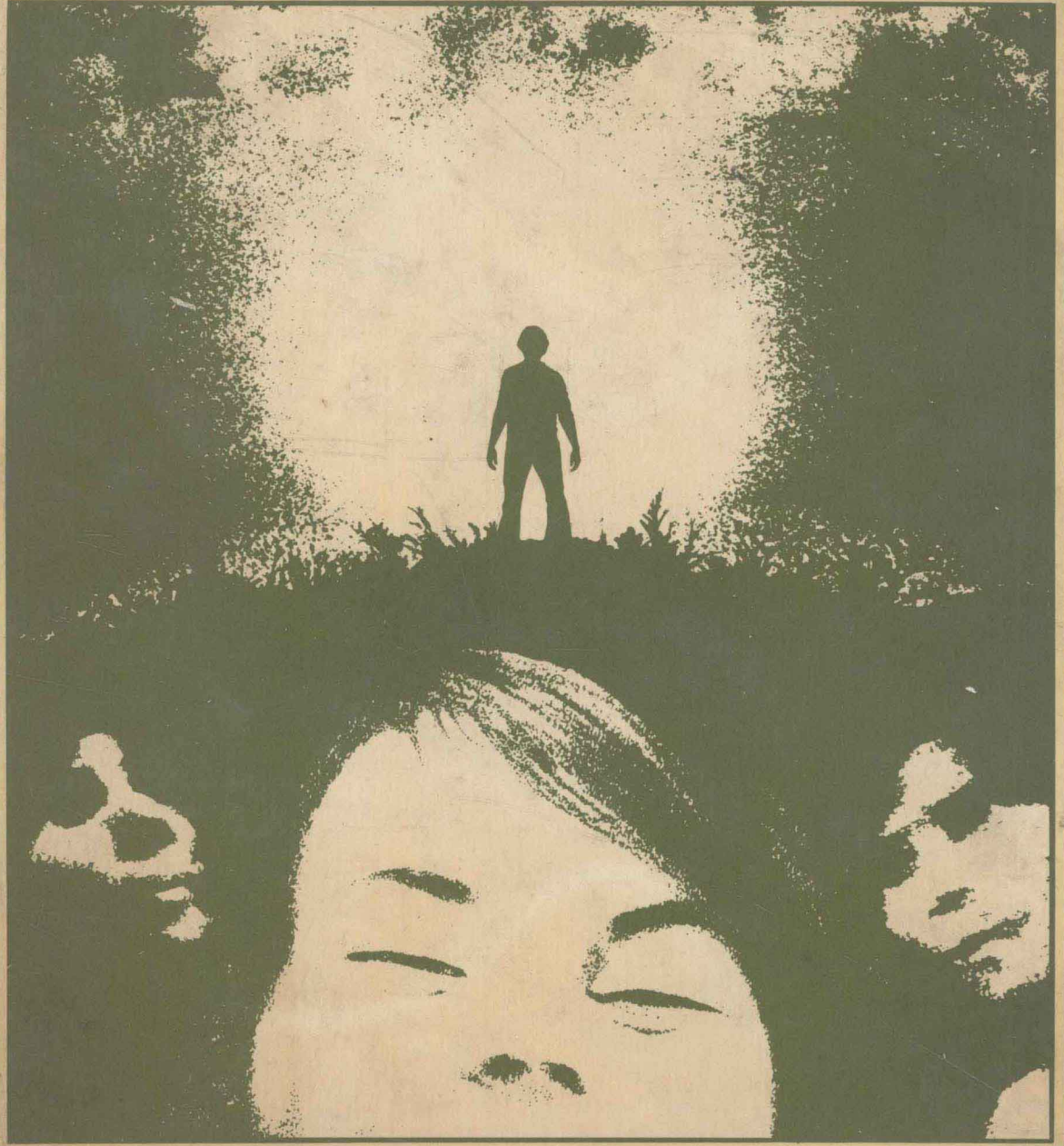


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SLEEP & DREAMING

Origins, Nature & Functions



DAVID B. COHEN
Psychology Department, University of Texas at Austin

SLEEP AND DREAMING: ORIGINS, NATURE AND FUNCTIONS

by

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*For LESLIE KAREN
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INTRODUCTION

(Square) Again, was I not taught that as in a Line there are *two* bounding Points, and in a square there are *four* bounding Lines, so in a Cube there must be *six* bounding Squares? Behold once more the confirming Series 2, 4, 6: is not this an Arithmetic Progression? And consequently, does it not necessarily follow that the more divine offspring of the divine Cube in the Land of Four Dimensions, must have 8 bounding Cubes . . . ?

