50 Years of HUMAN ENGINEERING

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Preparing Man for Space Exploration

1955-1964

Sputnik will become a household word, and a daring young president challenges his nation to put a man on the moon and return him safely in the ensuing decade. The challenges are immense. Lt Col Fitts has left his indelible stamp of excellence on the Psychology Branch and moved on. The Grether years further fanned the flames of scientific excellence. The future of the Human Engineering Division is now turned over to Dr. Julien Christensen, ably assisted by Dr. Melvin Warrick.


Alluisi, E. A., Muller, P. F., Jr., & Fitts, P. M. (1955). Rate of handling information and the rate of information presentation (WADC Technical Note 55-745). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 91 878)


**“I was lucky enough to be on the selection committee for the original seven Project Mercury astronauts. I had done the anthropometry on all of the candidates, as well as stereo photographs. The photos were to be used to provide accurate body shape information, which would then enable us to make customized pressure suits . . . It was an interesting time in the lab for a few weeks, having all the astronaut candidates around taking tests, meeting, and discussing the results. All the candidates were very impressive, but John Glenn was in the 99th percentile on everything. He was amazing.”**  
— Charles Clausner, Anthropologist  
Human Engineering Division
By the 1950s, progress had been made at the lab that expanded work to include space research. Human engineering scientists studied the effects of weightlessness as well as the psychological problems peculiar to the spacecraft. They developed techniques to protect and enhance man's performance on supersonic rocket flights in new, high-altitude environments. Astronauts practiced working with new space tools during weightlessness missions while wearing bulky space suits and 160-pound backpacks which propelled them through space. They also learned how to assemble a space station and how to repair and retrieve satellites while in orbit.

May 1985, "Human Engineering, Yesterday and Today," Civilian Employees Reporter


Barcik, J. D. (1962). *Bibliography on memory* (MRL Memorandum Report P-1). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 273 640)


Barter, J. T., Emanuel, I., & Truett, B. (1957). A statistical evaluation of joint range data (WADC Technical Note 57-311). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 131 028)


“...was in the original Applications Branch, along with Charlie Bates, Dave Grteb, and Austin Kibler. We were involved with the preparation of MIL-H-26-207, which was the first human factors data for guided missile systems. We drafted and finally got acceptance from the Air Force for that first human factors specification. The new spec could then be incorporated in the system development programs, which legitimized a lot of the human factors people who were in the aerospace industry at that time. It forced management to have human factors people in the loop in the design approval process. Human factors personnel had sign-off responsibility on all top-line drawings during the design process. This was a real "first;" it had considerable impact on the field.”

— Donald Topmiller, Chief Systems Research Branch Human Engineering Division
EFFECTS ON PERFORMANCE OF KNOB SIZE AND SPACING

Turning and reach times for knobs of different sizes as functions of distance between knob edges. From a study of minimum allowable knob crowding carried out by James Bradley and Norman E. Stump under Research and Development Task No. 71514 on control design and arrangement. WADC-TR-55-455 (1955)


Julien M. Christensen, PhD  
Chief, Human Engineering Division  
1956 to 1974

Julien M. Christensen was assigned as a first lieutenant, US Army Air Force, to the Psychology Branch, Aero Medical Laboratory in October 1945. When he separated from military service as a captain in 1946, he was hired immediately by Lt Col (Dr.) Paul Fitts, Chief of the Psychology Branch. Prior to that time, Chris had been a personnel technician in the Trade Test Division of the US Army’s Adjutant General’s Office (1941) and in the US Army Air Force’s Aviation Psychology program conducting research on navigator selection. He went through Navigator Cadet training and later radar/bombardier training and was assigned to the Army’s Aviation Psychology program doing research on navigator training.

He became Chief of the (renamed) Human Engineering Division in 1956, a position he held until retirement from civil service in 1974. Chris supervised an interdisciplinary team of over 60 engineers, scientists, and technicians in human factors research and development programs for the United States Air Force. These programs included visual perception, displays, controls, control dynamics, environmental factors, performance modeling, maintainability, human reliability, information processing, decision making, safety, and physical anthropology. He was particularly honored by being elected to the International Explorers and Pole Vaulters Club, being the first civilian scientist to fly with the Air Force over the North Pole (1947).


