chapter 12

Dreaming II: Theories and Research

Theories of dreaming attempt to explain the process by which the manifest dream content is produced. In doing so they need to account for the common characteristics of dreams, such as their visual vividness, their story-like nature, and the incorporation of day residues. Ideally they should also account for other features, such as emotionality and bizarreness, that make some dreams especially salient and memorable, even though they are not present in all dreams. Finally, theories of dreaming should explain why most dreams are so easily forgotten.

Dream theory and research can be divided into four historical stages (Haskell 1986). The *ancient stage* was the prescientific stage, and it included notions of dreams as divine communications, with dreams being interpreted in terms of fixed symbols, as well as the alternative view that the dream world is a separate reality. The major event of the *psychoanalytic stage* was the publication of Sigmund Freud's monumental book *The Interpretation of Dreams* in 1900. Freud saw dreams as a naturalistic phenomenon, rather than a divine or supernatural event, and he attempted to explain how dreams are psychologically motivated and formed by unconscious mental processes within the individual. The *psychophysiological stage* was initiated by Aserinsky and Kleitman's (1953) discovery of REM sleep and its association with dreaming. Hobson and McCarley's (1977) activation-synthesis theory of dreaming is an attempt to explain dreaming in purely physiological terms, an attitude directly opposed to Freud's approach. The *cognitive stage* is the newest, and David Foulkes's (1985) cognitive theory of dreaming is its first major theory.

The cognitive approach attempts to explain dreaming in terms compatible with modern cognitive psychological theory, and also to modify and expand cognitive theory on the basis of dream research. The last three stages, and particularly the last two stages, are overlapping in time and represent shifts in theoretical and methodological approaches to the study of dreaming.

In this chapter I will discuss the theories of dreaming of Freud, Hobson and McCarley, and Foulkes, representing the psychoanalytic, psychophysiological, and cognitive stages of dream theory, respectively. We will see that different theorists have had different ideas as to the most important features of dreams needing explanation, as well as different ideas about dream-production processes and the most important topics for dream research. Freud studied dreams in the course of psychoanalyzing himself and his neurotic patients, whereas Hobson and McCarley studied the brain during sleep and emphasized correlations between neurophysiological events and dream events. Foulkes studied dreaming in children and drew comparisons between the development of dreaming and the development of waking thought. Finally, we will examine the question of what psychological functions dreaming might serve.

SIGMUND FREUD'S PSYCHOANALYTIC THEORY OF DREAMING

Freud's book *The Interpretation of Dreams* (1900/1965) had a profound impact on dream research and theories, extending through to the modern era of laboratory studies. Freud's dominant interest was the practical one of developing a systematic method of dream interpretation, since he believed that dreams are "the royal road to the unconscious" and that neurotic symptoms could be cured by uncovering their unconscious sources. However, he also wanted to develop a psychological theory of dreaming that would explain how manifest dream contents are produced. Freud's theory of dreaming has close ties with other aspects of his psychoanalytic theory, including his ideas about the structure of the psyche in terms of conscious, preconscious, and unconscious levels (see Chapter 1).

Freud distinguished between the *manifest* or surface content of the dream and its *latent* or hidden content. The objects and events in the manifest dream are *symbols* that represent the latent dream thoughts. For example, the manifest content of a dream might include images of riding a train through a tunnel. But, in Freud's view, the true meaning of the dream lies in its hidden content. Thus, the train might be a symbol for a penis, the tunnel might represent a vagina, and riding the train through the tunnel might represent the dreamer's desire for sexual intercourse. Freud's theory of dreaming was intended to explain how the latent content is converted into the manifest content—the dream as it is directly experienced by the dreamer.

In Freud's psychoanalytic theory, the unconscious part of the psyche (the "id") has certain instinctive wishes or desires, primarily of a sexual or aggressive nature. We usually cannot directly fulfill our instinctive wishes because of the constraints of reality. If we were to recklessly pursue our unconscious desires we would be punished by society, and even if our exploits

went undetected we would still feel guilt and anxiety (due to the "superego" or conscience). Yet unconscious desires, under the pressure of psychic energy, must find some outlet. Neurotic symptoms are one outlet, but dreams are the main outlet.

Characteristics of Dreams

Every theory of dreaming is influenced by the theorist's ideas about which characteristics of dreams need to be explained. Freud listed several surface characteristics of dreams: (1) The dream thought "is transformed into visual images and speech." (2) The thought "is represented as an immediate situation with the 'perhaps' omitted" (1900/1965, p. 573)—in other words, the dream world is accepted as reality by the dreamer. This is the *hallucinatory* quality of dreams. (3) Dreams are, for the most part, intelligible to the dreamer, though they may contain bizarre elements or distortions of reality. (4) Elements from the waking life—people, objects, and events, as well as desires and conflicts—commonly appear in dreams. These elements are the *day residues*.

How Dreams Are Produced

Dreams are produced in two stages. First, the unconscious wish motivates the production of *latent dream thoughts*. Second, the latent dream thoughts are transformed into the manifest content by the *dreamwork*, a preconscious process. Freud was not concerned with explaining how latent dream thoughts are produced—he took them for granted. His concern was to explain why and how latent thoughts are transformed into the manifest dream.

According to Freud, we do not dream directly—in the manifest content—about our unconscious wishes because to do so would cause us to feel guilt and anxiety, since unconscious wishes are mostly of a sexual or aggressive nature. (Freud wrote at a time when sexual desires were more a cause for guilt feelings than they are today.) The *psychic censor* (part of the preconscious) resists admitting the forbidden wishes to consciousness. Yet the wishes, driven by the psychic energy of the unconscious, are persistent. The dreamwork process translates the latent dream thoughts or forbidden wishes into symbols that form the surface content of the dream. When expressed in the form of a dream, the hidden desires can get past the psychic censor and be admitted to consciousness, since in their disguised form they do not cause anxiety.

If we were to dream directly about our unconscious desires, the resulting anxiety would cause us to awaken. Thus, in translating unacceptable unconscious desires into acceptable dreams, the dreamwork not only prevents conscious anxiety but also serves a secondary function of preserving sleep. In postulating a sleep-preservation function of dreaming, Freud attributed to dreaming a biological adaptive function consistent with Darwin's theory of evolution (R. M. Jones 1970).

The dreamwork. According to Freud: "At bottom, dreams are nothing other than a particular *form* of thinking, made possible by the conditions of the state of sleep. It is the *dream-work* which creates that form, and it alone is the essence of dreaming—the explanation of its peculiar nature" (1900/1965, p. 545).

In constructing the dream, two conditions must be met: the dream elements must be able to get past the preconscious censor, and the dream must be intelligible. The mental operations used to meet these conditions account for the characteristics of dreams. Four mental operations carried out by the dreamwork and the censor are particularly important in the dream construction process: displacement, condensation, visual representation, and secondary revision.[1]

(1) *Displacement.* The prominent dream elements are the ones most closely scrutinized by the censor. To deceive the censor about what is really important in the dream, the dreamwork may distort the relationship between the manifest content and the latent content in several ways. *Displacement*—the shifting of psychic energy (or affect—emotional feeling) from its original idea or object onto a substitute—is one of the chief means of distortion. With displacement a prominent dream element may appear to be of great emotional significance, whereas the truly important latent thought may be symbolized by a seemingly trivial dream element. A related type of distortion is *reversal*, which occurs when the dream seems to express a wish, or related emotion, that is really the opposite from, or quite different from, the hidden wish or emotion.

Energy displacement and wish distortion are shown in a dream reported to Freud by a young female patient. The patient lived with her sister, who had had two sons, Otto and Karl. But Otto, the patient's favorite, had died several months earlier. The patient reported: "I dreamt that I saw Karl lying before me dead. He was lying in his little coffin with his hands folded and with candles all round—in fact just like little Otto, whose death was such a blow to me" (Freud 1900/1965, p. 186).

The dream does not represent a wish that Karl would die or that he had died instead of Otto. Rather, following further interviews with the patient about her past and recent experiences, and her associations to the dream, Freud discovered the following information: Some time before, the patient had fallen in love with a man, a professor, who was a friend of her sister and often visited her sister's house. After a while the man stopped visiting, but the patient couldn't get over her desire for him, and she often attended his lectures. Over a period of many months she had talked with him only once, when he visited the house for Otto's funeral. But the next day (the day after the dream) she planned to attend a concert where she hoped to catch a glimpse of the professor in the audience. Freud's interpretation of the dream was that the patient strongly desired to see the professor again, so she dreamed of the funeral of a nephew, where she had last seen the professor, and could expect to see him again. The grief attached to her nephew in the dream was a reversal and displacement of her love for the professor. This dream shows how, in Freudian dream interpretation, the meaning of a dream may be far from obvious!

