exemplifies the difference between a possibl... and impossible object. You looked longer at the impossible one, didn't you? So do babies. Using preferential-looking and duration-of-gaze methods, the researchers found that infants as young a 4 months old indicate an awareness of the difference in that they stared at the impossible object longer, as if to say, "I can see something's wrong with this object and I need to try to figure it out!"

This is just a sample of hundreds of studies conducted every year by developmental psychologists and other behavioral scientists whose fundamental methodologies rest on Robert Fantz's discoveries. These methods are allowing us to peek inside the minds of infants as never before to see what they perceive and how they think. Virtually every time we take another look, we discover that they are "smarter" and perceive more of their world than we ever expected.

Horowitz, F. D., Paden, L., Bhana, K., & Self, P. (1972). An infant-controlled procedure for studying infant visual fixations. *Developmental Psychology, 7,* 90.

Shuwairi, S., Albert, M., & Johnson, S. (2007). Discrimination of possible and impossible objects in infancy. *Psychological Science, 18(4),* 303–307.

Talbot, M. (2006, September 4). The baby lab. *The New Yorker, 82*(27), 91–101.

Reading 6: TO SLEEP, NO DOUBT TO DREAM . . .

Aserinsky, E., & Kleitman, N. (1953). Regularly occurring periods of eye mobility and concomitant phenomena during sleep. *Science, 118,* 273–274. Dement, W. (1960). The effect of dream deprivation. *Science, 131,* 1705–1707.

As you can see, this section is somewhat different from the others in that *two* articles are discussed; this is because the first study discovered a basic phenomenon about sleeping and dreaming that made the second study possible. The primary focus is William Dement's work on dream deprivation, but to prepare you for that, Aserinsky's findings must be addressed first.

In 1952, Eugene Aserinsky, although a graduate student, was studying sleep. Part of his research involved observing sleeping infants. He noticed that as these infants slept, active eye movements occurred periodically. During the remainder of the night, only occasional slow, rolling eye movements occurred. He theorized that these periods of active eye movements might be associated with dreaming. However, infants could not tell him whether they had been dreaming or not. To test this idea, he expanded his research to include adults.

Aserinsky and his coauthor, Nathaniel Kleitman, employed 20 normal adults to serve as participants. Sensitive electronic measuring devices were connected by electrodes to the muscles around the eyes of these participants. The leads from these electrodes stretched into the next room, where the participants' sleep could be monitored. The participants were then allowed to fall asleep normally (participants participated on more than one night each). During the night, participants were awakened and interrogated, either during periods of eye activity or during periods when little or no eye movement was observed. The idea was to wake the participants and ask them if they had been dreaming and if they could remember the content of the dream. The results were quite revealing.

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For all the participants combined, a total of 27 awakenings were done during periods of sleep accompanied by rapid eye movements. Of these, 20 reported detailed visual dreams. The other 7 reported "the feeling of having dreamed" but could not recall the content in detail. During periods of no eye movement, 23 awakenings were instigated; in 19 of these instances, the participants did not report any dreaming, while in the other four, the participants felt vaguely as if they might have been dreaming, but they were not able to describe any dreams. On some occasions, participants were allowed to sleep through the night uninterrupted. It was found that the latter group experienced between three and four periods of eye activity during the average of 7 hours of sleep.

Although it may not have seemed so remarkable at the time, Aserinsky had discovered what is very familiar to most of us now: rapid eye movement (REM) sleep, or dreaming sleep. From his discovery grew a huge body of research on sleep and dreaming that continues to expand. Over the years, as research methods and physiological recording devices have become more sophisticated, we have been able to refine Aserinsky's findings and unlock many of the mysteries of sleep.

