NASA Facts

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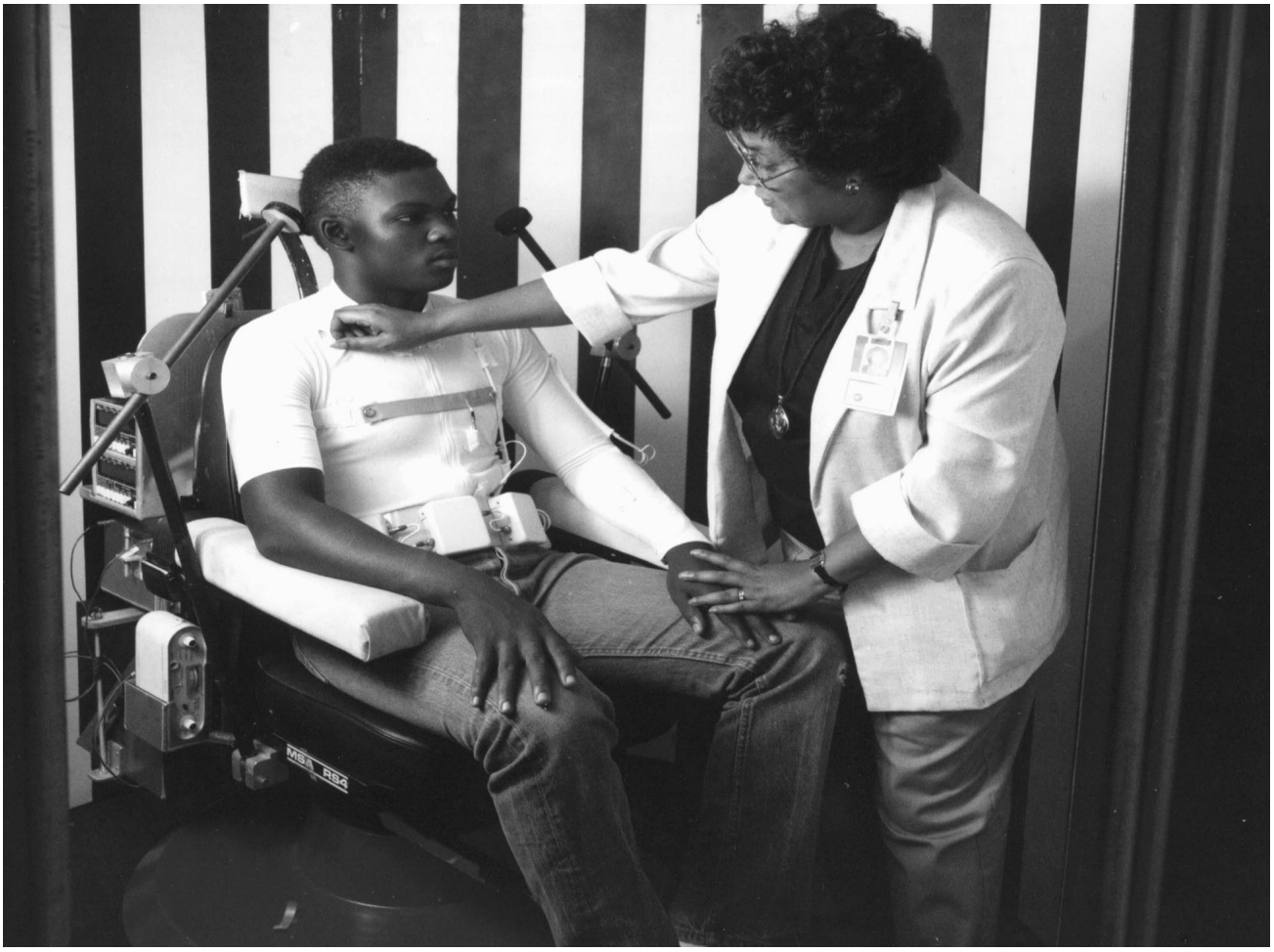
92/6-ARC-FS-006

SPACE MOTION SICKNESS

Introduction

Space motion sickness (SMS) is experienced by 40 percent to 50 percent of astronauts during the first few days of exposure to the microgravity environment of space. SMS is similar to motion sickness on Earth, with symptoms including loss of appetite,



A doctor at NASA Ames prepares a volunteer in a "rotating chair" designed to induce motion sickness. She will monitor his physiological responses, including temperature, heart rate, respiration and muscle tension.

malaise, nausea, vomiting, gastrointestinal disturbances and fatigue. SMS not only disrupts the well-being of crew members, but it also can impair their performance during critical stages of spaceflight.