Cohen, J., & Senders, V. L. (1958). The effects of absolute and conditional probability distributions on instrument readings: III. A

A SUBJECT USING BIMODAL CONTROLS TO OBTAIN DATA FOR DESIGN CRITERIA
A subject being tested on simultaneous activation of bimodal controls in a study done under Project 7184, "Human Performance in Advanced Systems," Task 718404, Advanced Systems Human Engineering Design Criteria. The work was performed by Melvin J. Warrick and Lester Turner. AMRL TDR-63-6 (1963)


Deese, J. (1956). The ability of untrained observers to match visual forms that are slightly disparate in contour (WADC Technical Report 56-570). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 110 535)


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DISPLAYS AND CONTROLS FOR MANNED SPACE FLIGHT

Cockpit mockup used in a study of display and control requirements for manned space flight. This work was done under Project No. 7184, "Human Performance in Advanced Systems," and Project No. 7185, "Design Criteria for Crew Stations in Advanced Systems." The work was done by Charles O. Hopkins, Donald K. Bauschmidt, and M.J. Anderson of the Hughes Aircraft Company. WADD-TR-60-197 (1960)


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ANTHROPOMETRY OF WORKPLACE LAYOUT

A chart for foot-pedal activation by a seated operator. The chart is from a compilation of human engineering recommendations on various aspects of the layout of workplaces including general considerations, workplace dimensions, location of controls and displays, and direction of motion relationships. This report was prepared under Research and Development Project 7180, "Human Engineering Applications to Equipment Design" by Jerome H. Ely, Robert M. Thomas, and Jesse Orlansky. WADC-TR-56-171 (1956)
The Human Has Limitations

Engineering psychology began with the intellectual discovery that the human was not a perfectly adaptable organism. Of course, no one had ever formally asserted that the man was perfectly adaptable, but up until a few years ago the applied psychologist acted as if the human's flexibility were sufficient to make possible all important adjustments between man and his environment. We now know that this is not so. All of us are aware of how, during World War II, the approach of designing the task to fit the operator was added to the more traditional psychological procedures of selecting and training operators to fit their jobs. This was necessitated by the variety and complexity of military equipment. Machinery had finally outrun the man's ability to adapt. And the recognition of this fact was the first important insight in the development of engineering psychology.

— Franklin V. Taylor, 1960, “Four Basic Ideas in Engineering Psychology,” The American Psychologist


Howe, R. M. (1955). *Coordinate systems for solving the three dimensional flight equations* (WADC Technical Note 55-547). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 141 282)


Howe, R. M. (1957). *An investigation of flight equation requirements for simulators of aircraft up to Mach 3.5* (WADC Technical Note 57-144). Wright-Patterson AFB, OH: Wright Air Development Center. (DTIC No. 210 834)


**VISUAL TRAINING PROCEDURES**

Julien M. Christensen testing a subject with a tachistoscope which presented brief exposures of a display in an examination of visual training procedures to expand the visual field of trainees. WADC-TR-54-239


As a student of Professor Fitts, I well remember his emphasis on rigor in research, on exhaustive inquiry, on plain hard work, his impatience with those who did not share his regard for these qualities, and his complete willingness to give unstintingly and unreservedly of his own ideas, assistance and time to any student who did. He was a firm but gentle and inspiring adviser.


TARGET DETECTION AS A FUNCTION OF TARGET ANGULAR SIZE

A graph of search time and errors as functions of angular target size in minutes of arc. This work was done under Task 71560, "Criteria for the Design and Arrangement of Displays," by William C. Steedman and Charles A. Baker. WADD-TR-60-93 (1960).


Kanareff, V. T., & Lanzetta, J. T. (1960). Effects of success-failure experiences and probability of reinforcement upon the acquisition and extinction of an imitative response. Psychological Reports, 7, 151.


Kanareff, V. T., & Lanzetta, J. T. (1960). Effects of success-failure experiences and probability of reinforcement upon the acquisition and extinction of an imitative response. Psychological Reports, 7, 151.