This next dream was told to Freud by a lawyer friend, who was having a love affair with a married woman.

> I dreamt that I came up to my house with a lady on my arm. A closed carriage was standing in front of it and a man came up to me, showed me his credentials as a police officer and requested me to follow him. I asked him to allow me a little time to put my affairs in order (p. 188).

On further questioning, it came out that the dream police had arrested the man for infanticide. The night of the dream, he had spent the night with his mistress. They had had intercourse several times, and he had used the *coitus interruptus* technique of birth control. Freud interpreted the dream to mean two things. The part about taking the woman home was a straightforward expression of the lawyer's wish that he could marry her. The part about being arrested for infanticide reflected his fear that he might have gotten her pregnant. The line of reasoning for the latter interpretation was as follows: The lawyer knew that some religious persons believe that preventing a baby from being conceived is morally equivalent to killing a baby. The dreamwork, Freud concluded, had used reverse symbolism to disguise the lawyer's true anxiety over *failure* to prevent pregnancy as anxiety that he had *succeeded* in preventing pregnancy (symbolized as infanticide). Freud consistently emphasized the point that dreams can be interpreted only in conjunction with knowledge of the dreamer's real-life situation and his or her associations to the dream.

In some dreams the fundamental wish or affect is expressed in its original form, though diminished in intensity, and displaced onto a different person or object from that of the latent thought. Or fears and desires may be reversed. For example, suppose a boy dreamed about the death of his family's dog. Though such an event in reality would cause the boy to feel great distress, during the dream he feels only the slightest sadness over the dog's death. In Freud's view, the latent idea behind the dream might be the boy's wish for the death of his father (the "Oedipus complex"), and the dreamwork selects the dog (a day residue) to represent the father. (The father is the dog's master.) The boy dreams of an event that would make him consciously sad to symbolically represent what he unconsciously desires.

(2) *Condensation.* Freud observed that a written dream analysis is invariably much longer than the written description of the dream itself, and he concluded that the latent dream thoughts are expressed in the dream in a condensed or abbreviated manner. Sometimes two latent ideas will be represented by a single symbol. Speech is also condensed in dreams.

(3) *Visual representation.* Dreams consist mostly of visual mental images; they include some speech, but other auditory images are rare, as are images from other modalities (touch, etc.). Visual images are preferred because they provide the widest range of possibilities for representing ideas in symbols. Visual images are rich in associations, such that one thought can lead to another one due to similarity in appearance, time and place, function, or emotional content. Thus, latent ideas—even abstract ones—can be represented by visual images with which they share some feature. (For example, consider the similarity between the image of a train going through a tunnel and sex-

ual intercourse.) Visual symbols can represent several latent ideas through condensation. Latent ideas have the best chance of getting past the censor when they are symbolized by visual mental images.

(4) *Secondary revision.* The preconscious censor requires that dreams be consciously intelligible. If they operated alone, the three main dreamwork operations—displacement, condensation, and visual representation—would tend to produce dreams that are fragmented and incoherent, with bizarre images. But in fact most dreams seem to tell some coherent sort of story, with recognizable images. The dreamwork selects and constructs symbol-images that are usually realistic or plausible, or at least recognizable. Then the censor does *secondary revision* of the dream, editing it and filling in the gaps to make a comprehendible story. Thus, the dream censor is responsible for the hallucinatory nature of dreams: the fact that the dream world seems to be reality—as long as the dreamer is still asleep.

Day residues. Why are day residues—memories of people and objects and events of the preceding day—so common in dreams? According to Freud, before an unconscious idea can be symbolized in a conscious dream, the idea must first enter the preconscious, where the dreamwork is done. In order to enter the preconscious, the unconscious idea must first establish some sort of *link* with an idea that is already in the preconscious. Day residues provide that link. The link between a day residue and an unconscious wish can be established in two ways: a wish may transfer its energy to a day residue, or a day residue may stir up an unconscious wish. In either case, an image from the day residue memory comes to serve as a symbolic representation of the unconscious wish.

The connection between day residues and unconscious wishes may not be obvious. Wishes are usually transferred to trivial day residues (displacement), because trivial day residues are less likely to have anxiety-evoking associations. Sometimes the day residue is not easily recognizable, since its appearance may be distorted by the dreamwork.

Forgetting dreams. Most of our dreams are forgotten. Freud explained this fact in terms of *repression,* an emotional block against retrieval. Presumably there is a danger that if we recall our dreams in the waking state we might see through the dream symbolism and recognize our forbidden unconscious desires, resulting in anxiety and guilt.

Evaluation of Freud's Theory of Dreaming

Freud's *The Interpretation of Dreams* (1900/1965) is one of most influential books of Western intellectual history. It was the seminal work of Freudian psychoanalysis, not only for its exposition of the method of dream interpretation, but for previewing ideas about neurosis that were developed more fully in Freud's later writings. Freud's theory influenced not only psychoanalysis and psychology, but also other disciplines, such as philosophy, literature, art, and anthropology. His ideas were the starting place for several other psychodynamic theories of dreaming and dream interpretation, such as those of Carl Jung and Alfred Adler (R. M. Jones 1970). Most other theo-

rists put less emphasis on sexuality and repressed wishes and more emphasis on current concerns in dreams than Freud. And modern theorists often take the manifest dream content more seriously, putting less emphasis on dream distortion and deep symbolism than Freud. But even when they disagree with Freud, modern dream theorists acknowledge the importance of his ideas and usually take the trouble to compare their ideas with his.

How does Freud's theory of dreaming stand up as a *scientific* theory? The main problem is that it is too vague, and as a consequence, it cannot be rigorously tested. The theory is flexible enough to interpret any dream after the fact, but is not precise enough to make any unique predictions that could be experimentally tested. For example, Freud said that latent wishes are sometimes represented as their opposite, but there is no way of knowing, prior to the dream interpretation, whether a wish will be represented as itself or as its opposite.

The central assumption of Freud's theory of dreaming is that the manifest dream contents are produced through the dreamwork process's purposeful and systematic transformation of latent dream thoughts into symbolic representations. This is a *paradigmatic* assumption: you have to agree with it in order for the rest of the theory to make any sense. And you have to agree with it in order to attempt to test the theory. The only way to test the theory is by interpreting dreams to see whether they could have been constructed by the dreamwork process described by Freud. The problem with using dream interpretation as evidence for dreamwork is that any dream can be interpreted in several ways, and there is no way of knowing which, if any, interpretation is correct. Thus, we cannot assume that interpreting dreams (decoding manifest content into latent content) necessarily reveals the process by which they are generated (encoding latent content into manifest content).

Freud claimed that dreams are symbolic expressions of unconscious desires. To be more specific, he said that "a wish which is represented in a dream must be an *infantile* one"—an instinctive wish with which we are born (1900/1965, p. 592). But in fact, R. M. Jones (1970) found that among the dozens of dreams analyzed by Freud (1900/1965), not a single one was traced to a repressed infantile wish. Every dream discussed by Freud represented either a conscious wish or a suppressed wish of postinfantile origin. Many dreams are blatant expressions of conscious wishes and desires, such as love, sex, social acceptance, prosperity, achievement, or prestige. For example, in the woman's dream of her nephew's death described above, Freud went through a roundabout interpretation to reveal that the dream was about a desire of which the woman was consciously aware, namely, her desire to be with and be loved by the professor.

In attempting to test Freud's theory, researchers have generally been lenient and accepted any evidence of wish fulfillment in dreams as positive evidence for the theory, regardless of whether the wish was adult or infantile, conscious or repressed. Indeed, Freud had an escape clause that encouraged this attitude: "a conscious wish can only become a dream instigator if it succeeds in awakening an unconscious wish with the same tenor and in obtaining reinforcement from it" (1900/1965, p. 591). Thus, Freud allowed that

conscious wishes can be expressed in dreams, though he thought that dream interpretation would reveal a repressed wish, too.

Freud's theory can easily be discredited by the evidence, if you are skeptical about the theory in the first place and you cannot see that a particular dream is really a symbolic representation of a wish. Ideally, a good scientific theory should be able to convince a reasonable, fair-minded skeptic that it is plausible, based on the evidence. As we will see, some modern theorists are not willing to grant Freud's assumption that dreams are psychologically motivated, symbolically disguised representations of repressed thoughts or desires.