The precise cause of space motion sickness is not fully understood. Scientists generally agree, however, that the problem originates in the vestibular system, or balance organs, of the inner ear. Crew members have reported that head movements and visual disorientation provoke space motion sickness.

The overall impact of SMS on mission operations in the U.S. space program has so far been minimal. Its effects on crew performance, however, have the potential to interfere with scheduling of extravehicular activities and to jeopardize the safety of space shuttle landings. Therefore, NASA has undertaken a vigorous research program to define the physiological and behavioral mechanisms underlying this phenomenon, find reliable predictors of susceptibility and develop preventive measures. Scientists at NASA's Ames Research Center are an important part of this effort.

History

During the first two flight programs, Mercury and Gemini, astronauts did not experience space motion sickness. Scientists now attribute this to the design of the capsules, which restricted the mobility of crew members, as well as their ability to see outside. Mercury and Gemini astronauts thus did not encounter spatial disorientation during spaceflight.

Space motion sickness was first reported by American crew members in the Apollo era. In the larger Apollo and Skylab spacecraft, crew members could move around freely and therefore experienced vestibular and other sensory problems in the microgravity environment.

As a result of the unexpected incidence of and Skylab flights, the need for developing countermeasures became increasingly apparent. The Skylab program enabled NASA scientists to investigate early mission space motion sickness in a systematic way.

Building on knowledge gained from Skylab and other research efforts, scientists in the space shuttle era use the term "space motion sickness" to describe the full range of symptoms encountered in adapting to microgravity, including those resembling motion sickness.

Ground-based Testing and In-flight Testing

Because of its complexity and uniqueness, this biomedical problem cannot be resolved solely with ground-based research. Data collected from astronauts during space shuttle missions is essential in finding valid solutions.

As part of the effort to find predictors of space motion sickness, crew members of early space shuttle flights were tested for susceptibility to motion sickness on the ground. Each crew member also was tested for sensitivity to experimentally-induced motion sickness.

Most crew members had some experience with motion sickness on Earth. This did not predict, however, who would experience motion sickness in space, or to what extent. Scientists at NASA Ames and Johnson Space Center in Houston, Texas, are continuing to work on ground-based methods for prediction of individual susceptibility.

Countermeasures

While research on predictors of SMS has been inconclusive, some progress has been made in the development of countermeasures. Current areas of investigation include anti-motion sickness drugs, autogenic feedback training and techniques for minimizing head and body movements.

Drugs that diminish the symptoms of space motion sickness are being used and studied. At present, the drug promethazine is available to crew members as a treatment for SMS. To date, the use of medication has been only partially successful, decreasing the symptoms of space motion sickness in most, but not all, crew members.

Another preventive technique, under development at NASA Ames, is autogenic feedback training. This combined application of biofeedback and autogenic therapy (a learned self-regulation technique) controls some symptoms of SMS associated with the autonomic nervous system, such as nausea and vomiting.

In the course of 14 years of research at Ames, more than 200 individuals have been trained in autogenicfeedback, with significant improvement in motion tolerance observed in 85 percent of them. The procedures also have been adopted as a treatment for air sickness in military flight crews.

Autogenic feedback has proven to be a superior method of physiological control because a) it produces relief with as little as six hours of training; b) it is effective in a wide population of individuals; c) it reduces the behavioral and physiological reactions to even the most provocative motion sickness stimuli; d) it is remembered over a long time.

Because crew members have reported that rapid head movements worsen the nausea and spatial disorientation associated with SMS, scientists now are testing head and neck restraints that restrict such movements.

Future Directions

Although past research has yielded a great deal of information applicable to space motion sickness, a definitive solution to this vexing problem is urgent.

Among the objectives of current SMS research are:

- more precise predictive indices
- more effective drug treatments
- more efficient pre-flight adaptation procedures
- methods to evaluate performance impairment induced by SMS and anti-motion sickness drugs
- early detection of incipient symptoms
- mechanical restraints such as neck fixating devices

Of primary importance in developing methods for the prevention and treatment of space motion sickness are the health and efficiency of crew members. To this end, the countermeasures, whether used alone or in combinations, must be relatively fast-acting but they cannot inhibit the ability of a crew member to perform tasks.

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