May 2007

Perspectives in Dream Function Theory

Rachel Kornfield
Macalester College

Honors Paper

Macalester College

Spring 2007

Title: Perspectives in Dream Function Theory

Author: Rachel Kornfield

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RUNNING HEAD: Dream Theory

Perspectives in Dream Function Theory

Rachel Kornfield

Macalester College

April, 2007

Introduction

The scientific study of dreams utilizes an array of methodologies including content analysis, electroencephalogram (EEG), rapid eye movement (REM)-deprivation, and neurophysiological localization, among others. Recently, lesion and imaging studies have distinguished the neural mechanisms that underlie dreaming. However, important questions remain about whether these mechanisms can clarify dreaming as a phenomenal experience.

The results of recent neurophysiological investigation are of interest not only to those in the neuroscientific community, but also many others concerned with the scientific study of dreaming and consciousness. Kelly Bulkeley (1999), one psychological dream researcher whose perspective I present, has described dream studies as a divided discipline. Investigators lack consensus not only over appropriate research methodologies, but also over the relationship of dreaming to rapid eye movement (REM) sleep, over the value of dream interpretation, and over the degree of variability in dreaming. Researchers even lack consensus over how to define "dreaming" (Bulkeley 2002).

Another longstanding debate is over the functionality of dreams. Antti Revonsuo (2000), author of the threat-simulation theory (TST), has described that cognitive neuroscience treats dreaming as epiphenomenal of sleep-related processes. In contrast, dream functionality has long been upheld in depth psychology. Psychologists have argued that dream functions may include promoting emotional stability, solving intellectual problems, and fostering personal development. Depth psychology and

cognitive neuroscience seem to correlate with disparate and potentially incompatible perspectives on dream function.

This thesis considers the intersection of phenomenological and biological accounts of dreaming and looks closely at recent theories that link neurophysiological and psychological data. Discussion of methods is essential to dream studies; the unique challenges of data collection and interpretation in this discipline are daunting. Each of the five sections of this paper reviews the work of a dreaming or consciousness researcher who has significantly contributed to this dialogue. The five scholars whose work is the focus of this paper are J. Allan Hobson, G. William Domhoff, Kelly Bulkeley, Owen Flanagan, and Antti Revonsuo.

Naturally, many views must be left out. This paper does not deal extensively with psychoanalytic approaches to dream function despite the fact that some psychoanalysts have substantially integrated recent findings from cognitive neuroscience with psychodynamic dream theory, even establishing neuropsychoanalyisis[1] as an emerging discipline. The legacy of Freud and Jung in dream studies is steadfast and continues to motivate many dream researchers. Accordingly, elements of an interpretive or psychoanalytic perspective will emerge in every chapter. In particular, Revonsuo and Bulkeley attend to the subjective experience of dreaming and both build upon decades of research utilizing dream reports. Although dream reports have long been a data source, one flexible and widely-implemented content analysis system, the Hall and Van de Castle (HVDC) scale, has expanded the relevance of dream reports as a source of empirical data.

Hobson, a co-author of the earliest influential neurophysiological account of dreaming, the activation-synthesis hypothesis (A-S), is an outspoken critic of content

analysis and interpretive methods. He argues that dreams can be sufficiently understood as an epiphenomenal effect of sleep-related brain activations. The formal elements of dreaming, such as loss of directed thought and memory deficits, can be mapped isomorphically onto cortical and subcortical neural activations. According to Hobson's revised A-S, random images are generated by chaotic pontine activity and then interpreted by the forebrain circuitry of dreaming. Hobson describes that understanding our dreams does not require religious or psychoanalytical explanation. Our dreams do not reveal universal truths, do not include hidden messages, and do not contribute to our psychic balance: they are functionless. Hobson argues that the dream state is comparable to delirium, and he supports his epiphenomenalism by invoking a relationship between REM dreaming and psychosis. Both states, according to Hobson, differ systematically from waking mentation and non-rapid eye movement (nREM) mentation, particularly in their deficits in reasoning.

Like Hobson, Domhoff studies the cognitive component of dreaming and the corresponding neurophysiology. Unlike Hobson, his major measure is content analysis. Domhoff describes that empirical studies have shown that themes in dream content remain consistent across generations, across cultures, and across the individual lifespan. He concludes that dreams are not nearly as chaotic or irrational as Hobson claims. Rather, they correspond to the individual dreamer's major concerns and conceptions and reveal his or her cognitive development. For example, children only report dreams when they achieve a level of cognitive sophistication that includes visuo-spatial skills and linguistic skills. Domhoff argues that the mechanisms that support cognition during waking also support cognition during sleep. Dreams arise epiphenomenally from automatic cognitive

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[1] For example, Mark Solms and Oliver Trunbull edit a new journal entitled *Neuropsychoanalysis*.

functions that cross states. According to Domhoff's model, the formal uniqueness of dreaming reflects the physiological requirements of sleep, not a distinct etiological function of dreams.

Bulkeley, the next author I consult, develops a theory that contrasts starkly with the previous two. Bulkeley has looked extensively at the social, anthropological, and religious contexts of dreaming. He describes that some societies utilize dream narratives in functional ways while other societies neglect the potential of dreaming. Bulkeley argues that dream experiences vary widely and that dreams are most useful to those who seek guidance from them. Dreams work, he argues, by facilitating "creative play", the use of symbols and metaphors for interpersonal development. Like Revonsuo, Bulkeley does not look for evidence of their function in all dreams, but in certain memorable dream "types", including threat simulations as well as prophetic dreams, religious dreams, and "root metaphor" dreams. Remembered dreams may have particular functionality; unlike non-remembered dreams they achieve personal resonance. Salience, Bulkeley argues may be one important variable, related to functionality, which popular methods consistently overlook. Bulkeley argues for intellectual rigor in integrating findings from multiple disciplines, including philosophy, literary studies, sociology, and psychology.

In contrast, Flanagan describes a much narrower standard for dream functionality, emphasizing the potential relevance of dreaming to our ancestors' survival in the evolutionary environment. A reasonable theory of dream function must provide evidence that dreaming gave a survival advantage to our ancestors and was selected for. Flanagan has little hope for such an account. He explains that the evolutionary environment is too remote to envision with accuracy and he questions that dreaming can

be considered a distinct evolutionary achievement. Perhaps our dreams reflect the interaction of multiple mechanisms, including functional sleep processes and specializations of consciousness that are functional only during waking. This chapter also utilizes arguments from Tom Polger, Stevan Harnard, and others to highlight the difficulty of constructing evolutionary theories of conscious states testable by available empirical methods.

Revonsuo's (2000) Threat-Simulation Theory (TST), which I explore last, also considers dreaming in the framework of evolutionary biology; however, unlike Flanagan, Revonsuo concludes that dreaming has clear adaptive function. TST posits that nightmares were the evolutionarily functional dreams. Our ancestors faced many dangers to their lives and reproductive abilities but, according to Revonsuo, their dreams provided a safe realistic virtual reality in which they could rehearse their responses to and detection of danger. Revonsuo uses the content of children's dreams, the dreams of hunter-gatherer populations, and evidence of threat-simulations in the wake of trauma to demonstrate dreaming's robust bias towards the presentation of ancestrally relevant dangers (e.g. fierce animals and male strangers). With his TST, Revonsuo attempts to construct testable predictions for psychological and neurophysiological dream research.

Although each chapter of this thesis focuses on a single author's work, I will attempt to establish a logical flow around the themes of phenomenology, functionality, and integration. The goal of this paper is not to argue for any one dream theory, but to test the coherence of the discipline. In each chapter, I ask: What questions is the author attempting to answer in his theory of dreaming? What philosophical and cultural assumptions does his research build on? I will also ask, what unique empirical findings

does the author provide that may contribute to our nuanced understanding of dreaming? I assess the validity of competing theories by weighing each one's ability to explain the complexity and variability of dreaming, accounting for such striking characteristics as nightmares and recurrent dreams, and also for cross-cultural and developmental distinctions.

Flanagan's evolutionary perspective highlights the limitations of models of both dreaming and consciousness. Philosophy may have set reasonable theoretical guidelines for judging the evolutionary relevance of conscious states, but psychology and neurophysiology cannot generate the necessary empirical tests. TST, while it makes testable predictions, cannot be proved. The new methodologies in neuroscience may have reorganized and reinvigorated dream studies, but they have not given us reliable tools for assessing dream meaning or etiological dream function.

As Bulkeley (2002) describes, methods can improve in the social sciences as well as the hard sciences. Domhoff's work, with its emphasis on cognition, demonstrates a reasonable integrative strategy. However, a plausible neurocognitive model of dreaming does not preclude additional interpretive strategies. Similarly, Hobson provides only one "level" of explanation. His research does not prove that dreams are meaningless, and no neurophysiological approach could. Furthermore, neither Domhoff nor Hobson provides a sufficient criterion for designating the psychological properties of dreams. The variability in each author's characterization of normative dream phenomenology reveals the inherent subjectivity in dream studies and the true breadth of dream experience. Neuropsychological and neurocognitive models must move *towards* empiricism by

making a priori predictions that cross domains (e.g., predicting psychological effects of differential neural activations).

Bulkeley, by emphasizing created dream functions and the correspondence of dreaming to the broader functional mechanisms of play, does not provide a framework for assessing dream etiology, but he does generate valuable research questions: Do the similarities of dreaming and play reflect shared neurocognitive properties? Do dreams perceived as significant differ according to any neurocognitive properties, or only according to psychological properties such as salience? Bulkeley's bias toward the measurement of psychological dream variables does not preclude research strategies that test that neural correlates of the phenomenal properties of altered states of consciousness (ASC). This strength, in addition to the therapeutic possibilities of treating dreaming as play and his attention to variability in dream features, sets Bulkeley's work apart from that of the other dream theorists discussed here.

I conclude that many of these men overlook the methodological and theoretical limitations of their own models. Hobson emphasizes the importance of an empirical dream science, but he has not achieved objectivity. While the goal in consciousness studies, as Revonsuo describes, must be eventual integration of phenomenological and biological models, we cannot yet achieve it. Neurophysiological accounts, in particular, must avoid reductionism. Whether we believe we can "explain" dreams inevitably depends upon the conceptual framing of our research questions.

Hobson

In 1977, Hobson and McCarley co-authored the original A-S account of dreaming, the first influential dream theory from cognitive neuroscience. Finally, dream studies had physiological measures with which to investigate dreams and their significance. The scientific community and beyond turned to the authority of these new methods, and Hobson enthusiastically corroborated their suspicions, reporting that dreams did not have meanings beyond their transparent ones. Along these lines, dreams had no etiological function according to A-S, but were the unintended and structurally irrelevant products of other processes, particularly those cognitive programs that characterize REM sleep.

