

BEHAVIOR

Wray Herbert reports from San Antonio at the meeting of the Association for the Psychophysiological Study of Sleep

Dreams and memories

One theory about dreams is that they facilitate learning and the consolidation of memories. Infants and young children reportedly experience more dream sleep than adults, and dream sleep tends to increase following learning. But it has been difficult to study the effects of dreaming on subsequent memory, because people tend to slip very quickly from dream sleep into non-dream sleep. Lawrence Scrima of Mt. Sinai Medical Center in Miami Beach has studied a group of narcoleptics — people subject to brief daytime attacks of sleep — because it is easier with narcoleptics to isolate so-called REM (rapid eye movement) sleep, during which most dreams occur, from non-dream sleep. He tested the subjects on a recall task following dream sleep, non-dream sleep, and wakefulness, and found that dreaming improved memory significantly more than did deep sleep. He also found that dream sleep alone had more noticeable effects on recall than did dream and non-dream sleep combined, suggesting that it is not simply alertness that improves memory — but rather the consolidation and differentiation of stored information. The findings have implications for the way people schedule their sleep, Scrima says. Most dreaming is compressed into the last few hours of sleep, so that cutting sleep short — in order to study, for example — may actually interfere with learning.

Insomnia myths

Recent research calls into question two commonly held notions about insomnia. The first holds that insomniacs lie awake at night because they cannot stop thinking. The second assumes that insomniacs actually don't lie awake for as long as they think they do — that they are simply poor at estimating the passage of time. Robert R. Freedman and Howard Sattler of the Lafayette Clinic in Detroit studied the sleep patterns of 12 insomniacs and 12 controls, including reports of mental activity prior to sleep; although it took the insomniacs much longer to fall asleep (43 minutes compared with 12 minutes for controls), there were no differences between the groups in the occurrence of repetitive thoughts, in the character of mental activity, or in the progress from one thought to another. Although all the insomniacs reported being unable to fall asleep because they were unable to "turn off their mind," so did 11 of the controls — leading the researchers to conclude that clinical reports of cognitive hyperactivity may be explained by the fact that it is a common experience, but one unrelated to insomnia.

Another research group, headed by Linda Kamens of the Illinois Institute of Technology, investigated the "time distortion" hypothesis of insomnia. They studied a group of 13 insomniacs and 14 controls and found that, while insomniacs tended to overestimate the time that it actually took them to fall asleep by about 11 minutes, they were no different from controls on time estimation tasks performed during the day. The tendency to overestimate time spent lying awake at night cannot be due to a general perceptual difficulty, the researchers conclude.

Sodium and sleep

The low-sodium diet prescribed for many elderly people may have an adverse side effect — disturbed sleep. In order to study the relations between sympathetic nervous system arousal and nighttime wakefulness, psychiatrist Michael V. Vitiello of the University of Washington tested young subjects on a low-sodium diet, which reduces blood levels of norepinephrine, a marker for nervous activity. He found that they awoke more often, had less REM sleep, less deep sleep and less total sleep — suggesting that sodium restriction might exacerbate sleep problems caused by the norepinephrine increase that accompanies aging.

TECHNOLOGY

Ivars Peterson reports from Charlotte, N.C., at the Electric Power Research Institute's Nondestructive Evaluation Center

Centering on nuclear plant inspections

Pipes, pumps and other nuclear power plant components are accumulating at a site in Charlotte, N.C. The 1-year-old Nondestructive Evaluation Center, operated for the Electric Power Research Institute (the research arm of the electric utility industry), evaluates and field tests new technologies for improved inspection and maintenance in nuclear power plants. The center is a response to more stringent Nuclear Regulatory Commission rules, the industry's growing awareness of significant generic problems, such as pipe cracks in boiling water reactors or steam generator tube leaks (SN: 2/13/82, p. 105), and the need for a quick response to new problems. The center also offers an extensive training program in newly developed techniques.

Nuclear power plant inspection techniques must be able to handle materials like carbon steel, in which grains can mimic flaws, penetrate compounds with several-inch-thick walls, and operate where access may be limited and radiation levels high. Projects include the use of X-rays and ultrasound to probe welds and flaws in materials or components like turbine rotors. Much of the testing is done on actual components and under realistic working conditions.

A Minac for high-energy X-rays

It takes high-energy X-rays to inspect reactor coolant pump welds that may be almost a foot thick. Manufacturers can use large, permanently installed accelerators weighing nearly two tons to perform the initial inspection. In the past, the only practical radiation sources for in-plant inspections were radioactive isotopes of cobalt or iridium. Now in use, although still in the prototype stage, is Minac, a portable, miniature linear accelerator that provides 3-million-electron-volt X-rays and is one-fifth the size of manufacturers' accelerators. Its design applied declassified microwave waveguide technology to reduce the accelerator's size.

Minac was first used in May 1981 to inspect the main reactor coolant pump at the Ginna plant in Ontario, N.Y. The instrument's X-ray source was suspended inside the pump with X-ray film positioned outside the pump housing. Exposure times ranged from 20 minutes to 3.5 hours. Since then, Minac has been used three times, and other utilities are awaiting their turn. A program is underway to upgrade Minac to 6 million electronvolts to allow shorter exposure times or the inspection of greater thicknesses of steel.

Tube defects and current events

Steam generator tube leaks, like the one that closed the Ginna plant in Ontario, N.Y., for four months (SN: 1/30/82, p. 68), are a costly problem for utilities. The usual tube inspection technique is to lower a coil, through which alternating current of a particular frequency flows, into the tube and to detect the eddy currents induced in the tube wall. Defects in the tube perturb the eddy current flow. However, single-frequency methods are unreliable because tube corrosion deposits, support plates and tube irregularities may hide flaws.

The center is now evaluating methods in which the coil is driven at more than one frequency. In this way, extraneous factors can be subtracted, leaving information only about defects. Project manager Steve Brown says the instrument is more capable than it needs to be and can overwhelm an operator with data. The researchers are now developing an automated analysis system that trains a microprocessor to recognize important defects by looking at numerous examples of flaws. When specimens with real flaws are unavailable, newly developed techniques allow flaws to be "grown" to order.