(Sphere) But men are divided in opinion as to the facts . . . no one has adopted or suggested a theory of a Fourth Dimension.

(Square) Those who have thus appeared — no one knows whence — and have returned — no one knows whither have they also contracted their sections and vanished somehow into that more Spacious Space, whither I now entreat you to conduct me?

(Sphere) They have vanished, certainly — if they ever appeared. But most people say that these visions arose from the thought — you will not understand me — from the brain; from the perturbed angularity of the Seer.

(Square) Say they so? Oh believe them not. Or if it indeed be so, that this other Space is really Thoughtland, then take me to that blessed Region where I in Thought shall see the insides of all solid things.

E. A. Abbott

Sleep and wakefulness are manifestations in higher organisms of a fundamental “circadian rhythm” of inactivity-activity. Sleeping is as common as wakefulness (virtually all of us do it virtually every night) and yet it is a most curious phenomenon. Consider that a person who lives 70 years will spend about 27 of them asleep, and at least 5-6 of these will include vivid dreaming experiences. Can it be that nature has played some kind of malicious trick by periodically requiring organisms to forego those activities which appear to maximize pleasure and survival: feeding, fleeing, fighting, and sex? Why is it not sufficient for us periodically to remain in a state of quiet wakefulness without having to lose touch with our environments? During the past 30 years research has provided a great deal of new information about the phenomena and phenomenology of sleep and the relationship between sleep and wakefulness. No longer can the textbooks of psychology ignore the dark third of existence with its full complement of behavioral, cognitive, and experiential characteristics. My goal is to describe, organize, and interpret some of this new knowledge in order to stimulate a greater appreciation of the role of sleep and dreaming in human adaptation.

Learning through assimilation refers to selection, retention, and modification of information that readily fits a pre-existing knowledge. It is the latter which largely explains the speed, complexity, range, and novelty of information processing. However, by concentrating on opportunity and training, we have underestimated or ignored biological factors which determine, in a general sense, what the individual knows before he shows evidence of learning. Thus, we have erroneously placed the locus of explanation for learning in the more readily observable and comprehensible external environment. However, evidence combines

with common sense to suggest that the parameters of learning are largely determined by endogenous capacities that differ among individuals and across species. Language learning, despite minimal exposure to information and little systematic training, is remarkably easy for the average child (compared to his application of language). The process accelerates about the time that the rate of brain maturation approaches asymptotic levels (about two years). This is not the place to discuss it, but the evidence clearly indicates that understanding precedes the accurate use of language, and no amount of training can induce the child to communicate something that he does not already intuitively know. Likewise, there is evidence that no amount of experience with, or training on, a mirror can induce a monkey to learn that the mirror-image represents himself. In contrast, the chimp readily learns to appreciate the image for what it is. As Gallup says, "a mirror simply represents a means of mapping what the chimpanzee already knows" though, of course, "it provides him with a new and more explicit dimension of knowing about himself . . ." (1977, p. 335).

I am explicitly subscribing to the idea that much of what is learned is based on prior "knowledge" which characterizes the nervous system. Thus, we learn through experience to speak a language, to produce creative ideas, to be skilled in movement, to be sensitive about things or people, because we are endowed differently with the ability to assimilate experience into prior structures that are in large part biologically (not necessarily in the narrow sense of genetically) determined. These structures or capacities are not static. They mature, just as our bodies do, and are affected by experience. This approach to learning, which, in contrast to much contemporary psychological theory, tends to give more weight to assimilation of, than to accommodation to, the environment, is made explicit in order to provide the reader with a fair indication of two major themes of this work: the biological basis of experience, and the importance of individual differences to the understanding of psychological phenomena.