HOBSON AND McCARLEY'S NEUROPHYSIOLOGICAL THEORY OF DREAMING

Allan Hobson and Robert McCarley (1977) devised the *activation-synthesis hypothesis* to explain dreaming in REM sleep. (They called it "D" sleep, the "D" referring to both desynchronized brain waves and dreaming.) Hobson subsequently elaborated on the hypothesis in his book *The Dreaming Brain* (1988). The activation synthesis hypothesis was developed from a neurobiological viewpoint, rather than a psychological viewpoint, and thus it is different in many ways from Freud's theory. Hobson and McCarley do not grant Freud his main assumptions, that dreams are psychologically motivated, and that the manifest content is a symbolic representation of latent dream thoughts. Rather, the activation-synthesis hypothesis says that dreams are a byproduct of neurophysiological events during REM sleep.

The essence of the activation-synthesis hypothesis is that dreams occur as a result of the forebrain (particularly, the neocortex)[2] constructing images to correspond *isomorphically* to the fluctuating pattern of internally generated stimuli that occurs during REM sleep. Isomorphism means, literally, having the same shape or form. Here, isomorphic correspondence means that the dream images fit or match up in a one-to-one manner with the physiological responses. For example, when the sleeper's eyes move to the right, a fitting dream image is constructed, such as an automobile moving from left to right.

The activation-synthesis hypothesis is designed specifically to account for hallucinoid dreaming during REM sleep. It is not concerned with less vivid or nonperceptual (thought-like) forms of mental activity during sleep, nor is it concerned with dream-like experiences that occur in states other than REM.

Hobson and McCarley's Definition of Dream

Hobson and McCarley's definition of *dream* is important, because it points out what they are trying to explain in the activation-synthesis hypothesis. Their definition of dream has five points, of which the first three are most critical:

> A dream may be defined as a mental experience, occurring in sleep, which is characterized by (1) *hallucinoid imagery*, predominantly visual and often vivid; by (2) *bizarre elements* due to such spatiotemporal distortions as condensation, discontinuity, and acceleration; and by (3) a *delusional acceptance* of these phenomena as "real" at the time that they occur. (4) *Strong emotion* may or may not be associated with these distinctive formal properties of the dream, and (5) *subsequent recall* of these mental events is almost invariably poor unless an immediate arousal from sleep occurs (1977, p. 1336, numerals and italics added).

Two Sides of the Activation-Synthesis Hypothesis

Activation. There are two sides to the activation-synthesis hypothesis: the activation side and the synthesis side. The activation side involves explanations of the cyclic occurrence of REM sleep and of the particular physiological responses that occur during REM. Hobson and McCarley (1977; Hobson 1988) presented evidence showing that the REM sleep cycle is controlled by a neurobiological clock located in the pontine (of the pons) reticular formation of the brain stem (see Figure 5.1). The evidence comes mainly from animal studies involving small brain lesions and/or measurement of brain waves from single neurons in various parts of the brain stem and cortex. For example, bursts of phasic eye movements are strongly correlated with *PGO waves* spreading from the pontine system to the cortex.[3] (PGO stands for pons, lateral geniculate [of the thalamus], and occipital cortex.) Both phasic eye movements and PGO waves are preceded by firings of "giant cells" of the pons, which are an integral part of the biological clock that controls the REM cycle.

Several physiological responses of REM are caused directly or indirectly by the periodic activation of the pontine reticular formation. These responses (see Table 10.1) include: (1) tonic activation of the cortex (shown by desynchronized brain waves [EEG]); (2) tonic inhibition of spinal motoneurons (reduction of muscle tension [EMG] and motor paralysis); (3) phasic rapid eye movements (EOG); (4) blockade of exteroceptive input; and (5) phasic activation of the vestibular system (sense of body position and balance). Also, (6) autonomic responses (heart rate, breathing) become more irregular during REM sleep.

Synthesis. The synthesis side of the activation-synthesis hypothesis is about the actual production of dreams during REM sleep. The *primary stimuli* for dreams are internally generated stimuli produced by the fluctuating pattern of physiological responses during REM. Primary types of sensory activity include: (1) feedback from eye movements and (2) corollary discharge from the motor system, where the brain commands certain movements and at the same time sends information to sensory systems to allow the brain to anticipate the consequences of those movements. Other stimulation comes from (3) vestibular system activity and (4) feedback from the autonomic nervous system (indicating increased heart rate, and so on). Also important as part of the overall sensory pattern are the *absence* of (or reduced sensitivity to) exteroceptive stimulation (vision, hearing) and the absence of kinesthetic feedback from actual movements (since the major muscles are effectively paralyzed due to motoneuron inhibition during REM sleep).

The dream itself is produced by the brain's attempt to synthesize a series of images to match the changing pattern of internally generated sensory activity. Presumably, the brain selects images—involving activity by the dreamer or events that he or she observes—to correspond isomorphically to the pattern of eye movements and body-movement commands during REM sleep. The synthesized (constructed) images are based on information in memory. Day residues commonly occur in dreams because memories of recent waking experiences are likely to be readily available for selection by the synthesis process.

Hobson and McCarley did not attempt to explain *why* the cortex synthesizes images to fit the sensory frames. Synthesis was assumed to be an automatic cortical process. This is not too far-fetched an assumption. It is related to the fact that the waking brain interprets the varying pattern of sensory input to produce coherent, conscious perceptions of objects and events.

Recently, Hobson (1988) added a third component to the activation-synthesis hypothesis—the concept of *mode switching*, which accounts for the way the activated forebrain synthesizes information in dreaming (compared with waking). Mode switching involves changes in perception, thinking, and memory processes during REM sleep. As a result, unusual or bizarre combinations of objects, scenes, and events may be produced in dreams. Critical judgment and reflective thought are disrupted, such that bizarre dream images may be accepted as reality by dreamers (while they are still asleep). Also, mode switching entails the disruption of information processing for storing new memories.

The activation-synthesis hypothesis attempts to explain only the formal or abstract qualities of dreams, such as variations in the intensity of activity, the direction of movement, scene shifts, bizarre elements such as fragmentation and condensation, and their visual nature. The activation-synthesis hypothesis does not attempt to explain specific dream-image contents (particular persons, places, events). The only requirement of the synthesized images is that they have an isomorphic correspondence with the spatiotemporally specific but fluctuating frames provided by the primary stimuli. The conceptual content of the images is arbitrary, and hence often bizarre: "The forebrain may be making the best of a bad job in producing even partially coherent dream imagery from the relatively noisy signals sent up to it from the brain stem" (Hobson & McCarley 1977, p. 1347).

Examples. According to the activation-synthesis hypothesis, *flying dreams* could result from irregular activity in the vestibular system, which produces sensations of changes in body position and movement. The forebrain synthesizes an image to fit the proprioceptive information—such as an image of flying, floating, or swimming. A Freudian interpretation in terms of sexual symbolism is unnecessary. *Chase dreams*, where the dreamer has trouble fleeing from a pursuer, could result from the activated motor cortex "commanding" running movements, while at the same time the absence of kinesthetic feedback tells the forebrain that the legs are not moving: hence the dream of trying to run, but not being able to do so. Feelings of *anxiety* in dreams could be the forebrain's interpretation of momentary changes in au-

tonomic arousal (increased heartbeat, breathing) during REM. (This notion is consistent with the Schachter-Singer [1962] cognition-arousal theory of emotion.) Dreams with a lot of rapid movement could result from bursts of eye movements during REM sleep, whereas relatively quiet dream intervals would correspond to periods with relatively little eye movement.

Comparison to Freud. The activation-synthesis hypothesis differs profoundly from Freud's theory on a number of key issues. (1) The motivating force behind dreams is not wishes or conflicts. Dreams are not psychologically motivated at all. The motivating force is nothing more than the physiological drive for REM sleep. Dreams are a byproduct of physiological responses and brain processes that occur in REM sleep. (2) There is no distinction between manifest dreams and a latent dream contents. Dreams are not symbolic, disguised representations of hidden thoughts. Rather, they are images synthesized to match a fluctuating pattern of physiological responses. (3) Thus, there is no need to assume that there is either a psychic censor or a dreamwork process. (4) The forgetting of dreams is not a result of repression. Rather, in keeping with the neurobiological orientation of the activation-synthesis hypothesis, the usual poor recall of dreams is attributed to a "state-dependent amnesia" having to do with decreases in neuronal activity in memory-encoding circuits during REM sleep (Hobson 1988).

The activation-synthesis hypothesis claims only to account for the formal properties of dreams. It does not attempt to predict or explain the specific meaningful content of dreams. The hypothesis does not deny that dreams may reflect aspects of the dreamer's personality or current concerns. After all, dream images are synthesized from material in the individual's memory.

