The Role of Sleep in Psychological Development: Introduction

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Classical psychoanalytic approaches to sleep and dreaming have seen an erosion in credibility as neurophysiological insight into sleep has steadily gained ascendancy during the last nearly fifty years, to the point that neurophysiological data are now universally recognized as being more pertinent, even though interpretations of these data remain controversial. A question to be decided is whether all conceivable psychoanalytic theories of sleep and dreaming should be dismissed out of hand in favor of the new promising but conceptually deficient approach or whether there might be some utility at this juncture to formulating a psychoanalytic theory that can possibly shed new light on the neurophysiological data.

Physicists faced a similar situation at the turn of the last century. As the 20th century dawned, physicists began recognizing that they would have to replace much of classical physics, components of which had served for centuries, with quantum mechanical theory, which promised to provide a much more fundamental understanding of Nature. Virtually no physicist, however, completely abandoned classical theory in favor of the new emerging viewpoint. Rather, the common practice was to blend the two in what should have been called "quantum classical" descriptions, but which were typically dubbed "semi-classical" explanations. Physicists did this to describe phenomena approximately that couldn't yet be handled exactly using quantum mechanics (or were too cumbersome mathematically to do so) and because the somewhat inaccurate semi-classical explanations were intuitively useful. Use of semi-classical depictions persists to this day (Billing 2002) in physics and chemistry because they continue to provide useful shortcuts to intuitive understanding while being accurate enough to meet the needs at hand.

In this spirit, this article will outline a theory of normal adult human sleep cycling that will be formulated in cognitive/psychoanalytic language, but will nonetheless be amenable to empirical test on numerous fronts. In contrast to the current practice of chopping up nights of sleep into intervals suitable for statistical analysis, the attempt will be to interpret continuous episodes of normal adult human sleep on a moment-to-moment basis in terms of ongoing cognitive processes. This discussion will be framed by the psychoanalytic theory of Joseph Weiss (Weiss et al., 1989; Weiss, 1993).

Weiss's psychoanalytic theory of the mind was developed about 40 years ago as a cognitive alternative to classical Freudian theory. At the heart of Weiss's theory is an hypothesis concerning the nature of unconscious mental functioning that departs significantly from the basic orientation of early Freudian theory. Freud in his 1911-1915 theory proposed what Weiss has called the "automatic-functioning hypothesis," according to which the unconscious mind is portrayed as consisting of powerful psychic forces—namely, impulses and defenses—that are regulated automatically by the pleasure principle. Such regulation lies beyond a person's control and takes no account of the person's thoughts, beliefs, or assessments of current reality. By contrast, Weiss formulated a "higher mental functioning hypothesis," according to which "a person may carry out unconsciously many of the same kinds of functions that he carries out

consciously. He may think, make inferences, test reality, and make and carry out decisions and plans. Moreover, he may exert some control over his unconscious mental life in accordance with these decisions and plans" (Weiss, 1993, pp. 4–5).

According to Weiss's theory, assessments of reality in the form of expectations derived from experience act as fundamental unconscious determinants of human behavior and personality development. Therefore, psychological development may be seen largely as the progressive establishment and elaboration of an integrated set of beliefs and other adaptations (Rappoport, 1996) arising from a concept of reality that embraces objects, one's self, others, and human relationships in general. This implies that when a person falls victim to psychological dysfunction, the problem likely lies with some aspect of the person's inner reality concept. More specifically, according to Weiss, it implies the existence of "pathogenic beliefs," which Weiss describes as "compelling, grim, and maladaptive." These beliefs "warn the person guided by them that if he attempts to pursue certain normal, desirable goals, such as a satisfying career or a happy marriage, he will endanger himself or others" (Weiss, 1993, p. 5). It is through the agency of such altruistic concerns that pathogenic beliefs inhibit personal expression and development.

The theory assumes that the overriding motivation of unconscious psychological cognition involves a strong drive toward adaptation in a social environment. Empirical studies of clinical practice by Weiss and members of the San Francisco Psychotherapy Research Group (SFPRG) (Weiss et al., 1989; Weiss, 1993; SFPRG, 2003) have shown that patients enter therapy with unconscious developmental goals in mind and tentative strategies for achieving those goals. The unconscious strategies are aimed at enlisting the therapist's aid in gaining experiences that will help undermine the validity of the patient's pathogenic beliefs. The unconscious strategies involve tests for the therapist, which are formulated in the hope that the therapist will pass them by acting contrary to the way the patient expects, based on his pathogenic beliefs. This testing process continues throughout the course of therapy, as do defensive behaviors, which are seen as being provoked in the patient as an attempt to avoid retraumatization, the possibility of which is falsely predicted by the person's pathogenic beliefs. Patients progress by acquiring disconfirming information when tests are passed. They are also helped in reconstructing their reality concepts through the therapist's interpretations.