Although some of the specific causal claims about dreaming in the original A-S were later reconsidered (e.g., that dreams were essentially products of the brainstem and that dreaming only occurred in REM sleep), the epiphenomenalist thrust of A-S was maintained in many subsequent neuropsychological constructions of dreaming, including the Activation-Input Source-Neuromodulation (AIM) model[2] (Hobson et al. 2003). In the scientific community, many continue to view dreams as random images woven together by the mind, and results from new imaging technologies have frequently been interpreted according to a revised A-S model.

Hobson (2004) writes, "Recent advances in brain imaging, coupled with cellular and molecular neurobiology data, have given us a remarkably clear picture of the differences in brain activity between waking and activated states of sleep, such as REM"

(21). Hobson uses REM-linked activations to explain the distinctness of REM mentation from nREM mentation and normal waking thought. He argues that REM and waking states have divergent neural substrates, and accordingly, that dreaming and waking are "polar states of consciousness" (Hobson 2000, 15). The formal phenomenal properties of REM dreaming, constructed as a series of cognitive deficits, arise from a distinct break, formally and neurophysiologically, from the mechanisms of normal, reason-based cognition. Hobson invokes dreaming's relationship to psychosis to explain that it could not be a phenomenally functional state. He rejects content analysis approaches in dream research, arguing that they are either concerned with superfluous psychoanalytic interpretation or insensitive to the true formal distinctions between dreaming and waking.

Hobson et al. (2003) describe various methodological pitfalls in psychological dream research, particularly where researchers rely heavily on dream reports. First, verbal reports reduce multimodal experiences to narratives. They write: "if a picture is worth a thousand words, we are certainly not getting the whole picture with a 7-word report!" (10). Furthermore, dream narratives are constructed during waking, possibly contaminating the phenomenological character of the dream, and dream reports are always constrained by the cognitive and linguistic abilities of the individual dreamer. In some cases, fabrications or confabulations may even occur. As Irwin Feinberg (2003) reports, "Virtually all modern sleep-dream research is based on the unproved assumptions that narratives given by subjects (Ss) when awakened from sleep represent mental activity that was going on prior to awakening" (143). He suggests the possibility that Ss create dream narratives "*de novo*, while… in a fugue state intermediate between sleep

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[2] The AIM model creates a three dimensional state space for consciousness. Experience is modulated by neurophysiological variables: level of activation, source of information inputs (interval vs. external), and

and waking" 143). While this particular argument might be challenged by studies of deliberate eye movement during lucid dreaming[3], dream reports are doubtless shaped according to the conditions in which they are remembered and shared.

A related shortcoming not discussed by Hobson and his colleagues is the self-selection bias that operates all sleep and dream research, and particularly research involving content reports. Factor such as recall ability, attitude toward dreams, and intensity or type of dream experience may influence who is likely to volunteer for research. Researchers should especially resist generalizing the rates of occurrence of various types of dreams. For example, nightmares might occur much more frequently outside the lab, but the population that has most of these dreams may avoid studies that force them to dwell upon or relate their dream content. The self-selection bias may affect not just PTSD research, which has shown lower than predicted rates of sleep disturbance, but all sleep and dream research. Hall's data on norm dream, taken from a large sample of college students, has a level of reliability that other samples lack, but is still fallible. Domhoff demonstrates that dream reports collected over large spans of time from one individual can be useful in content analysis; these studies are also less hampered by selection biases.

Hobson et al. (2003) next consider the unnatural environment of the sleep lab, in which much dream research has taken place. They argue that dream research that relies "solely on verbal reports of the poorly recalled subjective experience of Ss sleeping in

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mode of cognitive organization.

[3] The term lucid dream designates dreams in which the dreamer is, while dreaming, aware that he or she is dreaming. In Hearne's (1978) study, Ss were trained lucid dreamers. Their deliberate eye movements within their dreams, apparent in EEG measurements, confirmed to experimenters their lucidity. Simultaneously, their physiological measurements indicated sleep. These studies showed the temporal location of lucid dreams: within sleep, particularly REM sleep.

unfamiliar, non-natural settings has led, not surprisingly, to a sterile and nonproductive controversy about whether the conscious correlates of" sleep and waking states are more similar or different (15). Here, Hobson responds to claims of researchers like Domhoff that thought during dreams largely resembles waking thought. That these researchers have found such similarities between the states reveals the crudeness of their measures, not any true phenomenal overlap. Hobson et al. reject "one generator" models that attribute dreaming across the sleep-wake cycle to a single mechanism, activated to varying degrees (e.g. Moffitt 1995). Such accounts, argue Hobson et al. (2003) "minimize the importance of physiology, which they assert to be irrelevant to the understanding of dreaming" (12). Only psychophysiology, Hobson and his colleagues argue, can reveal the true isomorphism of consciousness states. Psychology must be checked against neuroscience.

However, the problem is not that psychological approaches reject eventual integration of phenomenal accounts of dreams with physiological data. Instead, it seems that neither psychology nor neuroscience have made concrete or testable predictions in the other domain with regard to dreaming. John Antrobus (2003) has described the limitation of cognitive models of dreaming such as Hobson's: they rely very heavily on waking models of cognition and on neuroscientific data. Such explanations are "woefully simplistic, rather like a Manhattanite's picture of San Francisco from Manhattan in Steinberg's famous cartoon, where California is merely a small undifferentiated smudge on the other side of the Hudson River" (115).

Figure 1. ***View of the World from 9th Avenue*****, by S. Steinberg (1976).**

Furthermore, Hobson's causal claims about how the cognitive characteristics of dreams arise from REM and nREM neural mechanisms are "highly speculative" and "often contradicted by waking models upon which they are based" (116). Particularly, Antrobus (2003) questions the unsubstantiated association of pontine activity with dream bizarreness. Hobson's attempts to map the features of dreams onto specific cortical and subcortical regions further assumes that these regions have state-to-state invariability in terms of function or cognitive operation.

Rather than seeking new interpretations of the neurophysiological data that account for recent findings from psychological dream investigation, Hobson uses the new neural network of dreams to support his original position with regard to function, epiphenomenalism. Although Hobson has revised his theory to accommodate the robust

forebrain mechanisms that more recent investigations have discovered, he maintains that the pons plays a primary role in the genesis of both REM sleep and dreaming. He describes that activation in pons induces chaotic signals, generating random images that forebrain mechanisms then "synthesize". Hobson also pays lip-service to an emerging double dissociation between REM and dreaming, where REM sleep is no longer viewed as necessary or sufficient for the occurrence of dreaming; however, his recent work still implies a singular relationship between dreaming and REM sleep.

While the neurophysiological picture of dreaming is clarified through the use of new techniques, the application of these results to models of dream consciousness is not straightforward. In fact, it is not only neurophysiological data on dreaming that has been increasing, but also psychological data. While Hobson (2005) acknowledges that a descriptive study of sleep has been complemented by EEG mapping and imaging studies, he implies that such study is of a different era. He writes: "dreams as well as other unusual states of consciousness can finally be approached from the solid foundation of modern neuroscience" (2001, 321). It is orthodoxy in the psychological community and, particularly, adherence to Freud's "outmoded" ideas that hold back dream science (329). At great length, Hobson (2001) rails against the "cult of Freud" (329). This frustration has frequently been directed against Mark Solms (2000), who has constructed an eloquent Freudian interpretation of the forebrain dream network.

Hobson argues that psychoanalysts' predictions in regard to biology are so vague that nearly any neurophysiological findings might be construed as support, a criticism which may sometimes be justified. For example, psychoanalyst Anthony Stevens (1995) implies some compatibility between A-S and his Jungian dream theory. Steven argues

that our dreams "link us, as the neuroscientists have demonstrated, with the most ancient structures in our brains" (4). The brainstem, site of random activations in Hobson's model, becomes a vehicle of the collective unconscious in Stevens'. However, Stevens' account of dreams as reflecting a uniquely human capacity for symbol would be just as, if not more, consistent with the activation of evolutionarily recent areas of the brain than "ancient" areas like the brainstem. This example illustrates the ease with which neuroscientific results can support theories with vastly different allocations of dream meaning. In fact, the flexibility of neurophysiological data complements the suggestibility of psychoanalysis.

Although Hobson (2000) upholds scientific inquiry into dreaming over "pre-modern" systems such as religion and psychoanalysis, his own conceptualization of dreaming builds on unacknowledged philosophical perspectives. Hobson's epiphenomenalist perspective of dreams, while he asserts that it derives clearly from his data, also indicates his intuitions about the value of consciousness during "altered" states. His list of the primary formal features of dreaming emphasizes only the aspects of dreams that are distinct from waking patterns of consciousness: "loss of awareness of self (self-reflective awareness); loss of orientation stability; loss of directed thought; reduction in logical reasoning; and, last but not least, poor memory both within and after the dream" (6). In fact, each of these "cardinal features" is a deficit of a cognitive skill or ability.

Tracey Kahan (2001) describes that A-S' emphasis on dreaming's lack of higher-order mental processes, dissociation from waking life, and relationship to psychosis has shaped the scientific community's perspective on dreaming. Such biases in dream science reflect larger biases of the "Western cultural perspective", which treats dreaming as less

"real" than waking life (354). Nisbett and Norenzayan (2002) describe typical differences in the cognition of Asians and Westerners, where Asians utilize dialectical or holistic cognition, a style which assumes that reality is fundamentally dynamic. In this framework, contradictions may inherently emerge from any object or event, requiring multiple perspectives in "the search for the middle way to truth", as Tartz et al. (2006) put it. Nisbett and Norenzayan (2002) describe that Western cognition, in contrast, relies on logic, rules, and categorizations that attempt to describe a complete interactive system. A dichotomy between normal and altered states might emerge from such biases. Kahan (2001) writes: "The assertion that dreaming does not, cannot involve self-reflectiveness or volition has served as an unstudied, a priori assumption" informing empirical and theoretical study of the mind during sleep (336). Hobson and others create a narrow framework of dreaming as deficient.

In fact, few theorists have provided empirical evidence supporting the popular idea that metacognition[4] does not take place in dreaming. For example, Rechtschaffen's (1978) major evidence that dreaming does not involve metacognition is anecdotal, drawn from his own dreams and the dreams of four undergraduate students. Nonetheless Rechtschaffen's publications are frequently cited as evidence for the lack of metacognition in dreams (Kahan 2001). Kahan (2001) provides some new evidence that metacognition can occur in both lucid and non-lucid dreams. In these instances, dreamers have feelings of control, and may imagine, remember, or actively direct their thoughts. She recommends research strategies that allow us to test the relevance of popular conceptualizations of dreaming as deficient.