For example, we now know that after you fall asleep, you sleep in four stages, beginning with the lightest sleep (Stage 1) and progressing into deeper and deeper stages. After you reach the deepest stage (Stage 4), you begin to move back up through the stages: Your sleep becomes lighter and lighter. As you approach Stage 1 again, you enter REM, which is a very different kind of sleep. You do most of your dreaming during REM sleep. However, contrary to popular belief, research has revealed that you do not move around very much during REM. Your body is immobilized by electrochemical messages from your brain that paralyze your muscles. This is most likely an evolutionary survival mechanism that prevents you from acting out your dreams and possibly injuring yourself or worse.

Following a short period in REM, you proceed back into the four stages of sleep called non–rapid-eye-movement sleep (NON-REM, or NREM). During the night, you cycle between NREM and REM about five or six times (your first REM period comes about 90 minutes after falling asleep), with NREM becoming shorter and REM becoming longer (thereby causing you to dream more toward morning). (By the way, everyone dreams. Although a small percentage of individuals never remember dreams, sleep research has determined that we all have them.)

All this knowledge springs from the discovery of REM by Aserinsky in the early 1950s. One of the leading researchers who followed Aserinsky in giving us this wealth of information on sleeping and dreaming is William Dement of Stanford University. Around the same time of Aserinsky's findings, Dement was beginning his decades of groundbreaking research into sleeping and dreaming.

THEORETICAL PROPOSITIONS

What struck Dement as most significant was the discovery that dreaming occurs every night in everyone. As Dement states in his article, "Since there appear to be no exceptions to the nightly occurrence of a substantial amount of dreaming in every sleeping person, it might be asked whether or not this amount of dreaming is in some way a necessary and vital part of our existence" (p. 1705). This led him to ask some obvious questions: "Would it be possible for human beings to continue to function normally if their dream life were completely or partially suppressed? Should dreaming be considered necessary in a psychological sense or a physiological sense or both?" (p. 1705).

Dement decided to try to answer these questions by studying participants who had somehow been deprived of the chance to dream. At first he tried using depressant drugs to prevent dreaming, but the drugs themselves produced too great an effect on the participants' sleep patterns to allow for valid results. Finally, he decided on a novel method of preventing dreaming by waking participants up every time they entered REM sleep during the night.

METHOD DRASTIC

Dement's article reported on the first eight participants in an ongoing sleep and dreaming research project. The participants were all males ranging in age from 23 to 32. A participant would arrive at the sleep laboratory around his usual bedtime. Small electrodes were attached to the scalp and near the eyes to record brain-wave patterns and eye movements. As in the Aserinsky study, the wires to these electrodes ran into the next room so that the participant could sleep in a quiet, darkened room.

The procedure for the study was as follows: For the first several nights, the participant was allowed to sleep normally for the entire night. This was done to establish a baseline for each participant's usual amount of dreaming and overall sleep pattern. Once this information was obtained, the next step was to deprive the participant of REM or dream sleep. Over the next several nights (the number of consecutive deprivation nights ranged from three to seven for the various participants), the experimenter would awaken the participant every time the information from the electrodes indicated that he had begun to dream. The participant was required to sit up in bed and demonstrate that he was fully awake for several minutes before being allowed to go back to sleep.

An important point mentioned by Dement was that the participants were asked not to sleep at any other times during the dream study. This was because if participants slept or napped, they might dream, and this could contaminate the findings of the study.

Following the nights of dream deprivation, participants entered the *recovery phase* of the experiment. During these nights, the participants were allowed to sleep undisturbed throughout the night. Their periods of dreaming continued to be monitored electronically, and the amount of dreaming was recorded as usual.

Next, each participant was given several nights off (something they were very glad about, no doubt!). Then six of them returned to the lab for another series of interrupted nights. These awakenings "exactly duplicated the dream-deprivation nights in number of nights and number of awakenings per night. The only difference was that the participant was awakened in the intervals between eye-movement (dream) periods. Whenever a dream period began, the participant was allowed to sleep on without interruption and was awakened only after the dream had ended spontaneously" (p. 1706). Participants again had the same number of recovery nights as they did following the dream-deprivation phase. These were called *control recovery* and were included to eliminate the possibility that any effects of dream deprivation were not due simply to being awakened many times during the night, whether dreaming or not.