Once one recognizes that patients are generally ignorant of the nature of the therapeutic process, one sees that in testing therapists patients must be treating the therapists as they would anyone with whom they have an attachment relationship (see "Control-Mastery Therapy as a Secure Attachment Relationship," this website). Or put another way, the empirical studies supporting Weiss's theory imply that unconscious testing of significant others is a normal component of the human developmental process. This means that humans have an innate sense of the kinds of experiences that will help and hurt them developmentally and that they may unconsciously seek helpful experiences in everyday life, usually in the context of attachment relationships. Defensive behaviors may be exhibited whether or not pathogenic beliefs are involved, because psychological growth necessarily involves taking one's life beyond the boundaries of one's current self-concept. Invariably, then, growth initiatives are pursued ambivalently, which is one of the reasons they are initially undertaken unconsciously, with a person becoming

consciously committed to a growth path only after a fund of confirming experiences has been established through unconscious testing.

Weiss postulates a very sophisticated unconscious problem solving ability that takes into account relevant events that have happened in a person's past as the person builds a basis in experience for a desired future while avoiding retraumatization. It is Weiss's view, therefore, that human behavior at the unconscious level is much more complex and more cognitively driven than is usually supposed, and that these characteristics contribute toward a planned developmental process. This developmental viewpoint leads one to ask how and particularly when is a person's reality concept updated daily in light of recent experience in such a way as to serve as a basis for unconscious tests whose outcomes may help in overcoming inhibitions and in realizing personal potentialities. Only two possibilities exist: either the inner reality concept is updated in a helter-skelter fashion during a person's waking moments as the person attempts to cope with current life situations, or during a respite from external experience during which full attention may be devoted to updating the belief system that is central to the person's psychological existence, with sleep being the only viable candidate. Weiss assumes the latter, as does this paper.

The present theory of sleep goes farther by considering how the updating takes place. Weiss's psychoanalytic theory postulates the participation of childhood memories and beliefs in the operation of working memory as a found fact, and although Weiss argues to the appropriateness of this circumstance, he provides no mechanism on a cognitive level whereby such a participation can occur. What requires explanation is the circumstance that childhood memories do not seem to be subject to the usual laws of forgetting. On the basis of these laws, one would expect that childhood beliefs would yield readily to new experience and that with the passage of time they would gradually become less important to a person's life. Psychoanalytic evidence indicates, however, that childhood adaptations remain at the forefront, and are used as a Rosetta stone in interpreting subsequent experiences. The question to concern us here relates to the means whereby such an interpretative scheme becomes established and maintained.

It is clearly the intent of this paper to relate sleep and dreaming to implicit learning. It will become evident also that the language of this discussion will depart somewhat from that typically used, which tends describe sleep's possible participation in a subject's efforts at mastering a procedural task in terms of the "consolidation of a memory trace." The theoretical focus on memory consolidation is both understandable and unfortunate.

It is understandable because investigations into the transfer of newly created memories from short-term to long-term storage would seem to be a logical precursor to the study of more complicated issues involving the integration of new long-term memories with their already established counterparts.

It is unfortunate, first of all, because this preoccupation has led researchers to focus on the simplest learning situation, that involving confronting naïve subjects with clearly defined learning challenges. This is unfortunate because the research paradigm is at odds with the evolutionary realities that led to sleep's cognitive role, in two important respects. In the first place, this nearly ubiquitous experimental approach studies an extraordinary circumstance in an adult mammal's life, as by the time it has reached adulthood, a

mammal has become exposed to most of the types of challenges it will have to face in life. So the naïveté mandated by today's research paradigm is a rarity in an adult mammal. Studying situations that would more accurately reflect a mammal's everyday life—and which presumably shaped sleep's learning-related role—would, therefore, involve studying a mammal's learning from situations that have a basis in past experience. In this paradigm, a mammal could be seen as adding the outcome of its trials, during sleep, to the conceptual models it could apply in meeting similar situations in the future.

Secondly—and more importantly—the concentration on memory traces has led researchers to give short shrift to the learning process itself, a deficit I will attempt to compensate for in a few words.

A subject's efforts at mastering a learning challenge involve a good deal of trial-and-error effort initially, but gradually adaptations that enable the subject to meet whatever challenge the experimenter had in mind become established. What does this gradual establishment imply?

For there to be progressive improvement, each trial must be followed by what may be characterized as an analytical response in which the subject uses feedback from its efforts to home in on key perceptual clues and motor responses that enable it to get better at meeting the challenging situation. This analytical response is actually part and parcel of each set of trial responses and evidently continues in the interval between responses, otherwise it would be impossible to explain the changes in behavior from one response set to the next that are responsible for the subject honing its perceptual and motor responses as learning trials continue. The result at the end of a series of trials, when the desired level of learning has been reached, is a perceptual, motor, and motivational integration that is responsible for the learned performance. It is this that is to be the stuff of memory, and what is usually spoken of in gross oversimplification as a "memory trace."