The study of sleep and dreaming provides a very special perspective on human functioning. In many ways it stands in direct contrast to more traditional paradigms utilized in psychology that place the locus of explanation of human behavior in the external environment. What I would call the militant environmentalism of American psychology reflects two characteristics of American cultural tradition: *pragmatism*, emphasizing the conventional, concrete situational, immediately observable, ostensibly controllable, eminently practical; and *egalitarianism*, elevating to an ideal the notion that "all men are created equal". Pragmatism has led psychology toward defining itself as the study of behavior rather than the study of mind and brain function (the two fundamental constituents of the "black box"). Egalitarianism has encouraged suspicion of the very idea of individual differences ("error variance") especially when these turn out to reflect organismic differences. The result is somewhat embarrassing: naive and unnatural theories about normal and abnormal psychological phenomena: naive because they are "mindless", unnatural because they are "gutless". Contemporary psychology is moving closer to the view that, for organisms with even a modest claim to phylogenetic sophistication, what is learned is less movement than acts, that learning is rule more than stimulus governed, that information more than tension (drive) reduction is motivating, that individual differences in basic processes (e.g. ability to detect, identify, remember, innovate, and the ability to regulate affect, experience and behavior) reflect individual differences in constitution as much as or more than individual differences in opportunity or training. I suspect that the psychology of learning is most hampered when "the influence of the environment is nonsensically overrated . . . the essential factor in the process of life is precisely the

tremendous inner power to shape and to create forms which merely *uses, exploits* 'environment'" (F. Nietzsche).

No wonder that, until recently, American psychology has contributed so little to the problem of sleep. To the casual observer, sleep has three characteristics that are either uninteresting or positively offensive to behaviorists: an *absence* of behavior (e.g., it is noninstrumental), an absence of responsiveness to external stimuli (i.e., it is resistant to control), and the presence of mental phenomena (i.e., nonobjectifiable, private events). If anything, sleep would appear to be a problem for the physiologists (who, until recent times, have borne the major burden of describing it). But, as I hope this book will demonstrate, sleep *is* a psychological problem whose investigation may tell us much about wakefulness. Despite its limitations, research on sleep and dreaming serves to remind us of the importance of cognition and the organismic basis of experience and individual differences. This point is sufficiently important, both to an appreciation of sleep and dream research as well as to the broader field of psychology, to justify further elaboration.

Learning is generally conceptualized as a process of accommodation to the environment. The individual is stimulated and guided by cues, held by reinforcements (inducements), and gradually "shaped" according to the demands and requirements of the external environment. In this accommodation of psychological structure to environmental structure, the individual is conceived to be a "dependent variable".

An alternative view, which should be thought of as supplemental rather than competitive, holds that learning is a cognitive process by which information is extracted, transformed, and assimilated according to the given and acquired properties of the organism. This latter view is commensurate with the idea that learning is an organismic process which reflects the cumulative influence (degrees of freedom as well as constraints) of telencephalic evolution as much as the controlling and informational properties of the environment (Jerison, 1973). And further, it would seem that while the accommodation view of learning might be more appropriate to explain the behavior of phylogenetically primitive organisms, explaining the behavior of more advanced organisms requires that we pay more attention to learning as invention. Explanations of human behavior in particular, which traditionally have relied so heavily on concepts like classical conditioning, operant learning, modeling (concepts which give little or reluctant consideration to cognitive processes) have surely missed the mark.¹

The study of sleep and dreaming as organismic processes provides a perspective from which both kinds of learning can be evaluated. In the case of dreaming, while it clearly reflects some degree of accommodation, more than any other cognitive process it represents the epitome of assimilation. It is mind as reconstruction as much as representation. But more, it provides a "window" through which an appreciation, if not an understanding, of cognitive mediation may be achieved. It demonstrates the organism to be continuously active, flexible, inventive. And it suggests, as Klinger (1971) has ably argued, that such a process is part of and influences the learning of the waking state. In addition, as Marty Seligman has impressed upon me, it provides additional experience to which the organism accommodates. If we concede that cognition is what is most special about the human organism (that which permits psychological freedom from direct external control), if the

¹ After writing this, I came across Brewer's literature review (1974) which supports his thesis that "there is no convincing evidence for operant or classical conditioning in adult humans". Resonating to this review, Halwes remarked that "we find that the behaviorists have told us nothing of significance" but warns "that the 'cognitive explanations' are just common sense" (in Weimer and Palermo, 1974, p. 57).