RESULTS

Table 6-1 summarizes the main findings reported. During the baseline nights, when participants were allowed to sleep undisturbed, the average amount of sleep per night was 6 hours and 50 minutes. The average amount of time the participants spent dreaming was 80 minutes, or 19.5% (see Table 1, column 1). Dement discovered in these results from the first several nights that the amount of time spent dreaming was remarkably similar from participant to participant. In fact, the amount of variation among the dreamers was only plus or minus 7 minutes!

The main point of this study was to examine the effects of being deprived of dreaming, or REM, sleep. The first finding to address this was the number of awakenings required to prevent REM sleep during the dream-deprivation nights. As you can see in Table 6-1 (column 3a), on the first night, the experimenter had to awaken the participants between 7 and 22 times in order to block REM. However, as the study progressed, participants had to be awakened more and more often in order to prevent them from dreaming. On the last deprivation night, the number of forced awakenings ranged from 13 to 30 (column 3b). On average, there were twice as many attempts to dream at the end of the deprivation nights.

TABLE 6-1 Summary of Dream-Deprivation Results

	1.	2.	3a. NUMBER OF AWAKENINGS	3b.	4.	5.
PARTICIPANT	PERCENT DREAM TIME: BASELINE	NUMBER OF DREAM DEPRIVATION NIGHTS	FIRST NIGHT	LAST NIGHT	PERCENT DREAM TIME: RECOVERY	PERCENT DREAM TIME: CONTROL
1.	19.5	5	8	14	34.0	15.6
2.	18.8	7	7	24	34.2	22.7
3.	19.5	5	11	30	17.8	20.2
4.	18.6	5	7	23	26.3	18.8
5.	19.3	5	10	20	29.5	26.3
6.	20.8	4	13	20	29.0	—
7.	17.9	4	22	30	19.8 (28.1)*	16.8
8.	20.8	3	9	13	—**	—
Average	19.5	4.38	11	22	26.6	20.1

* Second recovery night.
** Participant dropped out of study before recovery nights.
(Adapted from data on p. 1707.)

The next and perhaps most revealing result was the increase in dreaming time after the participants were prevented from dreaming for several nights. The numbers in Table 6-1 (column 4) reflect the first recovery night. The average total dream time on this night was 112 minutes, or 26.6% (compared with 80 minutes and 19.5% during baseline nights in column 1). Dement pointed out that two participants did not show a significant increase in REM (participants 3 and 7). If they are excluded from the calculations, the average total dream time is 127 minutes, or 29%. This is a 50% increase over the average for the baseline nights.

Although only the first recovery night is reported in Table 6-1, it was noted that most of the participants continued to show elevated dream time (compared with baseline amounts) for five consecutive nights.

Now you're thinking, "Wait a minute!" Maybe this increase in dreaming has nothing to do with REM deprivation at all. Maybe it's just because these participants were awakened so often. You'll remember that Dement planned for your astute observation. Six of the participants returned after several days of rest and repeated the procedure exactly, except they were awakened between REM periods (the same number of times). This produced no significant increases in dreaming. The average time spent dreaming after the control awakenings was 88 minutes, or 20.1% of the total sleep time (column 5). When compared to 80 minutes, or 19.5%, in column 1, no significant difference was found.

DISCUSSION

Dement tentatively concluded from these findings that we need to dream. When we are not allowed to dream, there seems to be some kind of pressure to dream that increases over successive dream-deprivation nights. This was evident in his findings from the increasing number of attempts to dream following deprivation (column 3a vs. column 3b) and in the significant increase in dream time (column 4 vs. column 1). He also notes that this increase continues over several nights so that it appears to make up in quantity the approximate amount of lost dreaming. Although Dement did not use the phrase at the time, this important finding has come to be known as the *REM-rebound* effect.