Research Relevant to the Activation-Synthesis Hypothesis

A major strength of the activation-synthesis hypothesis is that, unlike Freud's theory, it is, in principle, capable of being tested and potentially refuted by research evidence.

Regarding the process of activation of REM sleep, Hobson and McCarley's (1977) original hypothesis that it depends on a biological clock located in a localized group of cells in the pons of the brain stem has been challenged in light of more recent animal research. Vogel (1978) summarized evidence that the REM cycle depends on an interaction between the brain stem and the forebrain. Hobson, Lydic, and Baghdoyan (1986) presented a new neural model that is less localized than the original. The details of the REM cycle-activation process continue to be controversial. However, for our purposes the synthesis side of the hypothesis is more important.

Let us consider evidence about the *synthesis* side of the activation-synthesis hypothesis. The hypothesis makes three major predictions. (1) Dreaming occurs only during REM sleep. (2) Typical REM dreams will have bizarre elements, due to the cortex's difficulty in consistently synthesizing meaningful and coherent images to fit the relatively haphazard and more or less randomly fluctuating pattern of internally generated stimuli. (3) The for-

mal characteristics of REM dreams (such as direction of movement, scene shifts) will show an isomorphic correspondence to the fluctuating pattern of physiological responses during REM sleep.

Limitation of dreaming to REM sleep. In Chapter 11 I discussed evidence that dreaming with visual imagery does, in fact, occur during NREM sleep, and also during sleep onset (hypnagogic state), when the pattern of physiological responses is quite different from REM sleep. Thus, Hobson and McCarley are incorrect to assume that dreaming occurs only as a response to the physiological events of REM sleep (Vogel 1978).[4] However, insofar as there are some differences between REM and NREM mentation, it is worthwhile to pursue the activation-synthesis hypothesis further to see whether it can account for the characteristics of REM dreams. REM dreams are more readily recalled, and they are more likely to be visually vivid, dramatic, emotional, and bizarre, compared to NREM dreams.

Bizarreness. On the question of whether typical REM dreams are bizarre, recall the discussion in the preceding chapter of Snyder's (1970) normative study, in which he concluded that most REM dreams are visual and story-like, but not particularly dramatic or bizarre. Snyder defined bizarreness as events that are "outside the conceivable expectations of waking life; to put it bluntly: the craziness of the dream" (p. 146). For example, a dream of Daddy riding a broom to work is bizarre; Daddy riding an airplane is moderately credible but it is not bizarre. In his sample, Snyder found only 13 percent of REM dreams to be moderately or highly bizarre, whereas 28 percent were slightly bizarre. Most laboratory studies have supported Snyder's conclusion that most REM dreams are realistic rather than bizarre (Vogel 1978).

McCarley and Hoffman (1981) presented further evidence on the question of bizarreness, based on a sample of 104 REM dreams collected from fourteen subjects in a sleep laboratory. They defined bizarreness in terms of events that would be impossible or highly improbable or inappropriate in waking life, and they scored bizarre events in three categories: (1) animate characters (such as distorted bodies, monsters, impossible actions); (2) inanimate environment (such as violation of physical laws, fantastic environments); and (3) dream transformations (such as sudden scene shifts "where the entire environment is altered without the character having moved from one scene to another," p. 912). By these criteria some 67 percent of the dreams had at least one bizarre element.

The most common type of bizarreness involved sudden scene shifts (37 percent of dreams), which the activation-synthesis hypothesis attributes to major shifts in the pattern of physiological responses. About 55 percent of the dreams had one or more bizarre elements other than a scene shift. The most common other types of bizarreness were impossible actions (23 percent, for example, humans flying, animals talking) and fantastic environments (15 percent). I would argue that sudden scene shifts should not be classified as bizarre. After all, daydreams often have sudden shifts of topic or scene without creating an impression of bizarreness. (Wollman and Antrobus [1986] found that topic shifts actually occur more often in waking

thought than in REM mentation.) Nor do sudden scene shifts in movies create an impression of bizarreness.

Overall, the evidence on bizarreness in REM dreams is mixed. The McCarley and Hoffman (1981) and Snyder (1970) data cannot be directly compared, since they used somewhat different criteria for classifying bizarreness. Snyder rated the degree of bizarreness, whereas McCarley and Hoffman did not rate degrees of bizarreness but went into more detail on types of bizarreness. It seems safe to say that at least a large minority of REM dreams have some degree of bizarreness, though only a small minority of dreams are highly bizarre. If this conclusion is accurate, then the evidence provides only weak support for the activation- synthesis hypothesis, which seems to predict that most REM dreams should be highly bizarre.

Isomorphism. The isomorphism principle suggests that there will be a correspondence between the form of dream events and the form of physiological events occurring at the same time. According to the activation-synthesis hypothesis, the correspondence should be such that the dream images might plausibly have been generated to match the pattern of physiological responses. One can look for isomorphic correspondence at two levels: (1) *specific isomorphic correspondence*, where specific physiological events can be readily identified with specific dream events (for example, the direction of dream-image movements corresponding to the direction of the sleeper's actual eye movements); and (2) *nonspecific parallelism*, where the overall amount of some type of dream activity is related to the amount of activity in a corresponding physiological subsystem (for example, the amount of observed movement in the dream being greater, the greater the frequency of eye movements). Bear in mind the fact that an observed temporal correlation between dream events and physiological events would not prove the direction of causality between the events; conceivably, the correlation could be caused by some third factor that has not been measured.

Possible correspondence between dream-image movements and the dreamer's eye movements during REM sleep was first investigated by Dement and Kleitman (1957). Earlier REM-dream researchers were interested in testing the *scanning hypothesis*, which suggested that eye movements occur during REM sleep because the dreamer is scanning the visual dream images. Thus, conspicuous movements in dream images (such as somebody jumping) should correspond to actual eye movements as the dreamer "watches" the action. (Note that the direction of causality between dream movements and eye movements assumed by the scanning hypothesis was the opposite of that assumed by the activation-synthesis hypothesis.) In support of the isomorphism principle, in one dream report the dream character walked up a flight of five stairs, and the polygraph chart showed that a series of five upward eye movements had occurred at the same time as the dream (Dement 1976; Roffwarg et al. 1962). Although this case has been widely cited, in fact it is highly unusual. Most studies have found no correspondence between the direction of dream action and the direction of eye movements, and earlier studies that found a correspondence have been criticized on methodological grounds (reviews by Rechtschaffen 1973; Pivik 1978; Schwartz, Weinstein, & Arkin 1978).

In a more recent study, Herman et al. (1984) found that a blind judge could postdict (predict after-the-fact) at a better-than-chance level both the directional axis (vertical or horizontal) and the relative frequency (high, medium, or low) of eye movements based on dream reports. But the researchers searched in vain for evidence of a more detailed correspondence between eye movements and dream images: "In no case did the timing, direction, and amplitude of recorded eye movements exhibit continuous isomorphism with the dream narrative" (p. 59).

Bearing in mind that eye movements are not continuous in REM sleep and may show considerable variability from one REM segment to another, several studies have found a positive correlation between the amount of eye movements and the amount of action in the dream (Dement & Wolpert 1958; Molinari & Foulkes 1969). Foulkes et al. (1972) found a correlation between the amount of eye movement and the amount of visual activity by the self character in the dream report. These studies support the notion of a nonspecific parallelism for eye movements between dream events and physiological events.

Several studies have looked for correspondences between dream events and other physiological events besides eye movements, including measures such as heart rate, vasoconstriction, respiratory rate, and skin potential. Such studies have found mixed, largely negative results. For example, an elaborate study by Hauri and Van de Castle (1973) examined some 120 different correlations between various aspects of dreams and several physiological measures. A few correlations were significant, but their pattern seemed to be random. The only finding that made much sense was a positive correlation between the amount of heart rate variability and the amount of emotionality shown in the dream report, and this finding has not been consistently replicated in other studies.

An isomorphism principle would seem to predict a correlation between the occurrence of penile erections during sleep and sexual activity in dream reports. Fisher (1966) found a relationship between these measures: In seventeen REM periods with little or no erection there were no instances of overt sexual content in the dream, whereas in thirty cases with moderate-to-full erections there were eight dream reports with overt sexual content. (Among the latter group, there was sexual content in dreams in five of six cases with particularly rapid tumescence.) In other words, while erections often occur without sexual dream content, sexual dreams are unlikely to occur in men without an accompanying erection.[5] However, while the activation-synthesis hypothesis would predict a high degree of correspondence between sleep erections and sexual dreams, this high correspondence does not occur.