When researchers, including Hobson, have tested such a priori assumptions about conscious cognition in dreams, their results are frequently unexpected. For example, Kahn and Hobson (2005) used a survey to test whether individuals exercised a *theory of mind* in dreams. They found that in over 80% of dreams, dreamers recognized the feelings of at least one dream character. Dreamers also frequently wondered what other characters were thinking or planning (90% of dream reports). Kahn and Hobson (2005) suggest that this evidence might support TST, in which assessing the intentions of dream characters may serve as practice for real life challenges. Thus, a closer look at subjective experiences during sleep reveals plausible functions of dreaming. Hobson's admission that dreams provide a virtual reality contradicts his previous position regarding the irrationality of dreaming.

Clearly, a major weakness of A-S is its failure to provide a rationale for delineating the normative psychological properties of dreams. While Hobson frequently emphasizes delirium, Revonsuo (2000; 2005) describes dreams as a realistic world model and emphasizes modulations in experience of "self". Also compare Hobson's list of dreaming's formal features to that provided by Vaitl et al. (2005), including "a virtual sense of reality, a wide range of primarily visual perceptions, covert speech, motor activities, emotions, and social interactions" (101). Furthermore, dream experiences range from "realistic" to "fantastic" (101). They make further distinctions according to temporal considerations: features other than primary ego involvement and the virtual sense of reality are actually phasic events and not continuously applicable. Another characteristic of dreams could be that, cross-culturally, they engage a waking narrative

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[4] Metacognition refers to instances where an individual thinks about his/her own cognition (memory, perception, calculation, etc.). Through metacognition, the individual plans, controls, or evaluates his/her

process or, as Bulkeley (1999) argues, that they primarily enact social scenarios. Clearly, describing the dream state in a series of propositions is an inherently subjective process, one that Hobson engages in without any consideration of his biases.

Frequently, Hobson (2004) attempts to illustrate the maladaptive or deficient nature of dreams by describing dream experience as comparable to madness. He argues that dreaming and certain mental illnesses, such as schizophrenia, feature internal generation of percepts and exaggerated emotionality. In schizophrenia, PET studies have revealed selective frontal lobe deactivation and, similarly, PET studies have shown deactivation of the dorsolateral prefrontal cortex in REM sleep (Hobson 2005). In both states, Hobson describes the disorganization of thoughts and actions that result from such activation patterns. He suggests that the lack of modulation of dopamine during REM may account for the bizarreness of dreams. Psychosis, similarly, is characterized by "an abnormal sensitivity to dopamine" (21). Hobson sees the distinctness of the dream self from the normal, unaltered self as evidence that dreams could not provide us with valuable information or insight. He writes:

> To deny the fact of normal brain-mind state differences is the intellectual and moral equivalent of telling schizophrenia patients that because most of their mentation is normal, they should not complain of sometimes hearing voices, of sometimes being subject to wild emotions, and of sometimes having difficulty organizing their thoughts" (23).

Subtly, Hobson invokes a moral division between altered and normal states. However, his designation between "internal" and "external" precepts is arbitrary. This perspective obscures the fact that "internally generated" ideas such as dreams also

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cognitive style.

originate in our real world experiences: dreams contain images, memories, and emotions, which are caused, as much as waking experience, by factors external to the dreamer. If I encounter a tree and have an immediate mental representation of it and then, two weeks later, the tree appears in a dream, the significant difference is not in the origination of the precept. Across the sleep-wake cycle, the individual's preconceptions and internal brain state interact with her environment, both during wake and sleeping. Perhaps dreams do express an "inner reality" better than our waking thoughts, reflecting persistent concerns and ideas, but isn't this further cause to evaluate their personal significance? In fact, Hobson's comparisons of dreaming to insanity build on his assumptions about the meaninglessness of the experience of the mentally ill. He fails to recognize that the subjectivity of studies of phenomenology extends to neuropsychology.

Hobson further fails to integrate his epiphenomenal view of dreaming into a larger framework of the adaptive or maladaptive nature of conscious experiences. Especially confusing is Hobson's (2000) admission that, "we might experience exotic movement [in dreams], including sexual movement, in order to refresh movement programmes that are crucial to survival. We might also regard dreams as efforts to revise those programmes in terms of emotionally salient or important memories" (31). Presumably, if they are compatible with the A-S or AIM model, these programs function at the unconscious level: their subjective experience must be irrelevant to the accomplishment of learning, memory, or other cognitive tasks. While this argument seems plausible, Hobson simultaneously treats regional activations in REM as the genesis of phenomenal dreams. If inseparable activations both produce dreams and serve cognitive functions, it becomes difficult to designate dreams as noise; they *are* the cognitive programs. The

investigations that will clarify the subset of neural activations that support phenomenal as opposed to unconscious elements of processing have not yet been perfected. Even if we isolate an exact substrate of phenomenal dreaming, only consideration of the selectability of this network could reveal its etiologically functional or epiphenomenal status.

Empirical evidence has not proved dreaming's epiphenomenalism or irrelevance and probably never could. Hobson believes that a neurophysiological explanation of dreams should be sufficient, but this is his opinion and not a matter of scientific truth. He does not support his epiphenomenalism with a consideration of the maladaptive qualities of the dream state, nor does not describe the positive evidence that would convince him of dream functionality. Repeatedly, Hobson even misrepresents psychological perspectives on dreaming, dismissing content analysis as unscientific and ultimately concerned with interpretation. However, Domhoff (1996; 2003) not only utilizes content analysis with scientific rigor and without any concern for "dream interpretation" as Hobson characterizes it, but he even draws the same conclusions as Hobson with regard to functionality.

Furthermore, a psychological or even religious account of dreaming is not necessarily incompatible with the neural activations of dreaming, although the exact relationship remains unclear. In a table, Hobson represents formal dream features and the explanations for them according to activation-synthesis and Freudian dream theory. For example, the Freudian explanation for "Forgetting" is "Repression", while Hobson's is "Organic (physical) amnesia" (18). Repression may be best understood as a psychological phenomenon, but Freud would not have denied its material manifestation as organic amnesia. "Repression" could describe a complex interaction of factors that result in

particular neural changes that enable forgetting. The important difference between psychoanalytic and physiological accounts of memory deficits is, again, whether the occurrence has a function or whether it is incidental. The chart Hobson provides, presented as evidence of the disparity of Freudian and neuroscientific theories of dreaming, actually reiterates the same unproductive functionality debate. As Willingham and Dunn (2003) describe, psychological and neuroscientific concepts describe distinct "levels" of reality.

While upholding the singularity of science, Hobson (2000) frequently encourages his reader to use "common sense" and resorts to dichotomies of sleeping vs. waking consciousness and sanity vs. insanity (7). Hobson et al. (2003) write: "If psychology so far failed to document the robust phenomenological differences between waking and dreaming that most people experience every day of their lives, then more vigorous and more creative psychological research is needed" (12). Hobson has his desired results in mind: to demonstrate a divergent relationship between waking and dreaming states.

Common sense, however, is not often the basis of good science, and in consciousness studies, it is difficult to apply. Is it really common sense that a neurophysiological explanation should explain all significant aspects of our dreams? While Hobson's methodology is valuable, it does not equip him to address the question of why we dream, only how we dream in the brain, and even this explanation is only partial. Hobson attacks the dogmatism of psychoanalysis, yet his reductionist accounts of dreaming, which "explain" complex mental life in terms of imperfectly correlated neural activation patterns, betray a similar bias in neuroscience. Hobson's interest in the learning- and memory-related cognitive functions of REM is justified by some interesting

findings. However, his supposition that these functions cannot be clarified through dream content studies may be premature. While any method may have pitfalls, unexpected results from psychological and content studies of dreams do not invalidate these approaches. Rather, these results indicate the complexity and specialization of dreaming at both psychological and physiological levels.

Hobson (2000) dismisses the "deep-seated human need to believe that dreaming, as for every apparent mystery, has a deeply veiled meaning inscribed by a benevolent hand whose ways are known only to a few chosen meditators" (7). However, it is ironic that Hobson refers to a "deep seated" need for belief in humans. He seems to acknowledge that even our delusions have structure. So why not our dreams?

Domhoff

The next dream expert I consult, William Domhoff, addresses parallels in dreaming and waking cognitive styles. He also explores dreaming cross-culturally and across other demographic differences. Recently, he has incorporated Solms' (1997) findings on the effects of various brain lesions on dreaming and data from imaging studies into a neurocognitive model of dreaming. Domhoff argues that dreams are a neurocognitive achievement reflecting the development, conceptions, and concerns of individual dreamers. While Domhoff documents universal trends in dream content, he does not attribute these to an evolved function of dreams, but to general cognitive mechanisms constrained by the physiological requirements of sleep.

Domhoff emphasizes that content analysis differs greatly from other methods in dream research. Some (like Hobson) may conflate it with interpretive methods in psychoanalysis but, unlike such approaches, content analysis "does not make use of free associations, amplifications, autobiographical statements, or any other information from outside the dream reports themselves" (2001, 307). Its distinction from other methods enables content analysis to reveal unique patterns. For example, the method is sensitive to changes and constancies within a single individual's dreamlife that are obscured when looking at many individuals' dreams. This strength of content analysis in part explains the popularity of the technique across disciplines, for example in literary studies.

As in literary studies, dream content analysis has always been performed, but according to different interpretive formulas. Currently, the predominant coding system is the Hall and Van de Castle (HVDC) scale, which was developed and first employed in

the 1950s. The scale's major developer, Calvin Hall, began gathering dream reports from his undergraduates at Case Western Reserve University in the 1940s. The HVDC system allows designations between types of characters, social interactions, settings, and activities. It has additional coding categories for emotions, temporal references, successes and failures, and good fortunes and misfortunes, among others. Over the past half century, HVDC coding has enabled comparisons of dream content in various populations of interest.

Domhoff (1996) notes several strengths of the system: First, it is flexible, allowing expansion or combination of categories or the creation of new categories. Second, researchers can achieve high intercoder reliability with the system. Third, the HVDC system produces results shown to be psychologically relevant: it is sensitive to those variables that best correspond to waking concerns. Finally, the widespread implementation of the system has allowed the compilation of a large body of analyzed reports from various cultures and has enabled the establishment of norm dreams. Thus, much of the rationale for the continued use of HVDC scoring is its practicality when applied to large samples of dreams.

Until his death in 1985, Hall himself collected around 50,000 dream reports, extending his sampling pool from American undergraduates to individuals from other industrialized nations and remote cultures. Until 1996, when Domhoff summarized Hall's results in *Finding Meaning in Dreams* (Chapter 6), much of this cross-cultural content analysis was unpublished. Domhoff, interpreting and expanding Hall's research, reports on the similarities and differences between dreams across cultures, between male and female dreams, and between dreams of college populations of the 1950s and the 1980s.