highest form of cognition is creative and productive ideation, and if we believe that such ideation mediates behaviors that are fundamental to cultural achievement, then the study of sleep and dreaming takes on a special relevance. If we are to pay more than lip service to the concept of incubation when we try to explain creativity, then we need to pay more scientific attention to *the* fundamental form of incubation. For me, the highest and best property of human functioning, what we so very appropriately call giftedness, is not a property of the social environment (though it does, of course, develop within the social context). Rather it is a property of what I would call "organismic inventiveness", the ability to *extract* information from the "raw material" provided by the environment, recognize its possibilities, and invent new forms. And this is accomplished with a facility, celerity, and dexterity that can not be explained in terms of the language of accommodation. So, whatever else it says about the nature of the organism, sleep and dream research is to some extent commensurate with a romantic view of human nature. It provides evidence of the active, spontaneous, self-determining, self-confronting, and self-revising qualities of human functioning. This view is not antiscientific. Rather it challenges the scientific method to accommodate to its physiological and phenomenological properties. The present book represents, in part, an attempt to assess the degree to which the scientific method has been successful.

Research on sleep and dreaming suggests another characteristic of human functioning, a tendency to return periodically to one's roots. I mean this in both the physiological as well as the psychological sense. Data and speculation scattered throughout the vast literature suggest that dreaming (perhaps more specifically, REM sleep) constitutes a reactivation of ontogenetically early forms of information processing. According to Freud, Piaget, and Werner, the initial stage of intelligence is characterized by information processing that is largely sensorimotor and affective in nature (i.e., primary, preoperational, syncretistic, physiognomic). What we are learning about the nature of dreaming, and the neurophysiological activity which underlies REM dreaming, is in the broadest sense consistent with the view that, whatever else it does, dreaming is a kind of "return to the basics". More specifically it is a more direct expression of phylogenetically older, ontogenetically earlier mental functioning which is normally concurrent with, but latent and only indirectly expressed in, the mental functioning of normal wakefulness.

I have suggested that dreaming is a return to roots. I would like to pursue this notion one step further by looking at the relationship between the phylogeny and the phenomenology of dreaming from the perspective of dream meaning. My brief discussion rests heavily on a paper by Franks (1974) that begins with the question: "Why are psychologists, linguists, philosophers, etc. so dumb when it comes to the problem of meaning?" (p. 231). For Franks, the answer has much to do with our inability to extricate ourselves from "surface structures" (e.g., words, images, behaviors) when attempting to develop hypotheses about the nature of the deep structure which generates those surface structures. "If images are seductive, then words are insidious. The ever-present play of words in awareness, on paper, and in speech seems to make it well-nigh impossible for us to resist inserting them as units of our meaning knowledge structures" (p. 256). The heart of Franks' argument is that images, like other kinds of surface (observable, manifest) structures, are derivations from tacit meanings which, themselves, are derived from a more general background called tacit knowledge. Further, the organization of these levels of deep structure is *not* obviously revealed by the content and organization of the surface structures. Alas, we can at best only infer the nature of deep structure from our understanding of the nature of observables (to which Franks says

we have paid too much attention). Formulations about tacit knowledge and situation-specific derivations or tacit meanings on the basis of observable surface structures is at best a theoretical convenience, at worst, misleading and erroneous.

So how do we gain access to deep structure? Franks suggests that we pay more attention to intuition. Along with other forms of surface structure, intuition is defined, in part, as a characteristic of consciousness which most closely embodies the qualities of tacit meaning. "Images, language expressions, and responses are clues to properties of particular derived meanings. In contrast, intuitions seem to be clues to more general relations in tacit knowledge. Intuitions of similarity and difference, of novelty, familiarity, anomaly, etc., are impressions of general, more global, structural relationships among events." Franks goes on to suggest that intuitions may be "a golden road to tacit knowledge" (p. 259).

Let us take some liberties with this idea. Perhaps intuition is a manifestation of knowledge that does not require, but most certainly is enriched and educated by, the ability to imagine and to verbalize. That is, intuition is a representation of the phylogenetically more primitive intelligence from which animal behavior is derived. It is related to the sensorimotor intelligence of the preverbal infant and to the preoperational intelligence of the child. (It is what paleocortical structures "know".) During dreaming, it is perhaps the deep structures of intuition more than the more recently acquired deep structures of syntax which generate the hallucinated experience. In this sense, both Freud and Jung appear to be profoundly correct in emphasizing a regression to ontogenetically and phylogenetically earlier meanings.