In conclusion, the evidence on isomorphic correspondence between dream events and physiological events is mixed and largely negative. There are formidable methodological difficulties in testing such a correspondence, for example, getting a sufficiently accurate and detailed dream report and knowing how best to score the dream variables and which physiological measures to correlate with them (Cohen 1979a; Rechtschaffen 1973). Although the evidence on isomorphism is mostly negative, and hence fails to support the activation-synthesis hypothesis, it is conceivable that more positive evi-

dence will be found in the future as a result of improvements in dream-research technology and methodology. Following their review of the literature, Schwartz et al. (1978) were optimistic: "The hypothesis of a relationship between REM activity and dream activity is not dead; we are dealing with a subtle, unimposing but nevertheless real finding" (p. 192).

Summary and Conclusion

The activation-synthesis hypothesis explains, in a general way, the five general features of dreams that Hobson and McCarley (1977) specified in their definition of dream. (1) Visual and motor hallucination result from the brain's attempt to match dream images to patterns of visual and motor system activation in REM sleep. (2) Spatial and temporal distortions occur because the spatiotemporal patterns of internally generated stimuli during REM sleep are unusual, so unusual images may be generated to match them. (3) Dreams are delusional because of the disruption of judgment and reflective thought, and because of the absence of external cues to provide a consistent frame of reference. (4) Intensified emotion occurs because of feedback from activated limbic system emotion centers and the autonomic nervous system (for example, faster or irregular heartbeat), which is synthesized into dream images. (5) Dream amnesia (forgetting of dreams) occurs because of changes in the information-processing mode in REM sleep, as if a "remember this" instruction had been omitted (evidence suggests a reduction of activity in certain aminergic memory-encoding circuit neurons during REM sleep [Hobson 1988]).

Attempts to test the activation-synthesis hypothesis more precisely have met with mixed results. Whereas the activation-synthesis hypothesis predicts that REM dreams will be bizarre and emotional, most sleep laboratory studies have found that most REM dreams are relatively plausible and mundane. Dreams spontaneously recalled at home are more likely to be dramatic and bizarre than are systematically sampled REM dreams, but home dreams are a biased sample of dreams based on selective recall of more salient, attention-grabbing dreams. Furthermore, dreams are not limited to REM sleep; they also occur at sleep onset (hypnagogic state) and in various NREM stages, although NREM dreams are less vivid and memorable than REM dreams. The evidence for the activation-synthesis hypothesis's strongest prediction—that of specific isomorphism between dream events and physiological events, such as between the direction of "dream eye" movements and actual eye movements—is largely negative.

It could be argued that the Hobson and McCarley's activation-synthesis hypothesis is more an explanation of popular dream stereotypes than an explanation of systematically sampled dream data (Foulkes 1990). But on the positive side, the activation-synthesis hypothesis can account for some of the bizarreness that does occur in dreams. And as for isomorphism, at a more general level of correlation between the relative amounts of dream activity and phasic physiological events, the evidence is largely positive (Antrobus 1990). It is to the activation-synthesis hypothesis's credit that it makes some predictions that are specific enough that they can be tested by research.

From an identity-theory viewpoint on the mind-body problem, there is

every reason to expect that specific types of conscious events are correlated with specific patterns of brain events at some level. But for both the sleep state and the waking state, the current evidence indicates only a rough correspondence. Perhaps the evidence for specific correspondences will improve in the future, with the help of technological advances in neurophysiological measurement techniques. But insofar as there continues to be a poor correspondence between dream events and internal sensory events in REM sleep, the implication is that the activation-synthesis hypothesis is incorrect in specifying that dreams are just a matter of synthesizing images to fit patterns of internally generated stimulation. Dreams may be synthesized from memory elements, more than from internal stimulus patterns. Or, insofar as dreaming is a thought process occurring during sleep, it may be an active, self-guided process that generates images to suit its own themes, largely (though not entirely) independently of current internal and external stimuli.

Even if it is not correct in all of its details, the activation-synthesis hypothesis probably is at least partly right: internally generated stimulation from physiological events during sleep do influence the dream generation process. Consider, for example, the common experience of dream themes associated with urination being followed by awakening and feeling the need to urinate. Undoubtedly other factors besides internal stimulation are also important. The next section describes Foulkes's cognitive theory, which is similar to the activation-synthesis hypothesis in proposing that dreaming is a process of interpretation and synthesis, but differs in emphasizing activated memory events, not internal sensory events, as the critical information to be synthesized in the dream-production process.

DAVID FOULKES'S COGNITIVE THEORY OF DREAMING

In his book *Dreaming: A Cognitive-Psychological Analysis*, David Foulkes (1985) considered over thirty years of modern laboratory dream research, including his own work on children's dreams, and interpreted it in light of modern cognitive psychology research and theory to provide a new interpretation of the psychological processes involved in dream production.

The Characteristics of Dreams

As with the other theories, I will begin with the theorist's ideas about the fundamental characteristics of dreams. Foulkes's (1985) list of dream characteristics was influenced by his cognitive viewpoint, and it shows what needs to be explained.

"Dreams are involuntary symbolic acts." By symbolic acts, Foulkes means simply that dreaming is a kind of thinking, and not some sort of faulty perception. In particular, dreaming involves thinking in visual mental images, though speech also occurs in many dreams. In saying that dreams are symbolic acts, Foulkes does not mean the deep symbolism stressed by Freud, where the surface dream contents are assumed to symbolize hidden dream

thoughts. Rather, Foulkes sees dreams as symbolic in the more general sense, where a symbol is something that stands for something else and, in particular, a symbol is a mental event that represents some real or imagined external reality. To say that dreams are involuntary means simply that we do not consciously will them to happen.

"The sources of dreams lie in what we know." Ultimately, all dream images are based on knowledge that we have accumulated throughout our lives, including personal experiences and relatively impersonal, conceptual knowledge. Even our most fantastic and distorted dream images are constructions and transformations based on what we know.

An implication of this characteristic of dreams is that the dreams of young children, who have relatively little conceptual knowledge or life experience, would be simpler than those of adults. Foulkes's research (1982a) shows this to be the case. For example, when my son Michael was a toddler (two years, two months old), as I was getting him up one morning he said "I saw a bus in the air." Upon questioning he revealed that it was a big yellow bus, but there was no elaboration, no story, and no personal involvement revealed in his report. It would be rare for an adult to have such an impoverished dream.

"Dreams draw on dissociated elements of memory and knowledge." Though dreaming is memory-based, it is not mere remembering in the sense of recall of past experiences. Dreaming is creative. We may have dreams with combinations of people, objects, settings, and events that have never occurred together in reality. Individual images can also be novel combinations of elements; for example, *physiognomic fusions* are faces that are a combination of facial features of two or more people, such as the eyes and eyebrows of one person and the mouth, beard, and hair of another. Here, dissociated elements are elements that normally occur together (such as all of the facial features of a person), but which become disconnected and appear separately or in novel combinations in dreams.

"Dreams are organized mental acts." Even though they are constructed of dissociated elements of knowledge, typical dreams are comprehensible and plausible. The sequence of dream events hangs together to form a narrative or story, rather than being random. Though sudden, dramatic scene shifts sometimes occur in dreams, typical dreams involve a continuity of characters and setting from one scene to the next (Foulkes & Schmidt 1983).

"Dreams are credible world analogs." Dreams are world analogs in the sense that phenomenologically they represent the shapes of people and objects and their spatial relationships in a manner similar to the way they appear in the real world of waking experience. Most REM dreams are so lifelike that we accept them as real at the time.[6] Truly bizarre dreams are relatively rare, though when they occur they are so striking that we remember them better than we remember the more typical mundane dreams. (The

bizarre Hieronymus Bosch paintings sometimes used to illustrate magazine articles on dreaming are not at all like typical dreams.)

"Dreams are self-revelations." Different people have different dreams because they have different knowledge bases, including personal autobiographical knowledge, to draw upon during the dream construction process. Furthermore, the "self" character appears in about 95 percent of REM dreams (Snyder 1970). However, the dream self may differ from the real self as knowledge about different persons (real or fictional) becomes dissociated and recombined in novel ways during the dreaming process.

Summary. To summarize Foulkes's characterization, dreaming is a thinking process, occurring during sleep, that operates "on our memories and knowledge to construct symbolic world-analogues in which events transpire in a narrative sequence" (Foulkes 1983, p. 355).