Domhoff has not only popularized Hall's important findings but has advocated and enabled the continued use of HVDC Scale and has enlarged the body of available dream reports. For example, he established DreamBank.net, a website containing 11,000 dream reports and several dream journals spanning decades. While many note the recent advances in dream science enabled by new technologies in neuroscience (e.g. Schwartz & Maquet 2002), computing advances have simultaneously enriched the possibilities for content analysis (Domhoff 2001).

Like Revonsuo, Domhoff is concerned with an integration of content analysis and neurophysiological findings. In fact, Domhoff (2003b) applauds Revonsuo's use of evidence from a variety of different kinds of studies and agrees that threat-simulations may reflect the "repetition dimension" of a vigilance/fear system centered on the amygdala (141). In many ways, Revonsuo's TST is consistent with Solms' (1997) forebrain mechanisms for the activation of dreaming, which Domhoff has largely adopted. Revonsuo's emphasis on repeated themes in dreaming corresponds to Domhoff's neurocognitive theory of dreams. Domhoff (2003b) writes: "Just as emotional memories can last a lifetime, so too can posttraumatic stress disorder dreams, recurrent dreams, recurrent themes in dreams, and heightened scores on HVDC indicators" (141). Domhoff and Revonsuo have both used the HVDC system, and much of the same body of evidence, to develop theories that emphasize the persistence of concerns central to the individual in his/her dream content.

However, like the neurophysiological data, the psychological dream data have supported contrasting theories of dream functionality. To Revonsuo, the repeated themes in dreams have evolutionary significance while, to Domhoff, they do not. Domhoff

(2003b) rejects Revonsuo's claim that REM sleep facilitates mental training and implicit learning; there simply isn't enough evidence. He writes: "The neurocognitive model is able to approach the question of dream function by suggesting that dreaming may have no function" (2003; 168). Certainly, dreams reflect evolved cognitive mechanisms, but the activation of these mechanisms while we sleep does not indicate that they are functional while we sleep. To Domhoff, it is questionable that dreaming would serve a distinct purpose from waking cognition, given the continuity between the two states.

Like Bulkeley, who acknowledges the dream-like structure of art and play, Domhoff positions dreaming within a spectrum of phenomenal experiences. Particularly, he looks at conscious experience across the sleep-wake cycle and concludes that dreaming and waking may not be so different, after all. For one thing, the content of dream reports, whether from REM or NREM awakenings, "is in large measure a coherent and reasonable simulation of the real world" (2003, 19) Thus, "a greater parallel exists in waking thought and dreaming than is assumed by clinical or A-S theorists" (19). Domhoff (2003) reports on studies of the waking thoughts of Ss relaxing in a darkened room, which were rated as dream-like in many cases. In another study, researchers contacted Ss with pagers over the course of their day, inquiring into their moment-to-moment cognitions, and found "more than a trace" of dreamlike mentation in 9% of cases and a "trace" in 16% of cases. According to Rock (2003), Domhoff has adopted Hall's position that dreaming is a particular kind of "thought" determined by the physiological conditions of sleep (66). In fact, Domhoff has substantiated and articulated Hall's position, demonstrating continuity in the content of thoughts between dreaming and waking.

Further evidence for dreaming as thought-like comes from individual dream reports which, when compared to norm dreams, can predict atypical conceptions and biases in waking life. For example, using HVDC coding categories, Domhoff (2003) assesses the dreams of a man called Mark over four years between his high school and college graduations. Mark's dreams are atypical in several ways, containing lower-than-average levels of aggression and a high ratio of female-to-male characters. Domhoff describes that these dream characteristics reflect Mark's demonstrably non-aggressive personality and the fact that his family is all women. In other populations, such as samples of people with schizophrenia, divergences from norm dreams can also indicate characteristic predispositions and attitudes. Domhoff's (1996) data on the content of schizophrenic dreams shows more aggressive interactions than are found than in norm dreams, for example.

Domhoff (1985, 2003) similarly analyzes the dream reports of Freud and Jung against norm dreams. He describes that Jung's dreams are detailed and more concerned with scenery while Freud's dreams are largely concerned with interactions between people. Domhoff interprets these findings as consistent with Freud's sociability and Jung's love of nature. In his dreams, Freud is the befriended where Jung is the befriender, and Freud is hostile towards female characters and friendlier toward males than the average dreamer. According to Domhoff (1996), the trends in the dreams of Jung, Freud, and others who have maintained dream diaries over many years, reveal patterns in these individuals' waking interactions and preferences. While we sleep, we may lack some monitoring control of our thoughts, but the same fears, relationships, goals, conflicts, and emotions that dominate our experience while we are awake still manifest themselves in

our dreams. Without reference to any materials outside of the dream or interpretation of any dream "symbols", dream reports still convey important psychological differences and life circumstances of individual dreamers (Domhoff, 2003).

While Domhoff is interested in how individual to individual personality differences manifest themselves in content, he emphasizes cross-cultural stability in content. He describes that general dream characteristics, such as gender ratio and familiarity of dream characters, frequency and type of social interactions and settings, and gender differences (e.g., heightened physical aggression in men's dreams), are very stable over time and across different populations (Domhoff 1996). In addition, Schredl et al. (2004) note that most individuals, regardless of their cultural background, have had certain common experiences in their dreams, including "being chased, falling, flying, failing an examination, and being unable to find a toilet or restroom" (485). These dreams are not consistently ascribed with the same meanings across cultures and they do not occur at the same rates, but they have generally the same rank order across populations (Schredl et al. 2004). Domhoff (2003) argues that the occurrence of such common dreams indicates that certain experiences enact "primary metaphors" (34). Thus, Domhoff's argument suggests robust continuity across cultures not only in dreams, but in *thought*.

He rejects dream theories that suggest "malleability" of the human character (1985). For example, Domhoff (1985) explores the evolution of Senoi dream theory, concerned with replicating the practices of a small Malaysian society whose mental health and social stability is supposedly enabled by their unique treatment of dreaming. Domhoff argues that the Senoi dream style, supposedly built on dream sharing, dream

integration in waking life, and therapeutic shaping of dream experience, was largely constructed by a few well-meaning but misguided storytellers, particularly anthropologist Kilton Stewart. The adoption of Senoi dream techniques in America, Domhoff argues, reveals more about the social idealism of the sixties than it does anthropological realities or true variety in dream experience: "Senoi dream theory seemed sensible to many Americans during the turbulent sixties, but that is because" it merged "traditional American ideas about the malleability of human nature with a story about a lost authenticity. And the evidence that dream sharing may be useful or dream control possible is only suggestive at this time" (96). While acknowledging the richness of the literature on societal uses and interpretations of dreams, Domhoff considers such study irrelevant to the development of an empirical neurocognitive model of dreaming.

Domhoff (2003) writes: "I have attempted to be as eclectic and encompassing as possible in incorporating ideas, methods, and findings from many different sources. I do, however, state the weaknesses of other explanatory systems quite frankly, because of their amazing persistence despite the absence of systematic empirical evidence for their main claims about the construction and meaning of dreams" (7-8). Particularly, Domhoff (2003, 2004) resists psychoanalytic interpretations of dream data. He argues that Freud's theory of dreaming was not built on solid evidence and has never stood up to empirical methods. Like Hobson, Domhoff (2003) claims that such theories rely on the suggestibility of individuals. Particularly when collecting dream reports and free associations, psychoanalysts have considerable power to elicit the responses that would fit their theories. In his dismissal of interpretive studies of dreaming, Domhoff shares some common ground with Hobson.

However, a major reason that Domhoff (2005) dismisses Solms' (2000) Freudian dream theory is its failure to take into account the systematic findings on dream content. This is also Domhoff's major dispute with Hobson. Domhoff (2003b) describes that Hobson and his colleagues "overlook the replicated longitudinal results with the HVDC system which show that dream content can be consistent for individual adults over years and decades, something that might not be expected if dreaming is as chaotic as they claim." Domhoff (2005) argues that both Hobson and Solms continue to characterize dreaming as similar to insanity because they ignore a quantity of studies demonstrating the reasonability and predictability of much dream experience: "the systematic empirical findings on dreaming and dream content... are as essential to a neurocognitive theory of dreaming as are the neurophysiological issues" (6). For Domhoff, these findings indicate continuity, certainly not a polar relationship between dreaming and waking.

However, Domhoff's emphasis on continuity may obscure the incredible variability of both states. For example, Vaitl et al. (2005) describe that daydreaming is a distinct state of consciousness from either normal waking thought or dreaming. While daydreaming shares certain features with dream mentation, including undirected ideas and thoughts, it also differs from dreaming in certain ways: Revonsuo (2000) describes that dreaming is more self-reflexive, features more negative situations and emotions, and less control. There have not been many neurophysiological studies of daydreaming, but EEG studies have returned some unique results, including periods of quasi-stability of the brain electric state for fractions of seconds ("microstates") followed by rapid reorganizations, (Vaitl et al. 2005, 100). Vaitl et al. (2005) emphasize the neuropsychological diversity of both waking and sleep states. Either state consists of

moment-to-moment experiences that are not well described in terms of broad categorical changes such as sleeping or waking. Domhoff's emphasis on continuity reflects his desire for clarity and simplicity in dream studies, perhaps at the expense of precision.

Domhoff's neurocognitive model not only features a simplistic continuity hypothesis, but may generally lack attention to gradations of experience, including experienced meaning. The HVDC Scale has many benefits over other dream report systems but is not free of the biases of either mainstream United States culture or the scientific community in which it was conceived. A more anthropological approach might look at dream reports cross-culturally in a naturalistic setting outside of the sleep lab to determine the variety of indigenous analysis styles. For example, the HVDC Scale deals with classifications of positive and negative events, but are these classifications used everywhere? What other experiential components are emphasized, if not those recognized by Domhoff and his colleagues?

Kelly Bulkeley, the researcher whose work is the subject of the next chapter, chooses to work within the framework of HVDC, but his studies code for additional themes. Bulkeley has also called for certain revisions to the HVDC scale. He suggests that the insensitivities of current content analysis measures ignore the rich variation in dream experience, its "staggering *plurality*" (1999, 3). According to Bulkeley, HVDC may overlook certain salient dream "types", the key to dreaming's true purpose and character.

Bulkeley

Flanagan (2000) describes that the well-adapted mind is tuned to the "good" and "true" in the environment (38). Here, "good" and "true" must be taken in the evolutionary sense of fitness-enhancing; evolution, after all, is "the blind watchmaker" and indifferent to its products (Dawkins 1986). Flanagan probably did not mean to imply that what is good or true for an organism's inclusive fitness is good or true in an objective sense. The well-adapted mind allows an organism only to detect and respond to stimuli in the specific ways that allow its survival and the successful transference of its genetic materials. Thus, cognitive mechanisms, including mental states, appear to vary widely by species, reflecting distinct ecological niches.