EXCERPT FROM A GUIDE FOR DESIGN AND MAINTAINABILITY

Required size of an access opening for one-hand tasks from a design guide for maintainability containing recommendations on design practices for maximizing the ease with which electronic equipment can be maintained. The work was done by John D. Folley, Jr. and James W. Altman of the American Institute for Research. WADC-TR-56-218 (1956)


SUBJECTS IN ZERO GRAVITY IN AN AIRCRAFT

Test subjects floating in zero gravity in an aircraft in a flight path that produces zero gravity. These flights were designed to test the effects of weightlessness on the crew members of future vehicles in orbit around the earth. These tests, conducted by the Human Engineering Branch, were later continued and extended by NASA.


Rhodes, F., Jr. (1964). *Predicting the difficulty of locating targets from judgments of image characteristics* (AMRL Technical Documentary Report 64-19). Wright-Patterson AFB, OH: Aerospace Medical Research Laboratory. (DTIC No. 601 378)


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BROAD-BAND BLUE LIGHTING FOR CONTROL ROOMS

Evaluating a broad-band blue lighting system for radar approach control centers (RAPCON) to assist in developing such a system as part of the research on human engineering problems of air traffic control. This work was carried out by Conrad L. Kraft of The Ohio State University. WADC-TB-56-71 (1956)


Colonel John C. Simons  
Researcher  
Human Engineering Division  
1956 to 1966  
1968 to 1971

John Simons was one of the most prolific and creative minds ever assigned to the Human Engineering Division of the Aero Medical Laboratory (now Armstrong Laboratory). His contributions span four decades as a soldier, scientist, engineer and leader. Early on, Capt Simons was an important contributor to the Aero Medical Laboratory's partial role in the Mercury Space Program. He was one of the principals responsible for development of the parabolic flight trajectory used to simulate "zero-G" for engineering and astronaut training. Zero-G testing included such things as hydraulics, space locomotion, and human and animal physiological response. Variations of the parabolic flight profile are still used today by NASA in their C-135 zero-G aircraft.

Another notable achievement by Capt Simons was the development of the Long Lines personnel extraction system. It had long been understood that an aircraft flying a coordinated "pylon" turn could lower a cable which at the pylon turn point would hang stationary. This quirk of physics was exploited to recover personnel from behind enemy lines. The Long Lines system was tested with both mannequins and human volunteers and was operationally deployed. Although later supplanted by the Fulton extraction system, the Long Lines system pioneered the concept of rescue by fixed-wing aircraft.

As a major, Simons flew combat in his third war, Vietnam, with the famous 1st Air Commando Unit. Wounded in combat, he convinced the doctors to let him convalesce in Dayton. His first day back in the country, he appeared on crutches in the laboratory and eagerly passed his new combat experience to his fellow scientists and engineers.

The most important idea to emerge was the lateral firing gun. Again employing the pylon turn, lateral firing ordnance could be aimed with extraordinary accuracy. Upon his reassignment to the laboratory as a branch chief, Simons doggedly pursued the idea and eventually wangled a briefing to the Chief of Staff, then

General Curtis LeMay. Gen LeMay was convinced and ordered that the prototype for what would become the AC-47 be built and tested at the Eglin AFB range. The tests were so successful that the aircraft was flown directly to Vietnam and immediately deployed in combat. John Simons is credited as co-inventor of the "gunship" which has served so successfully in Vietnam, Grenada, Panama, Iraq and Somalia.

John Simons continued to make creative contributions to the Human Engineering Division as a contractor after his retirement. His last contribution, one of the original 1968 combat-born ideas, was the Sensor Platform Imagery (SPI). SPI is a real-time reconnaissance drone which allows strike air crews to review the target minutes before they attack. A laboratory simulation completed in 1993 confirmed the effectiveness of SPI more than 20 years after the original Simons idea.

The creative genius of John Simons is a tribute to the soldier-scientist. The unique combination of master's degree, flying knowledge, combat experience, and a dedicated Air Force laboratory environment turned his creativity into exceptional productivity.


ASTRONAUTS, AIRCREW MEMBERS, AND EXPERIMENTERS
Participation in zero gravity flights conducted to determine effects on humans and their performance in space.

Thackray, R. I. (1962). *The measurement of activation level in stress research* (MRL Memorandum Report P-8). Wright-Patterson AFB, OH: 6570th Aerospace Medical Research Laboratory. (DTIC No. 284 048)


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