A Cognitive Theory of Dreaming

Basic assumptions. The two main principles of Foulkes's theory may be summarized before going into more detail. (1) Dreaming is instigated by *diffuse mnemonic activation*. That is, a variety of different memory elements are activated in a random or semi-random manner. The memory units may be either semantic (conceptual) or episodic (personal). (2) A *dream-production system* organizes the activated mnemonic elements into a comprehensible, conscious dream experience. The dream-production system uses our knowledge of narratives or scripts (common or plausible sequences of events) and the world (how things look, how they move, their spatial relationships, etc.) to produce dreams that are comprehensible, and usually plausible, both in terms of the momentary spatial organization of dream scenes and the sequential organization of dream events. Visuospatial thought processes are employed in the construction of organized, recognizable, kinematic (movie-like) conscious mental images.

Foulkes's theory can be clarified by contrasting Foulkes with Freud. Consider the following (hypothetical) dream report by a male subject: "I was driving down the highway in a red sports car. My mother was sitting beside me. I was driving pretty fast. Then a bear ran out in front of the car. I couldn't stop the car in time. I hit the bear and killed it." From a Freudian viewpoint, this dream could be interpreted in terms of the Oedipus complex: The dreamer has a hidden desire for sexual intercourse with his mother (symbolized by driving fast, with his mother beside him) and a desire to kill his father (the bear). The hidden desires motivated the dream, and the dreamwork process selected suitable mnemonic elements to serve as symbols to represent the hidden desires and wove the symbols into a comprehensible story. But in Foulkes's view, the mnemonic elements (mother, bear, sports car) were directly activated in a haphazard manner, without any prior wish or motive. The dream-production system then wove the elements together into a plausible, narrative sequence. Though based on the dreamer's knowledge, the dream is not psychologically motivated, nor does it necessarily symbolize any hidden desires.

Mnemonic activation. How does mnemonic activation occur? When we are awake, mnemonic activation occurs in three ways: (1) sensory elicitation, by either external stimuli (people and events) or internal stimuli (such as pains, tummy rumbles); (2) associative elicitation by other memory elements that have already been activated (spreading activation leads to the activation of semantically or episodically related concepts and events); and (3) directed retrieval, as when we willfully retrieve information that is relevant to the problem at hand.

When we are asleep, mnemonic activation operates much more haphazardly than when we are awake, for several reasons: (1) when we are asleep mnemonic activation occurs primarily as a result of spontaneous brain activity; (2) sensory elicitation is reduced during sleep, due to reduction of exteroceptive and interoceptive sensitivity; (3) associative elicitation is much freer during sleep, and more likely to follow unusual channels; and (4) directed retrieval is absent during sleep, since there is no voluntary, problem-solving–oriented thinking going on. Thus, mnemonic activation is a more passive process during sleep than when we are awake.

Mnemonic organization: The dream-production system. Interpreting one's experience seems to be a natural functional characteristic of the human mind/brain system. When we are awake we interpret our sensory experience though processes that select and organize the sensory inputs. In sleep, with external stimuli at a minimum, the interpretive system is bombarded with semi-randomly activated mnemonic units. It interprets this purely mnemonic experience by selecting and organizing it to produce a dream that we can consciously comprehend.

The dream-production process draws on thinking skills and knowledge that are essentially the same as those used in waking thought. Visuospatial thinking skills are used in generating recognizable mental images. Narrative thinking, whether awake or asleep, requires the ability to construct a linear sequence of events in time, which implies a capacity for advance planning. It draws on *script knowledge*—knowledge about typical sequences of events in particular situations (such as eating at a restaurant, going to a store, taking a bath).

It is instructive to compare dreaming with speech. Speech has semantics (meaning) and syntax (rules of correct sequence [grammar]). Ordinarily, when we speak we have a particular meaning that we intend to convey. We select the appropriate words and organize them according to rules of syntax to convey the intended meaning. But in dreaming there is no intent to convey anything in particular. Mnemonic elements are activated haphazardly. But they are organized according to syntactic rules to make them meaningful.

Neuropsychological studies of brain-injured patients suggest that image generation and narrative-sequencing processes in dreaming may occur primarily in the right and left hemispheres, respectively. Damage to the left hemisphere causes more disruption of dreaming than does damage to the right hemisphere (review by Antrobus 1987). Patients with injury to the left cerebral cortex—specifically, the left posterior temporal lobe—may experience both aphasia (loss or disruption of speech) and loss of dream re-

call. Right-hemisphere damage may lead to dreaming without visual images, though meaningful dream-like thought with narrative form and nonvisual spatial imagery still occurs. (This is also true of subjects blind since birth [Kerr, Foulkes, & Schmidt 1982].) These findings are noteworthy because Foulkes's theory implies that left-hemisphere verbal production processes—including verbal concepts and narrative knowledge—are critical for dream construction. Antrobus (1987) hypothesized that the left hemisphere constructs the dream and gives it its narrative form, and that bizarre events occur in dreams because the right hemisphere sometimes generates an image that does not fit the left hemisphere's narrative.

One dream process. Foulkes (1985) argued that there is one dream-production system that operates in all sleep stages. Differences in dreams or mentation between the different stages mainly reflect differences in the continuity with which the dream-production process operates. Enhanced cerebral excitation during REM sleep presumably produces abundant mnemonic activation. Thus the most fully formed dreams occur in undisturbed REM sleep. In NREM sleep, cortical excitation and hence mnemonic activation are reduced. Though NREM mentation has sometimes been called "thoughtlike," Foulkes said that it more commonly is like a dream fragment, with visual imagery, but with less narrative development than REM dreams. Supporting this point, Foulkes and Schmidt (1983) found that REM dream reports have more persistence of characters from one unit to the next, and more action units, than NREM and sleep-onset reports.

Amnesia for dreams. Foulkes (1985) explained the forgetting of dreams in terms of the type of information processing that occurs during dreaming. He suggested that the reason recall of dreams is poor is that the process of dreaming—involving memory retrieval and synthesis—is incompatible with the encoding process for storing new memories. The dreaming process is comparable to episodic memory recall, which involves construction of memories from retrieval and inference. Thus, trying to recall dreams is not so much like trying to recall actual life events as it is like trying to recall prior episodic memory recall experiences (that is, recalling the experience of recalling something). And recall of prior memory experiences is usually very poor. You may recall what you did last summer, but you probably don't recall yesterday's daydreams about it.

Foulkes suggested that dreams are only likely to be recalled when we wake up during a dream, while it is still fresh in short-term memory. If we can recall a dream from STM and do mnemonic processing on it (such as rehearsal and forming associations), then we can store it in long-term memory for later retrieval.

Meaning in dreams. According to Foulkes (1985), dreams do not have any deep meaning. Dreams are not expressions of unconscious desires or conflicts. Nor are dreams symbolic expressions of anything other than what they appear to be on the surface. Thus, there is no point in trying to interpret dreams to discover their hidden meaning, because they do not have any hidden meaning.

However, dreams are not entirely without meaning, according to Foulkes. They have *indicative meaning*. That is, they indicate something about the mind of the dreamer—his or her conceptual and personal knowledge—which in turn reflects the individual's personality. Thus, it is not surprising that dream analysis studies have found some degree of correspondence between dream contents and peoples' personalities and life situations. But the indicative meaning of dreams does not imply that they were purposefully constructed to reveal a particular meaning. Rather, the dream contents are a result of random mnemonic activation during sleep, and the dream structure is produced by the cognitive dream-construction process.

Do dreams have any psychological adaptive function at all? (This question must be kept separate from the question of whether REM sleep has any function.) Foulkes argued that there is no proof that dreaming serves any adaptive function, or that the dream-production system evolved for the purpose of producing dreams. Rather, the dream-production system is actually the operation of the normal memory and thought processes, operating under the conditions of sleep. Foulkes suggested that rather than trying to interpret dreams to reveal individual personalities and hidden meanings, it would be more profitable for dream researchers to study dreams to increase our understanding of how the human mind/brain system works.

Children's Dreams

A major implication of Foulkes's theory is that children's dreams will differ from adult dreams, since dreaming depends upon knowledge and thought processes that develop with age and experience. To be more specific, he hypothesized that the childhood stages of dream development will correspond to stages of cognitive development in the waking state.

Foulkes himself conducted the most extensive laboratory study of children's dreams (1982a, 1982b, 1983). The subjects were boys and girls in two different age groups at the start of the experiment: younger children, three or four years old ($n = 14$), and older children, nine or ten years old ($n = 16$). Each child spent nine nights per year in the sleep laboratory for five years. Thus, the study collected longitudinal data across the range of three to fifteen years of age. A typical test night involved two REM awakenings and one NREM awakening. After each report the experimenter asked a few questions to try to get more details about the dream. Also, each year each child was tested with several personality and cognitive performance scales.