For humans, who have learned to subsist in a variety of very different conditions, there may also be greater variability in cognition. Humans have uniquely sophisticated styles of thought, including a capacity for solving complex problems in spontaneous ways. For example, Kaas (2000) suggests that our greater number of cortical visual areas corresponds to the number of functions that visual information plays in coordinating our behavior. Language may also enable a repertoire of human behaviors and interactions that are not strictly genetically programmed, but that vary by culture. For example, **N & N** (2002) describe that Westerners have a different cognitive style than Asians, attending to personal attributes as major factor in behavior and often using rule-based logic. In contrast, they explain, Asians may attend to situational factors. Although such differences cannot be linked to specific environmental differences, they indicate the variability in cognition across cultures. Bulkeley (2002) writes: "the capacity to create culture has

powerful benefits for a species whose distinctive evolutionary advantage is a highly flexible and imaginative mind" (127).

However, there are also universal constants in human cognitive processes, including dreaming. Much research in cognitive neuroscience has attempted to localize task requirements to specific neural representations. In dream studies, Domhoff (2003) has argued that the subjective experience of dreaming can be understood in terms of a neurocognitive network. Dreams even appear to over-represent certain experiential elements, such as negative emotions, across large samples of dream reports in various societies (Domhoff 1996; Revonsuo 2000). Hobson (2000) argues that dream consciousness can be summarized as a system of deficits in waking skills and abilities. These theorists conclude: If dreaming has a function, it has the same function for everyone, related to automatic processing of information. Similarly, if dreaming is epiphenomenal, it must be epiphenomenal across the board. Revonsuo (2000) and Flanagan (2000) argue that the functional or non-functional nature of dreaming is best assessed in Darwinian context. They ask: could dreaming have enhanced the fitness of the human species?

However, as Bulkeley has suggested, a search for an evolutionary function of dreams may be futile. We do not even have direct evidence that consciousness is ever fitness-enhancing. Stevan Harnard (2002), in the tradition of Dennett, has posed the following question:

> Tell me whatever you think the adaptive advantage of doing something consciously is, including the internal, causal mechanism that generates the

> capacity to do it, and then explain to me how the advantage would be lost in doing the same thing unconsciously, with *exactly the same causal mechanism* (3).

Perhaps "zombies" could perform all the activities that humans perform, but without ever having internal experiences. The relationship we perceive between our decision processes and our actions may not actually exist.

Even if we put aside such an argument and assume a causal relationship of *some* of our thoughts to our actions, dreaming is a special case of consciousness, particularly remote from waking actions. For this reason, Revonsuo (2006) describes dreaming as a "pure" consciousness. A major factor in its remoteness is the lack of dream recall. Hobson (2001) describes that, "because dreams are so difficult to remember, it seems unlikely that attention to their content could afford much in the way of high priority survival-value" (328). In this model, non-remembered and remembered dreams must be functionally equivalent.

In contrast, Bulkeley (1999; 2002) argues that remembered dream experiences are a formally distinct subset of dreams. Some dreams achieve a profound personal relevance and salient dreams have a history of precipitating waking events, even major historical events. Dreams have been responsible for the genesis of religious precepts and they also guide our spiritual lives in individualistic ways, by expressing symbolically our major concerns and providing novel insights not available in less associative waking thought styles (Bulkeley 1999). Dreams may provide an opportunity to explore and practice necessary skills and behaviors. Bulkeley (2002) argues that dreaming is a type of "creative play"; it allows experimental application of symbols and metaphors, facilitating the individual's integration into and comprehension of his society. According to Jung

(1974), dreams have a continuity with the rest of conscious experience that extends backwards (they include remnants of ideas and experiences from the preceding day or days) but also forward: "dreams occasionally exert a remarkable influence on the conscious mental life even of persons who cannot be considered superstitious or particularly abnormal" (24).

Evolution could have selected for dreams because they inspire novel solutions to problems and cultivate symbolic capacities. The creativity-enhancing qualities of the dream environment may have particularly aided our ancestors, who would not have had time in everyday life for the creative, associational thinking that offers insights and satisfies emotional and psychic needs (Hartmann 1998). Bulkeley (2002) argues that even if dreams originally arose as an epiphenomenonal byproduct of sleep, the capacity to simulate realistic threats could have been adaptive even before the advent of culture (125).

Still, "the whole enterprise of evolutionary psychology and reverse-engineering should be regarded with a healthy skepticism, given how easy it is to weave plausible stories about the primal origins of this or that mental faculty" (124). Bulkeley (2002) addresses TST specifically: "Revonsuo's only interest is in the function of dreaming in the original ancestral environment... What if we are also interested in understanding the development of dreaming since that time, as human nature has shaded into human culture?" (127). After all, as Bulkeley (2002) argues, the way our dreams operate and their possible functions have everything to do with their social aspects: "dream content abundantly reflects the innately social existence of the human species. Dreaming (like playing) frequently simulates friendly, aggressive, and/or sexual interactions with other

characters" (126). Dreams not only reflect the social life of our species, but can differ from culture to culture and from individual to individual.

Certain societies foster insight in dreams while others reject dream meaning. The popular conceptions of dreaming even influence the sort of dreams one is likely to have. Bulkeley argues that some indigenous cultures, as they interact with modern Western civilization, may lose certain dream experiences. For example, "after the Mohave people of North America lost their battle to fend off the destructive encroachment of Anglo settlers, their dream life changed dramatically" (1999, 28). Power-giving dreams (sumach ahot), which had been a source of insight and motivation for centuries, became less common and diminished in importance, especially among the younger generation (28-29).

To test cross-cultural differences, Tartz et al. (2006) used HVDC coding, a Bizarreness Scoring System, and Hartmann's (1991) Boundary Questionnaire to assess dream reports from European American and Pacific Islander American Undergrads. They found that, while bizarreness did not vary significantly between the groups, other qualities of the dream report did. Particularly, Pacific Islander Americans had reports that were more dense and shorter and their European American counterparts. The authors also describe potential differences in "boundaries", a concept that describes differential "emotional defenses", structures of space and time, "fluidity of thought", interpersonal sensitivity, and ease of transitions between consciousness states (112). Tartz et al. (2006) also review a body of literature suggesting that European Americans and non-European groups may have substantial differences in their dream content and their reporting style.

Bulkeley (1999) suggests that the failure of modern dream theories to account for the diversity of dream experience reflects, in part, the limitations of popular methodologies. He writes: "It has been widely documented that Ss in a sleep laboratory (where the most scientifically rigorous dream research occurs) experience a narrower range of dream types than they do when sleeping outside the laboratory. For example, Ss in the laboratory experience fewer sexual dreams, fewer aggressive dreams, and fewer nightmares (Hartmann 1984; Van de Castle 1994; Bulkeley 1997)" (27). Furthermore, the HVDC Scale may be "the best available system for dream content analysis", but it is not perfect (Bulkeley 2006, 11). The focus of the scale, naturally, "has been on what is easiest to code, not necessarily on what's most important" (12). Bulkeley describes that biases in the coding qualifications may lead to apparent biases in dream content, "a self-fulfilling prophesy" (12). For example, the conclusion that dreams represent more misfortunes than good fortunes may reflect the fact that the system includes a six-point scale for misfortunes, but only one coding for good fortunes. Bulkeley (2006) suggests a revision of HVDC that would expand the good fortunes scale, compensating for this possible bias.

In other studies, Bulkeley has coded for salient dream types as well as HVDC content. For example, in his study of earliest remembered dreams (ERDS) Bulkeley (2005) measured the prevalence of common dream features including threat simulation, metaphor, salience, and archetype. In this study, Bulkeley et al. (2005) collected reports from American adults living in the Northeast. They used HVDC scoring to compare ERDs to HVDC norm dreams (of Ohio college students in the 1950s). They found ERDS featured fewer friends and family members and more animals and dead or imaginary

characters, consistent with the findings of Domhoff (1996) and Foulkes (1999). ERDs also featured fewer familiar and more fantastic settings and more physical aggression than norm dreams, frequently directed against the dreamer.

Using additional motif and theme categories, Bulkeley et al. catalogued evidence of specific dream types, including threat simulations, titanic dreams, and big dreams. Threat simulations were found to be the most common dream type. Bulkey et al. (2005) write: "Even though the selection and definition of motifs is an inherently subjective process, the predominance of fear, danger, and helplessness in these dreams is unmistakable" (219). However, this tentative support for TST is weakened by the more fantastical nature of threat simulations compared to other ERDs: these dreams did not include realistic defense strategies or realistic threats. Titanic dreams, which feature strange and powerful forces frequently directed against the dreamer, were also common. Often, the dreamer is the only character, located in an abstract or ambiguous setting. Many of these types of dreams are recurrent and frequently they are associated with negative emotions. Big dreams share certain similarities with titanic dreams, but can be either negative or positive emotionally. They feature archetypal or religious imagery and have particular emotional resonance. Both big dreams and titanic dreams were frequent ERDs and featured particular salience.

Bulkeley et al. (2005) describe the significance of salience of childhood dreams in general. For example, in their sample, 85 Ss (78%) were able to recall a dream they had between the ages of 3 and 12. While acknowledging that prior recounting may have enforced memory of ERDs in some cases, Bulkeley et al. describe that the major factor is the personal significance of these childhood dreams: "early childhood dreams can be

understood as provoking a developmental consciousness: enriching children's epistemological sophistication, stimulating their capacity for empathy, and expanding (both happily and frighteningly) their sense of existential possibility." Limiting conceptualizations of dreaming as insignificant may not only operate through cultural change, but also through integration into Western society as we grow up. Children's capacity for transformative dreaming may also reflect their familiarity with the possibilities of creative play.

Bulkeley (2002) argues that dreaming shares many features with play and that it functions similarly to develop representational and emotional capabilities. Dreaming, like play, may have primary importance or emphasis in development, when interpersonal and symbolic capabilities expand. Also, dreaming and playing involve the inhabitation of a quasi-real space, set apart from everyday reality, and both environments are relatively safe: dreaming and playing actions do not have the same consequences that similar actions would have outside the imagined space. Furthermore, both dreaming and playing take much of their material from major survival concerns of daily life and frequently feature strong emotions, both positive (affection, happiness, pleasure) and negative (aggression, frustration, anger, sadness). Both dreaming and play tend toward extravagance, exaggeration, and rich variation. In both, typical boundaries and rules that constrain ordinary life are suspended. The dreamer, like one engaging in play, can reorganize his/her conceptual systems. In dreaming, as in play, we might expect therapeutic results. We would also expect extensive variability.