There are several issues with respect to this behavioral integration that require clarification, particularly regarding a learning-related theory of sleep. During its formation, memories of each set of trial experiences evidently persisted long enough for adaptive analytical work to proceed between trials, but do the memories of mistakes then disappear from memory by the time the ultimate so-called memory trace is formed, or do they persist in memory in this initial trace? If so, is the memorial record cleansed of them with the passage of time? And what of the analytical activity that gave rise to the ultimate adaptation—does this continue while the behavioral integration is "consolidating"? In other words, does the complex behavioral integration formed at the end of a series of trials change in character over time due to memory cleansing and continuing analytical work while the shift from short-term to long-term storage occurs? There is evidence that learned performance gets better without any further practice after trials cease. Is this because the memorial record becomes cleansed, because adaptive analytical work continues, because of memory consolidation per se, or all three? It's impossible to say at this point because the first two factors have been virtually ignored.

Another problem with today's typical sleep-related research paradigm is that the well-defined learning situations found in experiments, in which correct responses inevitably

lead to the same favorable outcome, are relatively rare occurrences in the wild. Most mammals interact a great deal with other mammals, that is, with beings whose behaviors are driven less by instinct and more by learning derived from a unique set of prior experiences. This means that in virtually every predator/prey/social interaction, behaviors that led to success previously may lead to failure or only partial success in the future. What a mammal needs, therefore, is not a single routine for each life situation, but rather working memory access to a set of provisional routines the mammal can resort to quickly as situations change. Needless to say, humans require this basis for flexibility as well.

The motivation for this carping is to point out the possible need for sleep-related learning research to expand its horizons. This is particularly pertinent here, because sleep's possible role in memory consolidation will not be what we shall emphasize. Rather, our emphasis will be on memory cleansing and the continuation of waking adaptive analytical work during sleep.

Once one considers framing a theory of learning according to what memory systems must deal with in everyday life, one begins to recognize that behaving appropriately is less a matter of retrieving a single related memory trace and more a matter of constructing appropriate behaviors on the spot, on the basis of many memories perhaps drawn from various periods in a mammal's life. What is needed, therefore, is not an explanation as to how a particular memory trace can be readily retrieved, but rather how a complex of related memories can be established. This is the type of explanation we shall endeavor to provide with the foregoing theory of sleep.

A New Theory of Normal Adult Human Sleep Cycling

It seems safe to assume that sleep characteristics result from a confluence of physiological processes having diverse functions, which for the sake of this discussion may be categorized as Cognitive, Homeostatic, and Others. This classification scheme is not meant to imply that the physiological processes themselves operate separately. Indeed, the likelihood is that they are highly integrated. This situation does not, however, necessarily preclude the attempt to relate electroencephalographic and other physiological concomitants of normal adult human sleep to cognitive processes. Since all of the physiological processes are presumably important to long-term survival, it may be assumed that evolution has organized them in such a way that they interfere minimally with each other under normal circumstances. And given the importance of learning to the most adaptable of all earthly beings, it may be assumed that special leeway has been afforded this function with humans. This implies that to a first approximation one may discount the presence of other processes in describing the properties of at least a portion of sleep in terms of an ongoing unconscious cognitive process.

The evidential record indicates what that portion should be. The various stages of sleep are defined in terms of electrophysiological signs detected using a combination of electroencephalography, electrooculography, and electromyography (Rechtschaffen and Kales, 1968). Interpretations of how these waveforms may relate to cognitive processes remain controversial. Nevertheless, there is a growing body of data that indicates that information is being processed during slow-wave sleep (SWS) (e.g., Gais et al., 2000), REM sleep (e.g., Smith, 1996), and during stage 2 (e.g., Smith and MacNeill, 1994) as well. There is even evidence that slow-wave and rapid eye movement (REM) sleep

operate in conjunction with one another (e.g., Giuditta et al., 1995) in furthering learning. It would seem, then, that every moment of sleep is partially devoted to learning. Therefore, sleep cycling taken as a whole will be our focus. We will begin by assigning cognitive activities to the various stages of sleep on an ad hoc basis and then seek a provisional understanding of the flow of adaptive processes from one moment to the next.

Our model will build on Giuditta et al.'s (1995) "sequential hypothesis," which postulates that "information acquired by the brain during the waking period…is processed during the following period of sleep, initially during the episodes of SWS, during which it reaches an intermediate state (I_{sws}) and eventually during the episodes of PS [REM] during which I_{sws} achieves its final…state." Our extension will mainly involve explaining how multiple non-REM (NREM)-REM epochs may arise.

Slow-wave sleep. A person's initial moments of sleep are characterized by a rapid descent to slow-wave sleep (stages 3 or 4), which typically dominates the NREM portion of the first and second NREM-REM epochs of sleep. Slow-wave sleep is sometimes called "deep" sleep because attendant high auditory arousal thresholds (Rechtschaffen et al., 1966) create the impression that this form of sleep corresponds to a state of consciousness that is most "distant" from wakeful experiencing.

REM state. There is a wealth of neurophysiological data to support the conjecture that REM sleep involves active experiencing of information (see Hobson et al., 2000, for a review). However, controversy persists as to the nature of the information being experienced. Hobson et al.'s (2000) AIM model stresses a "bottom-up" informational flow, with the source of information being random signals from the brainstem, which the cerebral cortex tries to interpret as best it can.