Table 12.1 summarizes some of Foulkes's REM dream data for children at four different age levels. I will concentrate on the results for the younger group, which was followed from ages three/four to eight/nine. This age range is particularly critical, as it corresponds to Piaget's preoperational, transitional, and concrete operational stages.

Ages three to five (between third birthday and fifth birthday). This is the youngest age range at which it is possible to collect meaningful dream data. (In pilot studies Foulkes found dream reports to be extremely rare in children younger than three years old.) In the three- to five-year age group, the

TABLE 12.1 REM Dream Characteristics in Children at Four Age Levels*

	PRE-OPERATIONAL (AGES 3–5)	TRANSITIONAL (AGES 5–7)	CONCRETE OPERATIONAL (AGES 7–9)	FORMAL OPERATIONAL (AGES 13–15)
Frequency of dream reports	15% (median)	31%	43%	73%
Report length (median words)	14	38	59	86
% of reports longer than 100 words	0%	5%	25%	43%
Story form	isolated event	several events in series	complex narrative	complex narrative
Imagery form	static	kinematic	kinematic	kinematic
Common themes	animals, body state	social interaction	social interaction	social interaction
Animal characters:	39%	33%	22%	9%
Self-representation (any activity by subject as dream character):	12%	38%	47%	62%
Social interaction (two or more persons):				
prosocial	6%	38%	40%	40%
antisocial	3%	27%	25%	24%
Activity type (either self or other character):				
verbal	2%	19%	28%	43%
locomotor	26%	63%	69%	62%
Dreamer body state:				
hunger	2%	0%	9%	9%
fatigue	24%	8%	9%	7%
Dreamer feelings (one or more of fear, anger, happy, sad, excited):	8%	29%	34%	32%

*Dream content percentages are the percent of dreams showing that content (mean of medians for males and females). Data for the first three age groups are longitudinal data on the same set of subjects; data for ages 13–15 are from a different set of subjects.

Based on data in Foulkes, D. (1982). *Children's Dreams: Longitudinal Studies*. New York: Wiley. (By permission of the author.)

typical child reported dreams on only 15 percent of REM awakenings. The reports were quite brief, only one or two sentences. They depicted an isolated scene or event, with no story development. The content of the dream reports was quite different from that of adult reports. There was typically no active self character, and in fact most dreams showed no activity by any character. Social interactions were minimal. Strangers (constructed human characters) were quite rare (only 2 percent), while family and known persons appeared more often (about 17 percent). On the positive side, the younger children's dreams had a remarkably high frequency of animal characters, which were typically common farm animals or unaggressive wild animals (like frogs, birds, deer). (Foulkes [1985] speculated that young children might represent themselves by animal characters.) Fatigue was a more common theme at this age than later, for example, in dreams that the child is sleeping somewhere other than where he or she is. Notably absent were dreams with unpleasant emotions.

Here is an example of a dream from the youngest group (Dean, age four years, eight months):

> I was asleep and in the bathtub. [E: Was this in your bathtub at home?] Yes. [Was there anyone else in the dream beside you?] No. [Could you see yourself there?] Uhhh, no. [I mean, did you have like a picture of the bathtub and you could see your body inside the tub?] No. [How did you feel?] Happy. (Foulkes 1982a, p. 66).

Developmental trends. As the children got older the frequency of REM dream reports increased, as did the median report length. By age seven to nine years, the reports were complex story narratives, rather than relatively isolated, static images. Action by the self character, and activity in general, increased. Emotional content became more common, though emotional expression still occurred in only a small minority of reports. Animal characters became less common, whereas strangers became increasingly common. At all ages, the children's dreams represented fictional events that most often were mundane and more-or-less realistic. Though many of their dreams were unlikely, at least they were not terribly bizarre, in most cases.

As an example of changes in dreaming styles in children as they mature, compare my son Michael's simple, static dream at age two years, two months ("I saw a bus in the air") with this dream report made at five and a half years, which shows good narrative development and action by the self character:

> Mom was going somewhere and I couldn't decide if I wanted to go. She started up the car and drove away. Then I decided I wanted to go, so I ran after her. And I got lost. But a policeman found me and took me home. I told him I live on Norfolk street.

Credibility. There is little problem in accepting the dream reports of children five to seven years old or older pretty much at face value, as we do

the reports of adults. By that age their language development has advanced to the point that they should be able to describe their dreams with reasonable accuracy. But what about the youngest age group, three to five years: Is it possible that they really had longer, more complex dreams, but were unable to describe them accurately? Foulkes (1983) found this interpretation to be unlikely, based on results from waking measures of the children's mental abilities. For example, in the youngest group, there was no relationship between the frequency of dream reports and waking measures of the ability to describe and remember pictures.

Among the older children (ages five to seven years and older), Foulkes (1982a) found that dream reporting was strongly correlated with certain waking measures of visuospatial performance (for example, the Block Design Test, where subjects construct a visual pattern from colored blocks). This result (replicated in Foulkes et al. 1990) suggests that some of the same skills used in performance of waking visuospatial tasks are also employed by dream construction processes. Waking visuospatial skills were also related to certain aspects of dream reports in the youngest (three to five years) group (such as active self, use of animal characters [Foulkes 1983]). The correlational data on visuospatial performance suggests that differences in dream reporting between different children's age groups represent not differences in the ability to *describe* dreams, but rather, differences in the ability to *have* complex visuospatial dreams.

Implications. The basis of dreaming is in what the child *knows* and how well he or she can *think*, not what he or she can see or do. Dreaming is not like a videotape playback of what the child has seen. Rather, it is a novel kinematic image sequence constructed from elements of the child's knowledge about the world, including people, animals, and objects—how they look, what they can do, how they interact, and so on. The construction of complex narrative dreams depends upon two factors developed through the child's learning experiences: (1) organized conceptual world knowledge—the raw material from which dreams are constructed—and (2) thought processes involved in dream construction, including visuospatial abilities to construct organized visual mental images, and script knowledge to provide the basis for meaningful sequences of dream events.

Foulkes argued that it is only when children reach Piaget's stage of concrete operations (seven to nine years) that they have the knowledge and thinking abilities to produce nearly adult-like dreams. This is not the place to argue whether it is more realistic to speak of cognitive development as a continuum or as a series of discrete stages. The important point is that dreaming is a cognitive, constructive process, not a perceptual process, and the development of dreaming parallels the development of waking cognitive abilities and knowledge.

Evaluation of Foulkes's Theory

One complaint against Foulkes is that, according to his theory, dreams are not psychologically motivated and do not have any deep meaning. Many

people feel that dreams are so dramatic that they surely must have some sort of hidden meaning. But Foulkes (1985) replied that there is no way to prove objectively the validity of any interpretive scheme for revealing deep symbolic meanings in dreams. Acceptance of dream interpretation depends upon one's prior belief system.

I am sympathetic with Foulkes's cognitive approach to dreaming, but I would criticize his theory for not taking more account of the common occurrence of day residues in dreams. Mnemonic activation in sleep does not appear to be entirely random. People's daytime experiences and current concerns affect dream contents more than one would expect from the purely random mnemonic activation. It would not require any major changes in his theory to postulate that some "hot topics" in memory (current concerns, intrusive waking experiences) are more likely to be activated than others. Also, there are many cases where dreams show a "shallow symbolism" in which day residues and current concerns are represented indirectly in ways that are fairly obvious. (Pertinent examples were presented in the previous chapter.) These indirect representations might occur due to highly probable mnemonic associations, rather than due to a process of motivated symbolic disguise, and thus could be incorporated into Foulkes's theory without any major changes.

Haskell (1986) criticized Foulkes for minimizing the dreamer's personal motivational concerns: "If dreaming is the symbolic representation of physical objects and events, as Foulkes suggests, then one is left wondering why feelings, wishes, hopes, fears, and problems are not likewise represented, and fit into syntactic units as they are in the waking expression of a spoken sentence" (p. 150). Implicit in Haskell's comment is a suggestion of how motivational concerns might be incorporated into Foulkes's theory, as mnemonic structures that can be activated and provide a framework for organizing units selected from among randomly activated memories. The motivational units probably would not be randomly activated; rather, they would carry over from waking thoughts into sleep.

Antrobus (1986) took a similar position on incorporating goals into a cognitive theory of dreaming. He agreed with Foulkes that the dream-production system is the same cognitive system that is responsible for producing waking verbal and imaginal narratives. During sleep, where there is ordinarily no variety of external sensory input to produce varied thought associations, the dream narrative may continue on the same topic longer than ordinary thought does, then suddenly shift to a new topic that is, however, in some way related to the prior dream content via connections in individual's memory structure.

