collected during 8 PPB exposure periods as described earlier. RESULTS. All 7 subjects completed ten minute exposures at all 4 levels of PPB while wearing the TLSS ensemble. Mean durations for the same subjects wearing the CE ensemble were 9.3 ± 0.7, 8.3 ± 1.0, 6.0 ± 0.9, and 6.3 ± 1.3 minutes at 60, 70, 80, and 88 mm Hg PPB. There was a significant increase in HR ($P < 0.0001$) and a decreased SV ($P < 0.02$) with PPB duration, a fall in SV ($P < 0.002$) and an increase in MAP ($P < 0.01$) with increasing PPB levels. There was significant interaction between duration and garment type for HR ($P < 0.001$), SV ($P < 0.004$), and MAP ($P < 0.001$) and significant interaction between duration, garment type, and PPB level for SV ($P < 0.004$) and MAP ($P < 0.002$) and between PPB level and garment type for SV ($P < 0.0001$). There was a greater fall in stroke volume and corresponding increases in heart rate with the CE system. Subjects were unable to complete 10 minutes of the higher levels of PPB while wearing the CE ensemble. CONCLUSIONS. An increased g-suit coverage provides improved cardiovascular support during PPB at ground level.

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MINIATURIZED NUCLEAR PROBE TO MEASURE CARDIAC PERFORMANCE DURING PPB. L. S. Goodman*, J. Chan, L. Yang, M. Freeman. DCIEM, North York, Ontario M3M 3B9 and St. Michael's Hospital, Toronto Ontario, Canada.

INTRODUCTION. Detailed measurement of cardiac function during PPB is required to determine the relationship between venous return, G-suit coverage, and pressure breathing syncope. This study examined: (a) the feasibility of using a miniaturized nuclear probe (MNP) to study cardiac function during PPB; (b) the differences in cardiovascular protection against PPB afforded by TLSS vs. Combat Edge (CE) PPB ensembles. METHODS. Six experienced subjects were labled with Technesium99m, and and exposed to 70 mmHg PPB from an air source and regulator, wearing both CE and TLSS ensembles for 3 minutes. The MNP (Cardioscint™), positioned over the left ventricle, measured: ejection fraction (EF,%), left ventricular filling rate (LVfr) and relative end-diastolic volume (EDVr) every 10 s. RESULTS. EF increased by 9% from control for TLSS, but decreased by 8.5% from control with CE ($P < .05$). LVfr was decreased (-0.25) with CE, but was increased (+ 0.85 EDVcounts/s; $P < .05$) with TLSS. EDVr was reduced by -25 vs. -57 counts/10 ms for TLSS vs. CE, respectively ($P < .05$). CONCLUSION. MNP's rapidly and reliably measure cardiac function during PPB. An increase in leg bladder coverage results in greated protection against the PPB-induced reduction in cardiac filling .

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PANEL: PSYCHOLOGICAL FACTORS IN ASTRONAUT SELECTION AND TRAINING: AN INTERNATIONAL PERSPECTIVE. P.A. Santy.* UTMB, Galveston, TX 77550.

INTRODUCTION. From 1988-1991 an international working group of psychologists and psychiatrists examined the empirical literature and research findings from isolated and demanding environments for the purpose of developing optimal psychiatric select-out and psychological select-in procedures for astronaut selection. This same committee discussed psychological training methods for astronauts. Select-out procedures were implemented operationally in the U.S. Space Program in the 1989 selection. Also at that time, a study to validate select-in psychological criteria was initiated. In Japan and Europe, astronaut selection will be completed at the end of 1991. Panel members from the U.S., Japan, and Europe will present the results of the psychological selection and training procedures used in each country. The results of work on the validation of astronaut psychological selection criteria will also be presented. CONCLUSIONS. This panel will present the most recent data on the psychological selection and training of astronauts in the U.S., Japanese, and European Space Programs.

N95-16761

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RESULTS OF THE PSYCHIATRIC, "SELECT-OUT" EVALUATION OF U.S. ASTRONAUT APPLICANTS. D. M. Faulk,* P. A. Santy,* A. W. Holland,* and R. Marsh.* UTMB, Galveston, TX and NASA Johnson Space Center, Houston, TX.