Several interesting additional discoveries were made in this brief, yet remarkable article. If you return to Table 6-1 for a moment, you'll see that two participants, as mentioned before, did not show a significant REM-rebound effect (participants 3 and 7). It is always important in research incorporating a relatively small number of participants to attempt to explain these exceptions. Dement found that the small increase in participant 7 was not difficult to explain: "His failure to show a rise on the first recovery night was in all likelihood due to the fact that he had imbibed several cocktails at a party before coming to the laboratory, so the expected increase in dream time was offset by the depressing effect of the alcohol" (p. 1706).

Participant 3, however, was more difficult to reconcile. Although he showed the largest increase in the number of awakenings during deprivation (from 7 to 30), he did not have any REM rebound on any of his five recovery nights. Dement acknowledged that this participant was the one exception in his findings and theorized that perhaps he had an unusually stable sleep pattern that was resistant to change.

The eight participants were monitored for any behavioral changes that they might experience due to the loss of REM sleep. All the participants developed minor symptoms of anxiety, irritability, or difficulty concentrating during the REM interruption period. Five of the participants reported a clear increase in appetite during the deprivation, three of whom gained 3 to 5 pounds. None of these behavioral symptoms appeared during the period of control awakenings.

SIGNIFICANCE OF THE FINDINGS AND SUBSEQUENT RESEARCH

More than 40 years after this preliminary research by Dement, we know a great deal about sleeping and dreaming. Some of this knowledge was discussed briefly and previously in this chapter. We know that most of what Dement reported in his 1960 article has stood the test of time. We all dream, and if we are somehow prevented from dreaming one night, we dream more the next night. There does indeed appear to be something basic in our need to dream. In fact, the REM-rebound effect can be seen in many animals.

One of Dement's *accidental* findings, which he reported only as a minor anecdote, now has greater significance. One way that people may be deprived of REM sleep is through the use of alcohol or other drugs, such as amphetamines and barbiturates. Although these drugs increase your tendency to fall asleep, they suppress REM sleep and cause you to remain in the deeper stages of NREM for greater portions of the night. For this reason many people are unable to break the habit of taking sleeping pills or alcohol in order to sleep. As soon as they stop, the REM-rebound effect is so strong and disturbing that they become afraid to sleep and return to the drug to avoid dreaming. An even more extreme example of this problem occurs with alcoholics who may have been depriving themselves of REM sleep for years. When they stop drinking, the onset of REM rebound may be so powerful that it can occur while they are *awake!* This may be an explanation for the phenomenon known as *delirium tremens* (DTs), which usually involve terrible and frightening hallucinations during withdrawal (Greenberg & Perlman, 1967).

Dement spent decades following up on his early preliminary findings regarding the behavioral effects of dream deprivation. In his later work, he deprived participants of REM for much longer periods of time and found no evidence of harmful changes. He concluded that "[a] decade of research has failed to prove that substantial ill effects result even from prolonged selective REM deprivation" (Dement, 1974).

Research with its origins in Dement's early work reported here suggests that a greater synthesis of proteins takes place in the brain during REM sleep than during NREM sleep. Some believe that these chemical changes may represent the process of integrating new information into the memory structures of the brain and may even be the organic basis for new developments in personality (Rossi, 1973).

RECENT APPLICATIONS

Most experts in the field of sleep and dreaming credit Aserinsky with the discovery of REM sleep. Studies relating to sleeping, dreaming, or sleep disorders attribute that basic fact to him. Consequently, his early work with Kleitman is frequently cited in many recent scientific articles.

Dement's extension of Aserinsky's work continues to be referred to frequently in a wide range of research articles relating to sleep patterns. One such recent study made the remarkable discovery that humans may dream during NREM sleep more than we thought (Suzuki et al., 2004). Using daytime napping, during which we tend to enter NREM sleep sooner than during normal nighttime sleep, the researchers found that when participants were asked to report on dreams during naps consisting only of NREM sleep, they were frequently able to do so. However, the researchers also found that "dream reports from NREM naps were less notable in quantity, vividness, and emotions than those from REM naps" (p. 1486).