Antrobus and Conroy (1999) have offered a critical analysis of the viewpoint that the cortex relies on bottom-up input and make a case for the assumption that the cortex is "entirely capable of generating the imagery and thought that has the unique characteristics of our dreams—without any concurrent external input." The theory to be defended here accepts this position. REM sleep will be portrayed as a state in which mental content is experienced in a literal sense, with that content arising primarily from within higher brain centers. The current theory also stresses a fundamental distinction between REM and NREM sleep. That distinction is here held to be simply that mental content is experienced during REM sleep while during NREM sleep it is not.

Stage 2 sleep. Stage 2 sleep will be seen as a state of consciousness that facilitates informational flow between two very different states of consciousness, slow-wave and REM sleep. In stage 2, slow-wave adaptations are translated and organized so as to become suitable for REM presentation. This preparation is needed, in part, so that REM mental activities can proceed automatically in the sense that experiencing each REM moment functions dynamically in evoking the next REM moment. Stage 2 sleep is also seen as being capable of rendering information gleaned from REM sleep suitable for slow-wave consideration, with the movement toward slow-wave sleep being triggered by newly activated long-term memories during previous REM sleep.

Cognitive processing during normal sleep

The first approximately 100-min epoch of sleep consists mainly of slow-wave sleep and typically ends with a short (5-min) REM period. This leads to another NREM span dominated by slow-wave sleep and a generally longer REM period. The third epoch usually contains a reduced amount of slow-wave sleep (typically only stage 3) and a REM period that may be longer yet. After the third epoch, sleep usually cycles between REM sleep and stage 2. Thus, with each succeeding NREM-REM epoch, NREM intervals tend to get shorter and REM intervals become longer. Our model will capture these trends.

As we have seen, learning from a given life situation probably does not end with the overt activity that brings the situation to a conclusion, but continues afterwards during the same waking interval. This means that a mammal's adaptive processes are challenged to process information gleaned from previous experiences while dealing with new information from current life situations. This difficult circumstance creates the possibility that the processing of waking experiences is not brought to completion while a particular waking interval persists. An interval of time free of external experiences is needed for adaptive closure to occur. That needed interval is provided by sleep.

The first NREM-REM epoch. It has been hypothesized (Crick and Mitchison, 1983; 1985) that the brain during sleep sheds itself of nonadaptive associations formed the previous day, thereby weakening the strength of unhelpful memories. It is assumed here that an "unlearning" process of a sort does take place during sleep in conjunction with behavioral analysis, but that this takes place during slow-wave sleep, not REM sleep, as Crick and Mitchison supposed. Cleansing the memorial record allows a person to establish a focus on the experiences that are behaviorally significant.

To see what else slow-wave sleep might accomplish, let us consider some evidence that is usually interpreted in terms of memory consolidation. It has been found that the focus of the adaptive processes initiated by a learning situation shifts from the frontal areas of the brain to areas containing presumably related long-term memories with the passage of time (Shadmehr and Holcomb, 1997) during the same waking interval. This has been interpreted as a memory consolidation process because this shift is associated with retrieval of the memory of what was learned during the situation becoming less liable to disruption. It is conjectured here that contact with related past experiences is also established at this time, and that this contact serves to activate these memories. Thus, as a person learns from each waking experience, related memories become activated, with only relatively little integration between the new memories and the activated old ones taking place during the waking interval. A person is seen as going to sleep, in part, to complete the adaptive activities initiated during the previous waking interval in a manner akin to parallel distributed processing, with the aim being to construct appropriate behaviors by integrating new learning with that derived from past experience. The process of integration begins with the first slow-wave sleep episode.

During initial slow-wave sleep, an attempt is made to create adaptations on the basis of learned waking responses and their related activated long-term memories. After the

behaviors are constructed in slow-wave sleep, they are in a sense rehearsed during subsequent REM sleep, with the object of this rehearsal being reality testing. In other words, a person tests the validity of his adaptations by experiencing them in the real world of his long-term memory. This diagnostic process is possibly carried out by the anterior cingulate cortex, which detects discrepancies based on the continual evocation of memories that were initially neglected during slow-wave behavior creation, memories from the previous waking interval and from long-term storage. The presence of these memories points up inadequacies in the validity of the initial set of adaptations, both with respect to experiences exactly like those of the previous waking interval and experiences related to alternative ways of responding. Since the initial slow-wave adaptations were based closely on the specifics of the events of the previous waking interval, the number of excluded memories is relatively massive, and their evocation brings the REM period to a relatively quick end. It is assumed that the memories that have been evoked in a particular REM period are not integrated into the adaptations during that REM period to any great extent. Rather, they are merely activated for inclusion as new ingredients in the adaptations formed during the next interval of NREM sleep.

The activation of a new set of long-term memories induces NREM sleep to revert to slow-wave sleep once again, where this time a wider range of possibilities the adaptations to be constructed need to address is considered. This broadening of the experiential base of the adaptations is adaptive, since the events of the preceding day will never again occur in exactly the same way.