INTRODUCTION. The psychiatric exclusion criteria for astronauts are based on NASA Medical Psychiatric Standards for Space Flight. Until recently, there were no standardized methods to evaluate disqualifying psychopathology in astronaut applicants. METHOD. One hundred and six astronaut applicants who had passed initial screening were evaluated for Axis I and Axis II DSM-III-R diagnoses using the NASA structured psychiatric interview. The interview consisted of three parts: (1)An unstructured portion for obtaining biographical and historical information; (2)The Schedule for Affective Disorders-Lifetime version (SADSL), specially modified to include all disqualifying Axis I mental disorders; and (3)The Personality Assessment Schedule (PAS), also modified to evaluate for Axis II disorders. RESULTS. Nine of 106 candidates (8.5%) met diagnostic criteria for six Axis I disorders (including V-code) or Axis II disorders. Two of these disorders were disqualifying for the applicants. "Near" diagnoses (where applicants met at least 50% of the listed criteria) were assessed to demonstrate that clinicians using the interview were able to overcome applicants' reluctance to report symptomatomatology. CONCLUSIONS. The use of the NASA structured interview was effective in identifying past and present psychopathology in a group of highly motivated astronaut applicants. This was the first time a structured psychiatric interview had been used in such a setting for this purpose.

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PSYCHOLOGICAL EVALUATION OF EUROPEAN ASTRONAUT APPLICANTS: RESULTS OF THE 1991 SELECTION CAMPAIGN. C. Fassbender, & K.-M. Goeters. German Aerospace Research Establishment (DLR), Hamburg, Germany.

INTRODUCTION. In summer 1991 the European Space Agency (ESA) performed its second selection campaign since 1977 in order to find 10 astronaut candidates (laboratory specialists and space plane specialists). An integral part of this selection process was the psychological evaluation according to the principals laid down in the study report "Definition of Psychological Testing of Astronaut Candidates". METHODS. After national preselections, 59 applicants participated in the psychological evaluation which consists of the assessment of operational aptitudes (basic cognitive and psychomotor functions) and personality traits (motivation, social capability, stress resistance). The test program included a diverse number of tests, questionnaires, behavioral ratings, biographical data, and semi-structured interviews. About 50 scores were available for each subject. RESULTS. A comparison of the test scores with the original normative data, culture-fairness of the psychological selection, and discriminant functions analyzing the assessment decisions will be presented and discussed. CONCLUSIONS. Since the psychological evaluation was finished just before the deadline of the abstract, quantitative results and conclusions cannot be given in this abstract but will be reported in the conference paper.

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THE PSYCHOLOGICAL RESULTS OF THE JAPANESE ASTRONAUT SELECTION. C. Sekiguchi, M.D*[1]., S. Yumikura, M.D*[1]., M. Kume, Ph.D[2]., and N. Okada, Ph.D[3]. 1) National Space Development Agency of Japan (NASDA), 2) Waseda University, 3) National Univ. of Yokohama. Japan

NASDA has started the recruitment of Japanese Mission Specialist (MS) candidates who will join the NASA MS training course in 1992. Finally, two MS candidates will be selected. Our selection schedule is as follows:

1) Recruitment period	July 1 to August 31, 1991
2) Phase I selection	September, 1991 English exam. General intelligence, Some psychological exams.
3) Phase 2 selection	November 1991 Medical exams at hospital Psychological and general Interviews
4) Phase 3 selection	March or April 1992 Special medical exams (LBNP, Rotary Chairs etc), Interviews, NASA Class II medical exams

Announcement of final Japanese MSs will be on May 1992. As the psychological exams, NASDA will use the anxiety test, mental activity test, psychosocial personality test, aptitude test, and semi-structured psychological interviews based on the psychological criteria which is determined by the international psychological working group. Since the selection process is in progress, the results will be presented and discussed at the panel.

NASA
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N95-16762

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VALIDATION OF ASTRONAUT PSYCHOLOGICAL "SELECT-IN" CRITERIA. R. M. Rose, R.L. Helmreich, T. McFadden, P. A. Santy*, and A. W. Holland*. MacArthur Foundation, Chicago, IL; University of Texas, Austin, TX; UTMB, Galveston; and NASA Johnson Space Center.