While Bulkeley applauds Revonsuo for attending to one highly memorable type of dream, the threat simulation, he argues that TST is incomplete. Revonsuo fails to

account for several other distinct types of dreams, including religious and prophetic dreams, collective dreams, lucid dreams, dreams with unusual sensory elements, and "root metaphor" dreams. Cross-cultural dream analysis, including Jung's work, has established the significance of such fundamental types of dreams. Bulkeley (1999) describes that various "religious traditions have always recognized that some dreams are *different* –that some dreams come with a special clarity, energy, and vividness, distinguishing them sharply from the more ordinary, mundane types of dreams" (25).

Domhoff's neurocognitive model, while it may be adequate in describing the network of dreaming for typical adults in Western culture does not attend to potential differences fostered by such factors as societal attitudes toward dreaming or even societal attitudes toward play. While Domhoff's (1985) cautions about the dangers of nostalgic, self-appeasing anthropology are well taken, we might question whether the Senoi dream theory that was created in America is any less real because of its origins. Even if its origins, as Domhoff (1985) hints, are emotional, Senoi dream theory has therapeutic effects. Further research might address continuity in dream style with play style across cultures. Are there societies that are "better" at playing, and do members of these societies have atypical dreams? How could the potential of play therapy extend to those who have traumatic dreams, such as those suffering from PTSD? Researchers might ask, does the tendency towards PTSD reflect deficits in ability to play that might derive from cultural attitudes?

Consider Polger and Flanagan's (2002) position that "The effects of dreams are not functions relative to the nervous system, as dopamine reuptake is" (38). The effects of dreams are best considered in a "whole person system" (38). Thus, while dreaming could

be selected for in certain cultures, specific dream contents would not have immediate differential neural impact. Bulkeley's work suggests that such assumptions may warrant further consideration. Although Bulkeley's research interest is not the neural network for dreaming, he makes several valuable recommendations for linking neurophysiological techniques with relevant dreaming variables. For example, he asks, "Can the different types of apex dreaming be correlated with specific patterns of REM activation?" (2002, 123).[5] Along these lines, do cross-cultural differences in construction of dream-wake continuum correlate to real differences in the dream-wake continuum at the neural level?

Bulkeley (2002) also suggests that researchers could provide more nuanced cognitive and personality inventories of brain lesioned subjects with dreaming deficits. For example, Domhoff (2003) summarizes that these patients have corresponding cognitive deficits in waking, but does not elaborate. However, differences in regard to *theory of mind* or creativity may have particular import, given the continuity of dreaming with play. We might ask: what features does dreaming involve in autism and other conditions that affect social integration? Emphasizing the social, creative, and salient characteristics of dreams may lead to distinct and potentially more fruitful research questions than those generated according to Hobson's model where dreams are deficient.

Despite these possibilities, Bulkeley (1999) is skeptical about the prospects of scientific inquiry into dreaming. While acknowledging that new findings in neuroscience and experimental psychology, along with content-based, historical, and cross-cultural analyses of dreams, have led to a recent expansion of the field of dream studies, Bulkeley (2002) argues that current models of dreaming cannot easily accommodate and integrate

[5] Apex dreaming, as defined by Nielsen (2003), consists of "the most vivid, intense, and complex forms of dreaming: e.g. nightmare, sexual, archetypal, transcendental, titanic, existential, lucid" (61).

many of these new findings. He characterizes the *Behavioral and Brain Sciences* special issue on sleep and dreaming, published in 2000 and containing contributions from many of the leading researchers and theorists in the field of dream studies as "a group confession of discord and disunity" and notes ongoing disagreements over the REM-dreaming link, the specific REM-nREM relationship, the function of REM sleep, the reliability of dream reports, and the definition of "dreaming" (120). He questions how far our understanding of dreams has actually progressed. We should not be fooled by the authoritarian discourse of "empiricists" like Hobson.

Bulkeley invokes William James' distinction between the "farther" and "hither" parts of experience. Whatever the sources of our religious experiences may be transpersonally (which cannot be proven), the other side of these experiences is the awareness of our subconscious part of existence. Thus, the roots of our religious experiences in dreams are "the unconscious activities of the mind and the brain's neurophysiological workings during REM sleep" (28). So "religious and psychological approaches to dreams are logically compatible" (28). In psychology, we can assess the "hither" aspects of religious experiences, treating spirituality as an event in the brain/mind, while leaving speculation about the "farther" aspects of the experience, the question of metaphysical meaning, to others, if we wish.

Bulkeley (1999) challenges the stark contrast, presented by Hobson and other dream researchers, between ancient religious views of dreams and modern scientific understandings about dreams. Such a distinction "misrepresents what religious traditions have taught about dreams, it overstates what modern psychology has 'proven' about dreams, and it ignores the subtle but significant influence that cultural teachings,

traditions, and values can have on the types of dreams people do, and do not, experience" (24). Bulkely (1999) accuses Hobson of a sort of scientific fundamentalism: "Hobson ignores the extent to which what appears 'transparent' to him reflects more of his own unwitting assumptions than any fixed meaning" of dreams (70). For Bulkeley, very little is actually "transparent" in dream studies. There may be a domain in which "certainty, simplicity, and universality" should dominate, but it is not consciousness studies (70). Bulkeley writes: "If we want to understand our most profound and spiritually transformative dreams, we must let the dreams themselves be our guides" (14).

Flanagan

Owen Flanagan, much like Antti Revonsuo, has expertise in philosophy, psychology, and neuroscience. Both men apply this background to the study of the evolutionary context of dreaming. Exactly unlike Revonsuo, however, Flanagan takes a strong position concerning dreaming's epiphenomenal nature, rejecting functional theories of dreaming including those of depth psychology, cognitive neuroscience (e.g. memory consolidation), and Revonsuo's TST. Such theories, he argues, fail to recognize the complexity of the evolutionary process. While maintaining that certain conscious mental experiences, such as the feeling of pain or visual representations, are adaptations, Flanagan argues that other instances of conscious experience occur without conferring an adaptive advantage. Dreaming is one such instance. Flanagan describes that dreams arise from the neural activations that support sleep and from mechanisms of consciousness that are functional only while we are awake. Dreams are "free riders" of our brain-mind system, "the spandrels of sleep" (Flanagan 1995, 5).

Like Domhoff, another epiphenomenalist, Flanagan insists that, despite their lack of evolutionary function, dreams still have some meaning: they reflect the character of individual dreamers. Dreams do have unique features compared to waking consciousness, particularly a self-expressive quality, and they contribute to our identity construction, even when not they are not remembered. Furthermore, dreams may have important created functions. While, like Revonsuo, Flanagan treats evolution as the most relevant criterion for understanding functionality, his study of dreaming also incorporates

contributions from varied disciplines.

Flanagan suggests that dreams can best be understood when considered in as broad a perspective as possible. His "natural method" primarily incorporates phenomenology, psychology, and neuroscience. He also argues for the relevance of sociological considerations and evolutionary biology. Flanagan writes: "The idea is to keep one's eye, as much as humanly possible, on all the relevant hypotheses and data sources at once in order to construct a credible theory" (14). Such a perspective recognizes the complexity of the study of consciousness. Consciousness, after all, is a phenomenon that defies consistent characterization.

According to Ned Block (1995), consciousness is a "mongrel" concept, denoting radically different things to different people. He breaks consciousness down into several types including phenomenal-consciousness, which consists of experiences, and self-consciousness, which requires an awareness of self, among others. Others have subdivided consciousness along other delineations. Revonsuo (2006) describes that further debate concerns the location of consciousness: is it embodied in the brain or is it, as some philosophers have argued, a property of a nervous system in interaction with its environment?

While the search for the neural correlates of consciousness (NCC) accepts some representational relationship between consciousness and neural processes, Willingham and Dunn (2003) describe that "some researchers believe that consciousness is not localizable to any one place in the brain but rather arises from interaction of processes distributed throughout the brain, none of which has the property of consciousness". Polger and Flanagan (2002) write: "consciousness is at once phenomenologically

homogenous and heterogeneous" (21). While the "phenomenological unity of experience distinguishes conscious states from non-conscious states... conscious mental states vary widely" (21). They pose the following questions: Is consciousness a single phenomenon or is it a number of distinct phenomena? Does consciousness arise from a single neural mechanism or from various distinct mechanisms?

Still, Flanagan (2000) describes that, however differently we may describe our experiences, "there is something that it is like to be in different kinds of mental states" (54). If we deny that consciousness is real, we cannot address the potentially more productive questions of what consciousness is and why we have it. Even if the mechanisms that bring about consciousness are distinct neurally, they might all produce a state that is phenomenologically constant and that could confer a consistent function to its bearer, Polger and Flanagan (2002) write: "It might... be that despite the variety in their instantiation, conscious states were all independently selected for the same reasons; that is, that the having of phenomenal properties, however realized, always confers the same sort of advantage to its bearers" (23). For example, Bringsjord and Noel (2002) suggest that the connection between consciousness and creativity must explain its evolution. Conscious states may increase our fitness because of the richness they add to our experience, which lets us keep on living.

In contrast, Polger and Flanagan (2002) argue that consciousness is not adaptive in this strict sense, that only certain types of conscious experience could have provided an evolutionary advantage. Evolved states of consciousness are those that would have contributed systematically to our ancestors' fitness and that were selected for over evolutionary time. Our "fitness requires quick and reliable detection of the true," as

Flanagan (2000) describes (32). Organisms must maintain awareness, particularly, of the presence of environmental threats (predators, disease, obstacles, etc) and rewards (food, shelter, mates, etc). Their ability to maintain on-line representations of their environments aids organisms in coordinating their motor responses to the most relevant stimuli. The sensation of pain, for example, motivates us to remove ourselves from potential dangers. Among social animals, our awareness extends to the emotions of other members of our communities. Sensations of love or attachment may motivate mating strategies or the allocation of resources to kin, improving our fitness. Many of our states of consciousness seem adapted to the particular evolutionary challenges faced by our species.

However, just because some conscious states have evolutionary functions and all conscious states share the property of being experienced certainly does not imply that *every* conscious state has adaptive value. There may be non-functional residue of functional mechanisms of consciousness and, sometimes, there may be consciousness states that are functional without ever having been *selected* for via natural selection. After all, even evolved psychological mechanisms need not be optimally adaptive across the board, but need only to satisfice: the evolutionary benefits must outweigh the costs. "The claim is then that our rational and emotional capacities satisfice when we are up and about, that is, when utilizing these capacities pays off. And it is of no consequence that they continue to reverberate and serve no purpose when they are not on duty" (Flanagan 2000, 37). Flanagan sets up dreaming as a reverberation of psychological mechanisms only adapted for their usefulness while we are awake. Although our dreams may be functional in certain social contexts, these contexts are irrelevant to the evolutionary landscape.