The second and subsequent NREM-REM epochs. The second slow-wave period is concerned with arriving at adaptations that are based on both the memories of the events of the previous day and the related activated memories from the first REM period. This leads to a second REM presentation, which generally evokes more excluded memories, whose activation again points up inadequacies in the adaptations. Because there are generally fewer of these memories and the second NREM integration is better organized, the second REM period generally lasts longer. The prior activation of more memories in REM sleep leads to a NREM period that contains some slow-wave sleep and a subsequent REM period that is longer yet. During this REM period, generally no more excluded memories turn up, so organizational problems alone bring this REM period to an end, leading to subsequent cycling between stage 2 and REM sleep, as the effort to hone the set of adaptations continues as an organizational activity. Organizational changes are seen as being made within REM periods as well.

The reality testing that occurs within REM presentations do not merely evoke related memories; it also establishes the adaptations through a form of positive reinforcement with regard to those portions of the adaptations that are supported by both the person's adaptive goals and his internal concept of reality. Positive reinforcement is a progressive achievement as the adaptations are honed over several NREM-REM sleep epochs. This reinforcement is seen as giving the behavioral and motivational adaptations temporary prominence in a person's subsequent waking behavior.

Sleep and psychological development

I have introduced the concept of sleep cognition in such a way as to downplay its role in psychological development, so that it may be seen as something compatible with but

distinct from Weiss's theory. I would now like to restate this concept in psychological terms.

Upon going to sleep, a person assesses the outcomes of the unconscious tests and other behaviors employed the preceding day in relation to his developmental goals initially during slow-wave sleep, at which time all aspects of the person's life that were impacted during the day are considered concurrently, in a manner that may be likened to parallel distributed processing, but which is actually superior to it, because of the possibility for emergent conclusions arising from the application of various separate lines of thought to one another. It is through such emergent processing that diverse aspects of a person's life are knitted together in an integrated fashion.

During the initial descent to slow-wave sleep, a person attempts to form a set of adaptations based on the events of the previous day, taken as a whole. When the person has arrived at this adaptive "solution," a move is made toward REM presentation. The first slow-wave adaptations, being reactions to the events of the previous day, are tailored to the specifics of those events. As REM presentation continues, related but not included memories are continually evoked, whose growing presence helps point up inadequacies in the ongoing presentation. Since the first slow-wave adaptations are primarily reactions to previous-day events, the inadequacies of these adaptations become evident relatively quickly, with the recognition of these inadequacies bringing this REM period to a quick end.

The honing that takes place over sleep is largely involved with finding ways of looking at reality that support developmental initiatives while conflicting minimally with a person's longstanding reality concept. As a result, developmental progress remains a struggle for a person saddled with pathogenic beliefs, because the beliefs ever seek interpretative inroads as a person sleeps, with the result that the new adaptations represent a reconciliation between implications contained in recent experience and those found early in life. The progressive integration of long-term memories into new adaptations over several sleep epochs thus may be seen as providing a mechanism whereby childhood memories persist as a controlling influence in a person's adult behavior. It also explains why psychoanalytic therapies often require months to years. Psychologically beneficial experiences during therapy are initially misinterpreted in terms of the patient's pathogenic beliefs both during therapy and sleep. Even after significant gains seem to have occurred, the pathogenic beliefs largely persist, and continue to hobble further progress. There is some question whether pathogenic formations in a person's memory system are ever completely corrected.

To see what I mean by the latter, it is necessary to first discuss an aspect of the sleep theory I have not yet mentioned. What a mammal must deal with may change dramatically from one season to the next. Climatic changes cause physiological changes involving, for example, hair growth and fat storage, and prompt cognitive changes as well, as the mammal adjusts to different predator/prey/social relationships and sharpens skills that may have lain dormant for months. It's my position that sleep is involved in regulating all of this.

Much of the progress a person makes during the course of a successful therapy represents a person having in a sense moved into a new season of his life. The person has stopped

acting as if he were trying to survive through a bitter winter, but that doesn't mean that memories of winter have disappeared. Sunnier memories have just taken over, perhaps temporarily, as the result of the therapeutic relationship and the new interpretative skills the person has received. Childhood memories continue their influence, but now more hopeful childhood memories are used in the interpretations, instead of the damning memories the person was preoccupied with before. It remains possible that a change in life circumstances may allow the damning memories responsible for the person's pathogenic beliefs to reassert themselves again. This helps to explain why a psychoanalytic patient may lose psychological ground after his therapy has ended.

The structure of the human memory system

The foregoing discussion shows how sleep possibly facilitates the participation of childhood learning in adult behavior. Nothing in this discussion, however, mandates that the long-term memories that are evoked during sleep extend back to early childhood. For that, one must make some suppositions about the structure of the human memory system.

To begin seeing perhaps why our memory system is structured so that childhood learning tends to remain predominant in our behavior, one need only attempt to imagine what kind of societies humans would have developed were this not true.

