News
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**Waking experience affects physiology of REM sleep.

DALLAS -- "Dreaming is the experienced portion of a mind-body event," says Dr. John Herman, co-director of sleep research at The University of Texas Health Science Center at Dallas.

"Most people think that the function of dreaming must have to do with the material that's recalled. But as we study dreaming, we become more aware that it's related to a very complex state of the nervous system. The recollected dream is just one layer. It seems as if there are both encoding and playback structures," says the researcher.

He recently presented new information at the Symposium on Sleep, Dreams and Hemispheric Laterality in Lucca, Italy, and at the International Meeting of the Association for the Psychophysiological Study of Sleep in Bologna. His new findings shed light on how the waking experience affects not just dreaming but also the eye movements during the regularly occurring periods of rapid eye movement (REM) sleep.

Herman restricted his subjects' eye movements when they were awake by having them wear "tunnel vision" goggles that made everything appear smaller and limited the vision to a five-degree field. Looking through these goggles is like looking through the wrong end of a telescope. The small eye movements in the awake state resulted in increased size and frequency of eye movements during REM sleep. "This compensatory effect was quite unexpected," he says. The number and length of REM sleep periods were unaffected.

It has long been observed that the waking experience influences dream content. But Herman's report marks the first time an experimentally induced physiological effect in the waking environment has produced a measurable change in REM sleep.

REM sleep gets its name from the prominent eye activity that occurs during this period of sleep. The eyes dart rapidly back and forth behind closed lids, the middle ear muscles contract as they do in response to loud sound in the awake state, fingers and hands may twitch. In fact, it is as though the sleeper is awake except for the "paralysis" (atonia) of most muscles. Heart rate, respiratory pattern and electroencephalogram (EEG) resemble the active waking state. "Not just quiet or relaxed waking," says Herman, "but extremely active waking." The cortex and brain stem show heightened activity. Men experience penile erections, and women experience increased vaginal blood flow. Most dreaming takes place during REM sleep. "Brain and autonomic activity can be as intense as an anxiety attack."

Herman's studies are aimed at showing how the dream content and physiology occurring at the same time are related.

"Much of the waking experience is incorporated and kept available for long-term memory. What's encoded and used by the REM process and what's available to be recalled as a dream the next morning are two different phenomena," says Herman. "The average person has 90

(over)

minutes of REM sleep per night. During each REM period, there is a continual playback of waking perceptual and movement patterns. In other words, what you see and how you move when you are awake influences the content and physiology of dreaming. This is in sharp contrast to the compensatory effect that occurred with the 'tunnel vision' goggles. We know that a very insignificant portion of dreaming is available for recall. The recollected dream is probably an accidental by-product of a system whose function has to do with the structure and chemistry of the brain."

The sleep researcher says dreaming involves two problems of memory: first, how the dream remembers the awake state event and, second, how the dreamer recalls the dream. "What is recalled in dreams is related to visual imagery. But how does material get into dreams? What is the selection process, and what does it tell us about hallucinations, memory and the mind-body relationship? It's difficult to quantify facts about the physiology and mentation (content) of dreaming."

Previously Herman and Dr. Howard P. Roffwarg, director of sleep research at UTHSCD and director of the Presbyterian Hospital Sleep/Wake Disorders Center, have shown the effects on dreaming of wearing colored goggles when awake. In the red goggle experiment, dreams mimicked the waking visual impressions. Subjects experienced reddish tints pervading entire dream scenes. An increase in the frequency of red objects and a large decrease in the frequency of blue and green objects also occurred.

The latest experiment showed the opposite effect -- a physiological compensation in REM sleep for the waking restriction of eye movements. Dream recollections were not a part of the experiment because the protocol dictated that the subjects not be awakened. But subjects recalling dreams in the morning told of small, faraway objects -- a 35-cent candy bar was too small; a boat on a lake was small and very rickety; there was a "teeny" swimming pool.

The physiology of REM sleep and the content of the dream are related. Herman demonstrated this in a study in which he showed that the direction a subject glances in his or her dream is the same as the direction of the actual eye movement recorded during REM sleep. "For this study we used only selected subjects with exceptional dream recall." A technician would awaken the subject during REM sleep. Then Herman or one of his group and Dr. Milton Erman, medical director of the Presbyterian center, would question the subject in detail.

"It took us 20 minutes to establish the exact sequence of gaze in the last 10 seconds of the dream," says Herman. "The amount of perceptual detail and knowledge of minute points that the dreamer can describe, if so questioned, is exceedingly large."

In another study Herman and Roffwarg have shown that the physiology of the eye movements during REM sleep is similar to awake eye movements when there is head and body activity, but not like awake eye movements when the subject is immobile. "This is a paradox," says Herman. "It shows that the dream mimics awake state neuromuscular behavior so that the eye movements occur as if the dreamer were actuallly moving in space. These are extremely complex hallucinations indeed."

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