Flanagan (2000) writes: "some capacity can be adaptive, functional, fun, and a host of other good things without being an adaptation in the biological sense" (37). He gives the examples of calculus, quantum physics, and bocce ball, all of which may serve us well now, but did not contribute to the reproductive success of our ancestors. "Exaptations", as Polger and Flanagan (2002) describe, are "traits that were not selected for but were later co-opted for their adaptive advantage" (23). It is possible that dreams are examples of exaptations (Flanagan 2000, 22). Polger and Flanagan (2002), like Revonsuo (2000), use ecological reverse-engineering to begin to sort adapted mental states from epiphenomenal ones. The adaptedness of states depends on their tendency to bring about enhancements in fitness.

Others have questioned that *any* conscious states would have effects. As Polger and Flanagan (2002) describe, epiphenomenalism comes in several varieties. "Etiological epiphenomenalism" states that consciousness has physical effects, but these are not adaptations. Etiological epiphenomenalism may apply to one sub-type of consciousness, like dreaming, or to all consciousness. "Causal-role epiphenomenalism", while it also recognizes that consciousness has physical effects, states that these effects function outside the organismic system. The effects of consciousness cannot be attributed to the operational mechanisms of the organism. Finally, "strict metaphysical epiphenomenalism" claims that consciousness does not have physical effects. Polger and Flanagan (2002) describe that such epiphenomenalism, unlike etiological or causal-role epiphenomenalism, is a position not on the evolutionary history of consciousness, but on the nominological possibilities of phenomenology. "It is the strange idea that there is something that is itself caused but which can have no effects at all" (35).

Koch and Crick (1998) describe that many neuroscientists reject the study of consciousness, either considering it a philosophical problem or, alternatively, a scientific problem that we do not yet have the tools to appropriately address. Others have taken on the problem of consciousness in neuroscience by outlining a research program in which neurophysiological measures become tools for investigating the NCC (e.g. Revonsuo).

Koch and Crick (1998) have explored the NCC in the visual system, recognizing that visual information may either be processed by the on-line (unconscious) system or the seeing (conscious) system. In some instances, we may react to visual stimuli without any awareness of them. Those with blindsight, for example, lack normal sight but can still respond in limited ways to the movement of visual stimuli. Koch and Crick (2000) also describe the phenomenon of a runner beginning a race before he consciously "hears" the shot. Lower animals and, in some instances, humans, may process information and produce motor responses without any internal representations.

Koch and Crick (1998) suggest that visual *awareness* operates distinctly from the on-line system, allows more plastic responses to cues, and relates isomorphically to the neural representation. Unlike the online system, the seeing system can handle complex visual inputs, can motivate responses after longer delays, operates on object-centered coordinates, and is conscious. Rather than the "stereotyped responses" produced by the on-line system, the seeing system can generate "many possible responses" in the motor system (1288). While the on-line system consists of a dorsal visual stream, the seeing system consists of a ventral stream with projections to cortical areas not limited to the primary visual cortex. "The NCC must have access to explicitly encoded visual information and directly project into the planning stages of the brain associated with the

frontal lobes in general and with the prefrontal cortex in particular" (Koch and Crick 2000, 1291). Not only projections, but also histological structure, neuron properties, and temporal coding, among other differences, may distinguish functionally separate cortical areas in the online and off-line systems (Kaas 2000).

Flanagan describes potential NCC of dreaming: the specialized neural activations of nREM and REM sleep stages may correlate to specific types of dreaming. Among several similarities between Flanagan and Hobson is an interest in the distinctness of nREM from REM dreams. Flanagan adopts important elements of the A-S model: during REM, the mind attempts to make sense of essentially random activations originating in the brainstem. REM dreams are not designed to serve a purpose, they are just "noise" (36). Like Hobson, Flanagan compares REM mentation to psychosis. "As REM dreams share properties with psychotic thought, nREM dreams share properties with neurotic thought" (Flanagan 2000, 34). Repeatedly, Flanagan emphasizes the bizarreness of REM dreams, their emotional quality and their visual richness. REM dreams are "really weird" and full of "wild and crazy ideas" (34, 16). In contrast, nREM dreaming "involves worrying and perseverating" (34). NREM dreams are less bizarre, more mundane, and more like waking thoughts. To Flanagan, as to Hobson, these formal phenomenological distinctions reflect the particularities of REM and nREM neural activation.

Flanagan (2003) believes that NCC investigations bridge the divide between phenomenological and biological realities (148). He writes: "Explaining the mechanisms that give rise to the different types of waking consciousness, nREM, and REM-mentation, is all there is to solving the hard problem" of consciousness (148). Our intuition may tell us that there exists an "unbridgeable gap" between experience and

neural activity, but we should not trust this intuition as "it has no evidentiary status whatsoever when it comes to how things are" (148). In fact, an illusory discontinuity between phenomenology and biology is logical:

> Awake consciousness in the five sensory modalities is an adaptation precisely because it allows us to detect reliably what is going on outside us and to use this information in fitness enhancing ways. There was nothing to gain and everything to lose had Mother Nature designed us to be in touch with our mental states at the level of granularity that neuroscience treats" (Flanagan 2003, 148).

Knowledge that our experiences are somehow contained in the firing of neurons in our brains may be useful or interesting to us now, but it was irrelevant to our ancestors.

Flanagan describes that the search for the NCC implies acceptance of the dualism of consciousness. In fact, much of our scientific understanding relies on abstract representation. He suggests that representational knowledge (e.g. that water is also, chemically, H_20) may build on our experience with the dualism of the mind-body relationship: there is the world and there is our experience of it. Scientific discourses and mind-body dualism are thus mutually reinforcing. Matson (1966) describes that, for the Greeks, "Mind-body identity was taken for granted.... Indeed, in the whole classical corpus there exists no denial of the view that sensing is a bodily process throughout" (63). Maybe a mind-body problem emerged around the Enlightenment because increasingly sophisticated and useful models in natural science produced an expectation that well-known phenomena should be explainable.

Flanagan questions the relevance of mind-body dualism before scientific advancement, and especially before cultural development. The evolutionary environment,

characterized by persistent and severe ecological dangers, would have precipitated in psychological mechanisms supporting day-to-day survival (e.g. fight or flight responses). not specializations for solving epistemological puzzles or modeling complex phenomena. Flanagan (2000) writes: "Consider, for example, the view that dreams express or reveal deep truths about who one is and, in particular, that they yield knowledge about the moral quality of one's character or life. This sort of knowledge is something the gods might sensibly care about, but it is hard to imagine an evolutionary rationale for why such knowledge could matter" (42). Even if some dreams reveal "our deepest thoughts, feelings, desires, and needs", it may not be adaptive for us to become aware of these elements of our psyche. If dream interpretations were critical to our survival, we might expect better memory for dream experiences.

In contrast, many psychoanalysists have argued that dreams function by releasing hidden or unconscious elements of experience, with or without explicit memory. According to Freudian theory, dream elements express, in symbols, repressed desires that would be unacceptable to the dreamer. According to such a model, specific dream experience need not achieve conscious processing or memory representation for the accomplishment of its "psychic release" function. The manifest content of dreams, consisting of disguised symbols and obscured meanings, served a physiological purpose: the preservation of sleep. According to Freud, inappropriate wishes, if expressed as manifest content, would disturb the mental balance of the dreamer, waking him. Dreaming's natural function, thus, did not depend on recall or therapeutic interpretation, but on mental actions, performed automatically by psychological mechanisms. The "dream work", a hypothesized apparatus that transforms unacceptable desires (latent

content) into censored representations, thus prevents the dreamer from becoming aware of realities that would challenge his psychobiological balance (Solms 2000). The application of free-association techniques to dream interpretation, in contrast, is a "created" functional method in psychoanalysis.

Between the neuroscientists and psychoanalysts, there remains passionate debate about whether neurophysiological evidence supports the occurrence or efficacy of the dream function described by Freud (Rock 2003; Bulkeley 2002). According to Flanagan, psychoanalysts' theoretical mechanisms of psychic balance have not been conclusively linked to any functional physiological processes during dreaming, although Solms (2000) has described the suggestive involvement in the generation of dream content of brain centers associated with goal-directed behaviors. Many modern psychoanalysts have defended the functional dream theories of Freud and Jung by describing the compatibility of the neural network of dreams with "psychic balance" processes such as release of repressed thoughts and the generation of images to facilitate the dreamer's comprehension of his/her waking experiences (e.g. Solms 2000; Wilkinson 2006; Mancia 2005).

Other modern psychoanalysts (e.g. Hartmann 1999) do not attempt to map "psychic balance" effects of dreams onto the neurophysiological network of dreaming, focusing instead on the functionality of subjective experiences within the dream, including the integration of memories and emotions and enhanced self-knowledge. Thus, in the continuing etiological dream function debate, the depth psychologists "have no consensus on whether dreams function in the release of "deep thoughts" or in the recognition and use of such thoughts for "enhanced self-understanding" (Flanagan 2000,

41). Like Revonsuo (2000), Flanagan insists that if dreams have "function", it must be consistent with biological realities, and "there is a problem bringing a depth psychological account into a comfortable relationship with evolutionary biology" (42).

Flanagan draws a distinction between potential functions of REM sleep and potential functions of dreaming; potentially functional mechanisms of REM may never achieve evolutionary significance at the level of phenomenology. For example, Flanagan (2000) accepts that memory consolidation and reverse learning are potential functional properties of sleep, especially REM sleep. "It is just that the phenomenology of dreams gives no support to the idea that dreaming contributes to this process" (148). As Solms (2003) has shown, "Dreaming and REM are controlled by different brain mechanisms" (51). "There are people who REM but do not dream and there are people who dream but do not REM" (Flanagan 2003). An evolutionary function of sleeping, which seems likely, does not imply an evolutionary explanation of dreaming.

A search for an adaptive explanation for dreams must consider evidence from dream phenomenology and must explain the usefulness and selectablility of the specific phenomenal properties of dreams in the evolutionary environment. Revonsuo (2000) and Flanagan (1995; 2000) agree that potential dream functions may either be "invented" or "natural"; invented functions reflect cultural or psychological development. Revonsuo (2000) writes:

> It is doubtful that any truly natural function of dreaming could be based on the conscious recollection or verbal reporting of dream content, for the natural functions of dreaming, if any, must have been effective in such

> ancestral conditions and species in which self-reflective dream recollection or reporting were not likely to occur (86).