Another study relating to Dement and Aserinsky's foundational research contends that humans develop during REM sleep a kind of *protoconscious*, a basic biological form of brain organization necessary for normal consciousness (Hobson, 2009). This basic human brain development is thought to begin before birth and continues throughout childhood. Hobson's research proposes that early REM sleep provides us with a virtual model of our waking world that assists us in carrying out the tasks of our normal life while awake. The theory might help explain two phenomena: why infants spend more time in REM sleep than do adults, and why the human brain *insists* on obtaining a minimum amount of REM sleep every night.

CONCLUSION

In 2000, Dement, who continues to oversee a very active sleep medicine research program at Stanford University, published, *The Promise of Sleep: A Pioneer in Sleep Medicine Explores the Vital Connection Between Health, Happiness and a Good Night's Sleep*. In this book, written for the nonscientist, Dement draws upon his four decades of research on sleep and applies his vast accumulation of knowledge to helping all of us understand the vital importance of quality sleep and how to achieve it. In his book, Dement (2004) describes us as a "sleep-sick society" and sets forth his goals as a sleep researcher:

> For most of my career . . . I have worked unceasingly to change the way society deals with sleep. Why?
>
> Because the current way, or nonway, is so very bad . . . It greatly saddens me to think about the millions, possibly billions, of people, whose lives could be improved if they understood a few simple principles.
>
> Changing the way society and its institutions deal with sleep will do more good than almost anything else I can conceive, or certainly that was ever remotely in my grasp to accomplish. (pp. 4–5)

To learn more about Dement's ongoing work at Stanford University's Center for Human Sleep Research, see http://med.stanford.edu/school/psychiatry/humansleep.

Dement, W. C. (1974). *Some must watch while some must sleep.* San Francisco, CA: Freeman.
Dement. W. C. (2000). *The promise of sleep: A pioneer in sleep medicine explores the vital connection between health, happiness and a good night's sleep.* New York: Dell.
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Reading 7: AS A CATEGORY, IT'S A NATURAL

Rosch, Eleanor H. (1973). Natural categories. *Cognitive Psychology, 4,* 328–350.

In the 1934 Shirley Temple movie, *Stand Up and Cheer,* the great film actor and dancer who went by the name of "Stepin Fetchit," sat on the porch steps of an old house examining one of his old, beat-up pieces of footwear, and lamented philosophically, "Why's a shoe called a shoe?" His character often wondered why things were called what they were called, and in various ways psychologists have wondered the same thing. The behavioral scientists who focus on these sorts of questions study human *cognition* (thinking) and *perception* (humans' interpretation of the world around them).

One of the basic building blocks of these areas of research is the idea of *concepts.* Concepts are mental representations of your experience of the world that allow you to classify objects (furniture, vegetables, animals, professions, shoes, etc.) according to the characteristics they have in common. Concepts are extremely useful because they allow you to group objects into categories for efficient processing of information. For example, you know that a certain piece of furniture is a chair because it fits your "concept" of a chair. Therefore, it is not necessary for you to learn that a specific chair is called a chair each time you see an unfamiliar style so long as it fits into your category for chairs.

Because it has come up in our conversation here, you are now thinking of a chair (right?). What features comprise your "chair concept"? You probably think of a chair as having legs, a seat, and a back to lean against. Even though some chairs violate your rules (recliners and rocking chairs don't really have legs), they still fit into your chair category well enough. However, if you were to encounter a bean bag "chair" without knowing what is was, you probably would not call it a chair. In fact you might not be sure what to call it.

The question that has most interested cognitive psychologists is as follows: Where do you get your categories for objects? The traditional or "classical" view that was widely accepted prior to 1970 held that categories are a function of the language we speak. In other words, categories exist because we have words for them. For example, we have a category for animals that lay eggs, fly, have feathers, and chirp; the category is "bird." This traditional view maintained that if we did not have a word for bird, the category or concept for bird would not exist.

Therefore, concepts and categories should vary from culture to culture due to variations in language. And there is evidence of this. A frequently cited