Although human inventiveness is highly prized today, it wasn't unbridled inventiveness that insured human survival down through the centuries. Rather, it was the cohesiveness of human societies that enabled cultural groups to present a united front against adversaries, either human or otherwise. A little thought will show that this cohesiveness requires a memory system of the type suggested by Weiss's psychoanalytic theory. This type of memory system leads to a cultural value system based on how parents did things, which ensures that a culture will value traditional ways and will be structured so as to look at parental figures as sources of authority. Such a memory system also ensures that traditional technologies and societal roles that have been found to work over the years will be emphasized and will be passed on from father to son and mother to daughter. Had humans had a memory system that enabled childhood memories to fade in the distance with each new year of experience, none of this would have been possible, and mankind likely would not have survived.

Sleep Theory and Dreaming

The subject of dreaming is important enough to merit its own article. In this introduction, I will merely summarize several dream-related implications of the above theory of sleep cycling and then provide supporting evidence I presented thirty years ago. I am aware of no recent studies that provide contrary evidence, nor am I aware of any recent studies that significantly fill out the evidential record, despite the great amount of study that dreaming sleep has received. Such is what happens when research proceeds in a theoretical vacuum.

The NREM vs. REM dream controversy

Over the years, there has been a great deal of haggling over whether dreaming occurs during NREM sleep, or whether dreaming proper should be considered as occurring only during REM sleep, as judged by the mental activity report data. The arguments presented

center primarily on the fact that REM dreams were more "dreamlike" in the sense of being more tangible and more tightly organized, while NREM reports are more "thoughtlike" and more fragmented in content. The consensus now is that NREM reports should be considered dreams, despite these differences, although detracting views may still be heard.

In the first place, the argument that REM thought should be placed on a higher pedestal than NREM thought as dreams on the basis of their tangibility is to argue circularly. It is to say that REM dreams are more like what people think of as dreams. Since humans are much more likely to recall REM dreams than NREM dreams, their use of the word "dream" is defined on the basis of REM dream recall, so the argument is equivalent to saying that REM dreams should be called dreams because they are most like REM dreams. The position taken here is that REM dreams are more tangible because they are literally experienced, whereas NREM dreams are not, and that this physiological difference should not be a basis for disparaging NREM thought.

As for the matter that REM dreams seem more organized and richer in content than NREM dreams, it should be recognized that differing states of consciousness are involved. Learning theory recognizes that recall is greatest when it occurs during the same state of consciousness as the original experience, with relatively minor differences in waking consciousness being involved. It follows, therefore, that recall of mental activities during sleep should be best for the sleep state that is closest to waking consciousness and progressively worse as the respective states of consciousness differ. And this is what is found: REM activity is best recalled, and recall falls off with respect to stage 2 content and is worse yet for slow-wave sleep. To claim that NREM thought is somehow inferior to REM thought on the basis of mental activity reports is to ignore the possibility that content is less likely to be recalled simply because thought must be translated into terms suitable for a radically different state of consciousness in the case of NREM content, whereas fewer changes in content are needed for REM recall.

The conscious faculty that is responsible for dream recall functions primarily in the motivational realm; not surprisingly, therefore, what is recalled as REM and NREM content has only a motivational dimension. REM and NREM learning activities include a skill-development component, which is absent from dream recall, just as skill development mental activities escape conscious awareness during our waking moments. All this occurs because of the properties of the conscious faculty used in recall, it is posited here.

The properties of this conscious faculty most responsible for dream recall relate to the abilities of visualization (creating inner visual experiences) and thinking (creating inner auditory experiences [inner voice]). Psychoanalytically, feelings, moods, emotions, and neurotic symptoms may be thought of as having an inner-experience dimension as well. What allows us to recall dreams, therefore, is our ability to create inner experiences while we are awake. It is conjectured here that REM dreams are inner experiences, too. Not surprisingly, then, recall of REM dreams is best, particularly since our ability to create inner experiences while awake probably represents a borrowing of a similar ability during REM sleep. Most mammals and birds can create inner experiences in their sleep. What I am saying is that when humans evolved, this longstanding sleep ability was made available to waking consciousness as well. The notion that we recall dreams on the basis

of our ability to create inner experiences also helps explain why young children have difficulty remembering dream. This happens, it is conjectured here, because their faculty responsible for conscious recall is not fully developed.

With all this said, it is consistent with the current sleep theory that REM thought is more highly organized than NREM thought, since NREM thought is seen as a preparation for REM thought. REM dreams seem to happen to us unwillingly because they are organized in such a way that experiencing one dream moment evokes the basis for the next. These seeds of future REM dream experiences are contained in a dream's latent content, which additionally carries the dream's meaning. This view accepts Freud's distinction between manifest and latent content, to an extent. Manifest content is seen as an isocratic language in which each dream moment (word) is resolved into experienced elements having latent memories attached to them. These memories convey the meaning of the moment and shape the next moment's content. REM dreams can be nonsensical in manifest content because the dreamer focuses most on the latent content. Focusing on the REM dream images would be like focusing on the sounds one makes while speaking, which would be distracting.