INTRODUCTION. A optional astronaut selection strategy would select-in individuals on the basis of personality attributes associated with superior performance. METHOD. A test battery, the Astronaut Personal Characteristics Inventory (ASTROPCI) was developed which assesses positive and negative components of achievement motivation and interpersonal orientation and skills. The battery was administered to one hundred three Astronaut Candidates and sixty-six current U.S. Shuttle Astronauts. To determine performance, a series of conceptual areas related to space-flight performance were defined. Astronauts rated their peers on each of these dimensions. Ratings were obtained on all eighty-four current Astronauts (excluding those selected in 1990). In addition to peer ratings, supervisor assessments of the same dimensions were obtained for each Astronaut. RESULTS. Cluster and factor analytic techniques were employed to isolate subgroups of Astronauts. Those astronauts with both high achievement needs and interpersonal skills were most often rated among the top five by their peers and least often rated among the lowest five. A number of scales discriminated between Astronauts rated high and low on one or more performance dimensions. CONCLUSIONS. The results parallel findings from the personality assessment of individuals in other demanding professions, including aircraft pilots and research scientists, suggesting that personality factors are significant determinants of performance in the space environment.

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HUMAN FACTORS TRAINING OF SCIENCE ASTRONAUTS IN GERMANY: CONCEPT AND METHODS. D. Manzey & A. Schiewe. German Aerospace Research Establishment (DLR), Hamburg, Germany.

INTRODUCTION. Even though the significance of psychological issues of manned space flights is widely acknowledged, up to now very few attempts have been made in America or Europe to integrate some kind of psychological training within the normal training syllabus of astronauts. A human factors training program for science astronauts has been developed by the German Aerospace Research Establishment and approved as an integrated part of the biomedical training of five German astronaut candidates. METHODS The training program consisted of several elements: (1)Psychological training consisting of 4 two day-sessions with the topics "Communication and Cooperation","Stress-Management","Coping with Operational Demands" and "Effective Problem Solving in Groups." Training methods included lectures, group exercises, individual exercises, and group discussions.(2)Problem-oriented team supervision (POTS),integrated within the psychological training sessions and in the weekly "monday meetings" of astronauts. (3)Individual stress-management training during parabolic flights. (4) Training of psychomotor coordination under O-G conditions during parabolic flights. RESULTS AND CONCLUSIONS. The empirical results of the psychomotor training showed considerable improvement in O-G psychomotor performance. The predominant positive feedback of the astronauts who participated in this training program as well as an obviously improved team-efficiency which became evident during two follow-up POTS-meetings with the astronauts points to the success of this training approach.

NASA
-533- 52-53

N95-16763

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PSYCHOLOGICAL TRAINING OF NASA ASTRONAUTS FOR EXTENDED MISSIONS. A. W. Holland,* Behavior and Performance Laboratory, NASA Johnson Space Center, Houston, TX.

INTRODUCTION. The success of operational teams working in remote and hostile environments rests in large part on adequate preparation of those teams prior to emplacement in field settings. Psychological training, directed at the maintenance of crew health and performance, becomes increasingly important as space missions grow in duration and complexity. METHODS. Topics to be discussed include: the conceptual framework of psychological training; needs analysis; content and delivery options; methods of assessing training efficacy; use of testbeds and analogs; and the relationship of training to crew selection and real-time support activities. RESULTS AND CONCLUSIONS. This paper will discuss the psychological training approach being developed at the NASA/JSC Behavior and Performance Laboratory. This approach will be compared and contrasted with those underway in the U.S. Department of Defense and in other space agencies.

NASA
-534- 52-53

N95-16764

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HUMAN PERFORMANCE IN THE MODERN COCKPIT. R. K. Dismukes and M. M. Cohen.* NASA Ames Research Center, Moffett Field, CA 94035

This panel was organized by the Aerospace Human Factors Committee to illustrate behavioral research on the perceptual, cognitive, and group processes that determine crew effectiveness in modern cockpits. Earl Wiener will report on crew reactions to the introduction of highly automated systems in the cockpit. Automation can improve operational capabilities and efficiency and can reduce some types of human error, but may also introduce entirely new opportunities for error. Judith Orasanu will discuss the problem-solving and decision-making strategies used by crews led by captains with various personality profiles. Kevin Corker will present computational approaches to modeling the cognitive demands of cockpit operations and the cognitive capabilities and limitations of crew members. Asaf Degani and Earl Wiener will examine factors contributing to aircrew deviations from standard operating procedures and misuse of checklist, often leading to violations, incidents, or accidents. Walter Johnson, Mary Kaiser, and David Foyle will discuss the mechanisms of visual perception pilots use in aircraft control and the implications of these mechanisms for effective design of visual displays.