However, I would add that the tacit meanings which generate dream experiences are not merely primitive cognitive expressions of paleocortical activity. Both tacit knowledge in general, and tacit meanings in particular, are modified by maturation and development such that their products in human adulthood are different from those of infancy and childhood. These products are then the joint function of preoperational and operational processes. The obvious point is that intuition should not be maligned as merely "subjective". Intuition may sometimes represent the best fit for reality as exemplified by "solutions" arrived at nonlogically (e.g., common sense decisions, creative insights, clinical judgments, dreams) and subsequently demonstrated to be both valid and useful. If it is true that dreaming is an intensely intuitive process, and if Franks is correct to emphasize the importance of intuition as the best clue to the ultimate problem of tacit knowledge, then the study of the surface structures of dream content ought to have a special status within cognitive psychology. That it does not is as much the fault of academic psychology, which is only now moving back toward a productive appreciation of cognitive processes after its long bout with behaviorism, as it is the fault of sleep research, with its burden of establishing an objective and scientifically respectable framework for the study of dreaming.

In 1969 the late Arthur Shapiro thought that there was a sufficient data base for a general theory of sleep and dreaming. Neither the data nor hypotheses which continue to be published at a geometrically increasing rate appear to confirm such optimism. And I would add that this is especially true in the area of dream research which is still burdened by an unfavorable ratio of theory vs. data. Consider the following two statements (whose order of presentation I have taken the liberty to reverse): "the richer the theoretical network, the richer the network of theoretical relationships it will generate", and "the greater the richness of a network of experimental relationships, the narrower the range of available theories that will predict this network of experimental relationships *without recourse to highly implausible* auxiliary assumptions" (Dulany, 1974, p. 55). Such an ideal state of affairs does

not currently exist, especially in the area of dream research. In the present book, I have tried to advance an effective mix of data, theory and speculation. If I have erred in permitting myself the luxury of indulging too much in the latter, it is out of a conscious subscription to Charles Darwin's comment that "false views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness: and when this is done, one path towards error is closed and the road to truth is often at the same time opened".

A word about the organization of the book. I have decided to develop my discussion about the dreaming process from a biological perspective wherever possible. This bias is derived from my interest in sleep *per se*, the obvious fact that dreaming is part of the fabric of sleep, and the fact that there is precious little discussion of the biological foundations of dreaming in the literature. I do not for one instant minimize the importance of dream symbolism. Rather, I wish to provide a forum for a countervailing contrast to what appears to be an unfortunate imbalance in the dream literature. My bias accounts for two aspects of the organization of this book, one that is immediately obvious from a superficial perusal of the table of contents, the other more subtle. First, I discuss data and theory on rapid eye movement (REM) sleep: electrophysiological characteristics, cyclic rhythmicity, neurophysiology, ontogeny, and phylogeny. I also deal with questions regarding the cognitive capacity of the organism during REM sleep as well as the effects of REM deprivation on both sleep and waking behaviors. I do this in order to provide a broader perspective regarding the biological roots of a process that is usually thought of as purely "psychological". Modern sleep research has yielded far more information about REM than NREM dreaming. Therefore, in the interest of developing an effective rather than a necessarily comprehensive discussion, I have chosen to emphasize dreaming largely as a REM process despite compelling evidence that NREM (in particular, sleep onset) dreaming is phenomenologically similar to REM dreaming (Foulkes and Vogel, 1965). I have allowed myself to be guided by a biological bias regarding the electrophysiologically unique state of REM (Johnson, 1973a). Much of what I have to say, however, will undoubtedly turn out to be more or less true for NREM dreaming as well.

Second, within each of the chapters in the first ("biological") part of the book, I try to draw out where possible implications for the dreaming process. In short, the organization of the book is such that wherever possible, dreaming is approached as a psychobiological process which is manifested at cellular, physiological, psychological and phenomenological levels.

A third objective of this book is to draw attention to the potentially useful implications of individual differences in the phenomena. These crop up in both the animal and human data at all levels of investigation. We will not be in a position to say much that is conclusive because so little attention has been paid to this aspect of the problem. The material in Chapter 4 provides a fair example of the limitations in the current state of knowledge regarding individual differences in REM phenomena. Nevertheless, I am convinced that we will be able to strengthen significantly sleep and dreaming theory by exploiting analyses of correlational and interaction effects derived from the data of individual differences. I hope that one contribution of this book will be to demonstrate how on the one hand, individual difference theory can reveal more about sleep processes while, on the other, sleep phenomena can reveal something about the organismic basis of individual differences. After all, in the last analysis, what is important is explaining how the organism works, not merely how it sleeps or what it does during wakefulness. So in a sense, this book is about more than just