This viewpoint implies that the position that REM dreams have the character of delusion has no merit whatsoever. Hobson's position is based on discarding all latent content (Hobson, 1989). This is done with no credible justification, but once it is done, it allows an analysis of dreams on the basis of manifest content alone, which as I have indicated, is equivalent to analyzing the English language on the basis of the word sounds typically produced. REM dreams can seem bizarre, it is maintained here, because manifest content is a multimodal language that is meant to convey meaning with respect to many psychological issues simultaneously, in a manner similar to parallel distributed processing. REM dreams can seem bizarre to waking consciousness, not because REM state thought is inferior to that of waking consciousness, but because it is far superior to it. That REM dreams can be analyzed on this basis is provided by my analysis of Freud's botanical monograph dream, which may be found on this website.

Mental activity report data

I have conjectured that additional memories participate in the construction of each REM dream after the first and that REM dreams are tightly structured. This implies that REM dreams of the same night should not resemble one another at the manifest level, except perhaps to share a dream element or two, even though these dreams all pertain to closely related subjects. Dement and Wolpert (1958) studied the relationships in manifest content to be found in the dreams of the same night, and here is what they found:

"In the 38 nights' sequences, no single dream was ever exactly duplicated by another dream, nor were the dreams of a sequence ever perfectly continuous, one taking up just where the preceding had left off. For the most part, each dream seemed to be a self-contained drama relatively independent of the preceding or following dream.

"Nonetheless...the manifest content of nearly every dream exhibited some obvious relationship to one or more dreams occurring on the same night. In 7 of the 38 multiple dream sequences, all the dreams seemed to be united by a common theme, but in the majority of cases only contiguous dreams were obviously related. Accordingly, the first and second dreams in any given sequence might contain elements in common while the

third and fourth dreams would have different points of similarity. Occasionally, three or even four dreams would share a connecting link. There was also considerable overlapping of relationships. For example, the second dream might be related to the first by one element and to the third and fourth by another, while the fourth and fifth dreams might have still another connecting link. The manifest content of a dream was only occasionally closely related to the manifest content of another dream when there were intervening dreams which did not share the relationship."

A lack of a close relationship at the manifest level could mean, of course, that the REM dreams of a particular night are not closely related at any level. To decide this, what is needed is an examination of sequential dreaming from the point of view of underlying content.

Offenkrantz and Rechtschaffen (1963) conducted such an investigation. They examined the psychological content of sequential REM dreaming of a subject undergoing psychiatric treatment in terms of T.M. French's psychoanalytic viewpoint (e.g., French, 1952). They found that "despite the high variability of manifest content, all the dreams of a night were concerned either with the same conflict or with a limited number of different conflicts. Second, we believe the data support the hypothesis, derived from French's approach, that the organization of any particular dream depends at least in part on the consequences of the attempted solution to the conflict in the previous dreams. For example, when the solution of a problem in one dream was relatively gratifying, the dreamer usually would attempt an even bolder gratification of a disturbing wish in the next dream. In turn, reactive motives such as fear of retaliation, fear of loss of love, guilt, or shame were stimulated by the bolder gratification. Thus, an alternation of predominantly gratifying and predominantly disturbing dreams in the same night was not unusual. Third, we believe the data support the hypothesis of a parallel between the sequence of waking behavior and the defensive-adaptive ego activities in the dream sequence."

I interpret this data as indicating that the dreamer learned something from each REM dream and attempted to use that information in the next REM dream, in honing his adaptations for use in his subsequent waking interval. A struggle to reconcile opposing forces is also suggested.

I have claimed that the first REM dream is closely tied to the events of the previous day, but that in later dreams other past experiences participate. If this is true, then the manifest content of the first REM period should tend to contain many direct allusions to the events of this previous day, whereas in later dreams, there should be evidence that other experiences are entering the picture.

Offenkrantz and Rechtschaffen (1963) offer some data on this point. They state that "the manifest content of the first and/or second dream on 11 of the 15 nights was concerned directly with the laboratory situation. No later dream was concerned with the laboratory situation in an undisguised way." They state further that "the manifest dream was located in a geological setting of childhood or adolescence in 9 dreams occurring after 4:30 a.m., on 8 different nights, whereas childhood scenes never occurred early in the night." This shift backward in time also has been observed by Verdone (1965).

I have claimed that NREM content is related to that of REM dreams, with this relationship being conjectured as most apparent in the case of stage 2. If my interpretations are correct, then the manifest content of a particular stage 2 interval should bear a close similarity to the content of the very next REM period that appears. More generally, the content of each NREM-REM epoch should be similar. That is, great differences in content should be present only when content from different epochs is compared.