Like most theories of dreaming, Foulkes' theory is not an elaborated, step-by-step description of the dream-production process. Rather, it is more a characterization of the nature of the process. What is different and important about Foulkes's theory is that it attempts to explain dreaming in terms consistent with current knowledge about cognitive processes in adults and children. Foulkes's (1985) theory may be regarded as a valuable first approximation to a fully developed cognitive theory of dreaming. It is limited partly by our limited understanding of waking processes of narrative production and imagination.

THE FUNCTIONS OF DREAMING

Although both Hobson and McCarley (1977) and Foulkes (1985) argued that dreaming is merely a byproduct of brain-cognitive processes operating during sleep and serves no practical function, many writers have argued that dreaming is such a common and conspicuous characteristic of humans that it must have some sort of practical function. Conceivably, dreaming was originally a byproduct of brain processes operating during sleep, but later acquired some practical function. But what function? (Bear in mind that the question of the function of dreaming is separate from the question of the function of REM sleep, discussed in Chapter 10.)

As we have seen, Freud (1900/1965) thought that dreaming helps to discharge pressing unconscious desires through symbolic wish fulfillment. By providing symbolic wish fulfillment, dreaming reduces the chances that unconscious desires will produce neurotic symptoms. Also, symbolic dreaming preserves sleep, since direct awareness of our repressed desires would produce anxiety that would awaken us, in Freud's view.

Carl Jung (1933) argued that dreaming serves a compensatory function that helps maintain the individual's psychic balance. "The psyche is a self-regulating system that maintains itself in equilibrium as the body does. Every process that goes too far immediately and inevitably calls for a compensatory activity" (p. 17). In Jung's view, dreaming is a process by which the unconscious seeks to correct unbalanced or inadequate conscious experience. Thus, for example, a shy person might dream of being socially outgoing and popular. Or a sorrowful daytime experience might be followed by dreams with a happy mood. In addition, Jung argued that dreams may symbolically express "archetypes of the collective unconscious" having to do with universal themes of human existence of which Jung believed we have innate, unconscious knowledge (for example the theme of the child's dependence upon the mother, and the necessity of becoming independent of her).

Alfred Adler (1927) believed that dreams serve a personal problem-solving function. Dreams occur in response to significant personal problems, and in dreams people seek solutions that are consistent with their life styles and habitual choices. The problem and its solution may be presented symbolically. For example, a student who is a quitter and who wants to postpone an examination might dream of trying to climb a mountain but falling off the mountain, whereas a more motivated student might dream of struggling hard to overcome the obstacles and successfully reaching the top of the mountain. Problem solutions in dreams may be simplistic or unrealistic. (See Ryckman 1989 for discussions of the role of dreams in several major personality theories.)

Several theorists have hypothesized that dreaming serves a problem-solving function (reviews in Cohen 1979a; R. M. Jones 1970). Some scientists, writers, and artists have reported that creative problem solutions have occurred to them in dreams. Perhaps the most famous report is that of the Austrian chemist Friedrich August von Kekule, who in 1865 was trying to determine the structure of the benzine molecule. He dozed by the fire and had a dream in which he saw a snake seize its own tail, thus forming a ring. Kekule awoke with the inspiration that the form of the benzine molecule is a ring.

His idea proved to be correct: the basic structure of benzine is a ring formed of six carbon atoms linked together. However, Weisberg (1986) has pointed out the flimsiness of the anecdotal evidence for creative problem solving in dreams. It has not been proven experimentally that dreaming *per se* produces useful solutions to practical problems.

Breger (1969) suggested that dreaming serves an emotional information-processing function by helping the individual to organize and assimilate emotionally significant new experiences into thinking and memory schemas that have been effective in handling such experiences in the past. An implication of this hypothesis is that emotionally significant current concerns or recent experiences will be represented in dreams (at least symbolically), and that this will be true to a greater degree, the greater the emotional impact of the experience and the less the individual has been successful so far in resolving the problems associated with it. Over a period of time dreams should reflect solving of emotional problems.

Most theories of dreaming support the *continuity hypothesis*, which says that dreams reflect the individual's personality, current concerns, and emotionally significant daytime experiences. As we saw in the last chapter, the evidence is largely consistent with the continuity process. However, the available evidence does not prove that dreaming has any particular adaptive function. But perhaps researchers have taken too narrow a view of dream function, as Hunt (1986) suggested:

> A self-referential, self-transforming system like the human mind will evolve its uses as creatively and unpredictably as it evolves its structures. Indeed there do seem to be distinct types of dreaming: . . . a lucid-control line, a Freud-type pressure-discharge line, a Jung-type archetypal-mythological line, and perhaps a problem solving line and a Robert Louis Stevenson-type creative story line. It may be *because* dreaming (and human life) has no fixed function that it is open to so many different *uses* (p. 226).

Perhaps Hunt is right in suggesting that dreaming may serve many practical functions. But regardless of whether dreaming *per se* serves any practical functions, many people have found that keeping a dream diary, and trying to interpret their dreams in relation to personal concerns and recent experiences, has been a valuable project for increasing their self-understanding.

Theories of dreaming are only as good as the data on which they are based. In the next chapter I will discuss theories of dream recall and forgetting, and also lucid dreaming—recalling that you are dreaming while you are asleep and dreaming. Finally I will make some concluding comments about dreaming and its implications for consciousness.

SUMMARY

In his psychoanalytic theory of dreaming, Freud said that dreams are psychologically motivated to allow indirect expression of unconscious desires. Man-

ifest dreams are symbolic representations of latent dream thoughts. Symbolic transformations are produced by the dreamwork process in order to prevent anxiety and protect sleep. Freud's theory is hard to test because one has to assume that the theory is correct in order to interpret dream symbols for evidence of repressed desires.

A neurophysiological theory, Hobson and McCarley's activation-synthesis hypothesis, says that dreams serve no purpose, but are merely a byproduct of brain activity during REM sleep. REM sleep, with its unique pattern of physiological responses, is activated periodically by a biological clock in the brain stem. The cortex synthesizes images to fit the semi-random pattern of internally generated sensory events during REM sleep (isomorphism principle). The theory predicts REM dream bizarreness; but laboratory data show that perhaps half or less of REM dreams are bizarre, depending upon one's criterion for bizarreness. The search for specific isomorphic relations between dream events and physiological events has produced largely negative results; for example, eye movements and dream-action movements are usually not correlated.

Foulkes's cognitive theory postulates semi-random activation of memory units in the cortex, which are selected and woven into narrative form by the same cognitive structures that produce narratives in the waking state. Dreams are not psychologically motivated or deeply symbolic, but their content reveals some aspects of the individual insofar as dreams are constructed from material in the individual's memory. Foulkes's research on children's dreams indicates that their characteristics, such as narrative form, develop in parallel with development of waking thought processes.

Several different ideas about the psychological functions of dreaming have been proposed, ranging from wish fulfillment to creative thinking. It is hard to prove that dreaming has any particular psychological function. But most theories support the *continuity hypothesis*, which says that dreams reflect the individual's personality, current concerns, and emotionally significant daytime experiences.

ENDNOTES

[1]Freud said that dreaming is characterized by *regression*, that is, a change to a more primitive or immature form of thinking. Regressive thinking is more visual and less rational than conscious thinking. Freud also characterized dreaming (as well as vivid, wish-fulfilling daydreaming) as *primary process* thinking. Primary process thinking operates under the control of the Id to serve the *pleasure principle*. It is contrasted with *secondary process* thinking, which is rational thinking, mostly verbal, done by the Ego to serve the *reality principle*.

[2]The forebrain includes the cerebral hemispheres, basal ganglia, thalamus, amygdala, hippocampus, and septum. Though Hobson and McCarley consistently refer to the forebrain, we may assume that the image-synthesizing process occurs mainly in the cerebral cortex, so I will usually refer to the cortex.

[3]Phasic events are brief, discrete events, like individual eye movements. Tonic events are relatively long lasting (at least a few minutes), like REM sleep periods.

[4]See Chapter 11, endnote 3, on Hobson's attitude toward the evidence on dreaming in NREM sleep.

[5]In a related study, Karacan et al. (1966) found that REM erections were unlikely to occur during dreams characterized by high anxiety. Perhaps anxiety interferes with REM erections, just as it interferes with erections in the waking state.

[6]Lucid dreams, where we are aware that we are dreaming while we are dreaming, are the exception rather than the rule. In fact, lucidity during dreaming is most likely to occur when dreams are bizarre (LaBerge 1985) (see Chapter 13).