The relationship between REM and NREM mental activity has yet to be examined as carefully as required by the current sleep theory, as far as I know, because awakenings for the purpose of sampling mental content generally follow haphazard schedules. Rechtschaffen, Vogel, and Shaikun (1963), for example, awakened subjects either 30 or 90 minutes after each onset of sleep, depending on the toss of a coin. Such a schedule is incapable of examining the stage 2-REM association my view of sleep predicts. Nevertheless, their findings are generally consistent with the predictions my assumptions make:

1. "Identical or very nearly identical manifest elements are repeated in the reports from non-REM awakenings throughout the night. Repeated manifest elements occur in the accounts of sleep mentation obtained by awakening from all non-REM stages (EEG Stages 2, 3, and 4).
2. "Manifest elements reported from non-REM awakenings are also repeated in the accounts from REM periods, and vice versa.
3. "The identical, or nearly identical, manifest images reported in separate awakenings, both REM and non-REM, appear in different contexts in each account. This suggests that the repetition of manifest elements is not merely a recall of the previous report. When manifest images are repeated in the reports of consecutive non-REM, or non-REM and REM awakenings, the change of contexts in which these images appear indicates that manifest themes reported on different awakenings are not part of a continuous narrative. This observation parallels the report of Dement and Wolpert that contents of consecutive REM period reports are not continuous.
4. "A manifest element which is repeated throughout the night may first appear in the report from an early non-REM period before the first REM period of the night. We interpret this to mean that persistent non-REM images are not recalled from previous unreported REM period dreams...."

"In summary, the structure of sleep mentation, at least on the manifest level, is marked both by an apparent lack of observable connections between different episodes of mental activity on some nights and by the repetition of element in varying contexts in different episodes on other nights. On those nights when themes and images persist through both non-REM and REM periods, the dreams do not arise *sui generis* as psychologically isolated mental productions, but emerge as the most vivid and memorable part of a larger fabric of interwoven mental activity during sleep."

References

Antrobus, A., and Conroy, D. 1999. "Dissociated neurocognitive processes in dreaming sleep." *Sleep and Hypnosis* 1:105–111.

Billing, G.D. 2002. *The Quantum Classical Theory*, Oxford, U.K.: Oxford University Press.

Crick, F., and Mitchison, G. 1983. "The function of dream sleep." *Nature* 30:111–114.

Crick, F., and Mitchison, G. 1985. "REM sleep and neural nets." *Behavioural Brain Research* 69:147–155.

Dement, W.C., and Wolpert, E. 1858. "Interrelations in the manifest content of dreams occurring on the same night." *Journal of Nervous and Mental Disease* 126:568–578.

French, T.M. 1952. *The Integration of Behavior, Vol. 1: Basic Postulates*. Chicago: University of Chicago Press.

Gais, S., et al. 2000. "Early sleep triggers memory for early visual discrimination skills." *Nat. Neurosci*. 3:1335–1339.

Guiditta, A., et al. 1995. "The sequential hypothesis of the function of sleep." *Behavioural Brain Research* 69: 157–166.

Hobson, J.A. 1989. *The Dreaming Brain: How the Brain Creates Both the Sense and the Nonsense of Dreams*. New York: HarperCollins Publishers.

Hobson, J.A., and McCarley, R.W. 1977. "The brain as a dream state generator: An activation-synthesis hypothesis of the dream process. *Am J Psychiatr.* 134:1335–1348.

Hobson, J.A., Pace-Schott, E.F., and Stickgold, R. 2000. "Dreaming and the brain: Toward a cognitive neuroscience of conscious states." *Behavioral and Brain Sciences* 32:793–1121.

Offenkrantz, W., and Rechtschaffen, A. 1963. "Clinical studies of sequential dreams. I. A patient in psychotherapy." *Archives of General Psychiatry* 8:497–508.

Rappoport, A. 1996. "Freeing oneself from pathogenic adaptations: A contribution to Control-Mastery theory." *Psychotherapy Bulletin* 31:27–33.

Rechtschaffen, A., Hauri, P., and Zeitlin, M. 1966. "Auditory awakening thresholds in REM and NREM sleep stages." *Percept. Mot. Skills* 22:927–942.

Rechtschaffen, A., and Kales, A. (Eds.). 1968. *A Manual of Standardized Terminology, Techniques, and Scoring System for Sleep Stages of Human Subjects*. Washington, D.C.: Public Health Service, U.S. Government Printing Office.

Rechtschaffen, A., Vogel, G., and Shaikun, G. 1963. "Interrelatedness of mental activity during sleep." *Archives of General Psychiatry* 9:536–547.

SFPRG (San Francisco Psychotherapy Research Group). 2003. Publications list, available at http://www.sfprg.org/Publications/publications.html.

Shadmehr, R., and Holcomb, H.H., 1997, "Neural correlates of motor memory consolidation," *Science* 277:821–825.

Smith, C. 1996. “Sleep states, memory processes and synaptic plasticity.” *Behavioural Brain Research* 78: 49–56.

Smith, C., and MacNeill, C. 1994. “Impaired motor memory for a pursuit rotor task following Stage 2 sleep loss in college students.” *J. Sleep Res*. 3:206–213.

Verdone, P. 1963. “Temporal reference of manifest dream content.” *Perceptual and Motor Skills* 20:1253–1268.

Weiss, J. 1993. *How Psychotherapy Works: Process and Technique*. New York: Guilford Press.

Weiss, J., et al. 1989. *The Psychoanalytic Process: Theory, Clinical Observations, and Empirical Research*. New York: Guilford Press.