Societies or individuals may have devised uses for their dreams that have functions. These functions may even have adaptive value, but that does not mean that dreaming was selected for in the evolutionary environment.

While dream content studies may reveal dreaming's unique "form", we should hesitate before reverse-engineering a unique "function". Revonsuo may have discovered a plausible ecological explanation for the adaptedness of dreams, but as Polger and Flanagan (2002) describe, an ideal adaptionist explanation has four other elements: 1. evidence that selection has occurred 2. Evidence that the traits in question are heritable 3. Information about the population structure and 4. Phylogenetic information about trait polarity (27). Revonsuo's TST has many strengths, but it does not and could not provide enough evidence of the relevance of dreaming to our ancestors.

Revonsuo

Antti Revonsuo made a significant contribution to the dream studies discipline with the 2000 publication of his TST and some strengths and weaknesses of the theory have been discussed in prior chapters. For example, both Domhoff and Bulkeley applaud Revonsuo for uniting empirical evidence from many different types of investigations into dreaming. Among his evidence, Revonsuo cites animal and human lesion studies, neurophysiological data, and extensive content analysis data from several cultures. His theory also attempts to achieve consistency with evolutionary biology. As Flanagan (2000) has also argued, evolutionary considerations can potentially reveal the functional or epiphenomenal status of various consciousness states, including dreaming. Revonsuo, like Flanagan, has argued that consciousness can now be investigated according to the scientific method. He investigates the structure of dream experience in order to reverse-engineer its functionality.

According to the methods of evolutionary psychology, Revonsuo constructs a compelling possible function of dreams: they may have contributed to the fitness of our ancestors by generating a virtual reality for threat simulations. Revonsuo describes that exposure to grave threats to reproductive success and survival could have activated a mechanism in dreams that realistically reproduces the most relevant dangers. Such a mechanism would facilitate rehearsals in perceiving and avoiding danger. According to TST, especially in the wake of trauma, dreams would become more perceptually and behaviorally realistic. Dreams would also be expected to over-represent threats compared to other themes in content, especially threats that would have been relevant to our

ancestors. In hunter-gatherer societies, where the lifestyle maintains certain similarities to that of ancestors, the threat simulation mechanism may be particularly developed. Thus, the TST yields several testable predictions for dream content.

Revonsuo's draws his evidence from various content analysis studies utilizing HVDC scoring. Revonsuo uses the same data on norm dreams that Domhoff analyzes and draws the same conclusion: that dreams represent negative situations and emotions with greater frequency than positive emotions and events (Revonsuo 2000). Chasing nightmares, for example, are the most universal dream type and are frequently exceptionally vivid and realistic. In such nightmares, Revonsuo (2000) reports, typical "threatening agents were wild animals, monsters, burglars, or nature forces such as storms, fires, or floods" (94). These specific dangers correspond to the environmental conditions of our ancestors. Furthermore, our dreams lack instances of activity like calculating, although they may occur frequently in waking life. Due to such evidence, Schredl et al. (2004) describe that the continuity hypothesis, asserting consistency across sleeping and waking states, is far too vague in its present form. The evidence indicates that dreaming is not an exact replication but "a selective simulation of the perceptual world" (Revonsuo 2000, 878).

The emotional charge of threat simulation dreams, as Revonsuo (2000) describes, is also consistent with our understanding of the neural underpinnings of dreaming, including REM-related activations. Ponto-geniculo-occipital (PGO) waves, associated with "fight or flight" responses, occur in bursts during REM sleep, the stage associated with the most threat simulation dreams. A "hot" memory system, centered on the amygdala, may be particularly active in triggering threat simulation dreams, and "is

believed to have a role in releasing species-specific behaviors such as fear or defensive responses to emotionally charged stimuli" (887).

Chasing dreams and other realistic nightmares would have provided our ancestors a critical opportunity to practice essential escape or defense techniques. Although motor responses during dreaming are clearly not carried out at the periphery, Revonsuo (2000) describes that they are nonetheless neurally realized in the same way. He writes: "Mental imagery of motor actions uses the same motor representations and central neural mechanisms that are used to generate actual actions" (889). Only inhibition in the pons prevents forebrain motor cues from achieving realization. In REM Sleep Behavior Disorder (RBD), defined by an absence of the muscular atonia characteristic of REM, patients seem to act out their dreams. Revonsuo describes that most cases of RBD involve threat simulation dreams and that most actions are responses to threats. Similarly, in cats that lack atonia during REM, motions such as orienting toward, searching for, and attacking prey have been observed. Thus, across species, dream actions rehearse responses to real life challenges.

Revonsuo argues that dreamed threat simulations are effective practice by describing their operation as an instance of implicit learning. Whereas Bulkeley (2002) holds that remembered dreams have function, Revonsuo's TST attributes adaptive value to both remembered and non-remembered dreams. He writes: "Extensive literature on implicit learning... confirms that many skills important for human performance are in fact learned without any conscious access to their nature" (Revonsuo 2000, 890). In fact, REM may be particularly associated with cognitive processes that support implicit learning and associations. For example, in rats, REM deprivation has not affected

memory for explicit tasks but has impaired memory relevant to procedural tasks (Smith 1995). Revonsuo suggests that dreams enable repetition of survival-related procedures.

However, in the case of animal dreams, survival-related practice sessions operate not only without explicit processing but potentially without any phenomenal components. Revonsuo writes: "Although we cannot know with absolute certainty that other mammals have subjective experiences during sleep, we do know that they can manifest remarkably complex behaviors during REM sleep" (892). Although we know that humans can manifest complex behaviors during REM (in RBD) and that we often have experiences of dreams, it is impossible to know whether the unconscious physical processes or the subjective elements have function. Michel Jouvet (1980) proposed that a function of REM sleep was maintenance of the central nervous system through intrinsic survival-related programs. Dreams, in humans, may emerge from specializations of REM that are observed across species. Hobson (1994, 2000) has emphasized that dreaming is random noise produced as the sleeping brain performs automatic processes including memory consolidation and motor coordination with memory representations. In humans, the sophistication of the "noise" may reflect the sophistication of the automatic program and of the conscious capacities we have developed for waking life.

Revonsuo (2000) counters that dream form, in humans, is too specialized to emerge epiphenomenally. If dreaming was a functionally irrelevant by-product of sleep processes, we might expect its phenomenology to resemble that of a migraine headache, with "white or colorful phosphenes, geometric forms, and scintillating and negative scotomata" or of Charles Bonnet syndrome, in which perceptions are static images (Revonsuo 2000, 883). However, dreams have a typical narrative form, involve all

sensory modalities, reproduce a version of the waking world that is virtually indistinguishable from it, and usually involve embodiment of a self character (Revonsuo 2000, 2005). Whereas Hobson's (2000) "cardinal features" emphasize the distinctness of dreaming from waking experience, Revonsuo (2000) describes dream consciousness as a virtual reality: "it is remarkable how well the world model created during dreaming corresponds to the one created during waking perception" (898). He concludes that "the content of dreams shows far too much organization to be produced by chance" (882).

For Revonsuo, the organismal cost of producing complex, organized perceptual experiences as occur in dreams reveals that dreams also have a benefit, an evolutionary function. Patrick McNamara (2004) makes a similar argument: "Cognition during sleep is highly organized, with very unique and specific properties that require specialized brain circuits to be produced. Dreaming is metabolically and mentally costly" (104). A cost-benefit analysis must be performed not just for REM, but for dreaming itself. The REM-dreaming dissociation is more than the fact that dreaming occurs outside REM; dreaming can occur outside REM because, as Solms (2003) has shown, it arises from activation of a distinct neural network, a forebrain network. The form of dreams, while it may somewhat resemble other stages of consciousness such as daydreaming, is also unique. The phenomenal uniqueness of dreaming, according to biological determinism, represents a uniqueness of the neural substrate of dreaming. At this biological level, Revonsuo argues, natural selection could have occurred.

While Revonsuo's requirements for a possible function of dreaming mirror Flanagan's, the men differ in their interpretation of the evidence from dream phenomenology and evolutionary psychology. Like many other critiques of TST,

Flanagan's' (2003) suggests that dreams may not be sufficiently realistic (as is the case for REM dreams) or may not provide productive enough solutions to problems (nREM dreams) to serve as viable rehearsals (149). This criticism of TST suggests that Revonsuo misrepresents the formal constitution of dreams. A recurring theme in dream studies is differences in delineations of normative dream properties. At the level of experience, dreams defy categorization.

Flanagan's second critique is that TST lacks parsimony in its evolutionary explanation of affect in dreams. Flanagan (2003) suggests that the negative emotionality of dreaming may reflect evolved affect programs that inform our responses to threats, but that have adaptive function only while we are awake. Rozin and Royzman (2001) explain that negativity dominance in human cognitive processes may reflect evolutionary considerations such as the pervasive threat of contagion. There is no positive "opposite" of disgust, for example, because contagion is a process that only works in the negative dimension. Our ancestors never needed an emotion that would motivate visceral responses to purity. One major tenet of TST is that dreams over-represent negative situations, but there is little evidence that our waking affective mechanisms are not also biased towards the perception of threats. Domhoff (2003) has described various psychological continuities between waking and dreaming, and "negativity bias" may be one other.

Flanagan (2003) suggests that the emotional nature of our dreams may reveal, not an evolved mechanism, but the proximity of the brainstem to emotional centers of the brain. The particularly negative nature of dream emotions may reflect overall biases in our affective systems. Even the specific content biases Revonsuo describes, such as an

overrepresentation of dangerous strangers and animals, may be consistent with the overall nature of our affective programs, specifically tuned to relevant threats (149). He tentatively posits "that the affective programs governing the basic emotions contain scenarios preloaded with content of threatening creatures and situations" (149). Such an explanation features greater parsimony than Revonsuo's "because it requires no special selection pressures to have operated on dreaming" while simultaneously accounting for much of Revonsuo's evidence (149).

Another major critique of TST, which Revonsuo and others have addressed at length, involves the apparently non-functional nature of nightmares associated with PTSD. Although Revonsuo has responded substantially to the issue of PTSD nightmares in his original TST and subsequent publications, he does not provide any consistent explanation for the genesis of PTSD nightmares. Instead, Revonsuo provides several alternative accounts.

In his original TST, Revonsuo (2000) explains PTSD nightmares as extremely salient memory traces repeatedly activating the threat-simulation mechanism. Thus, the unprocessed emotional content of traumatic memories and, correspondingly, the frequencies of dreams associated with these memories may be reduced by therapeutic actions during waking life, such as recording nightmares, rehearsing them with changed endings, and desensitization. While our human ancestors presumably did not have access to effective methods for decreasing emotional salience of traumatic memories, he argues that they would not have needed them because they did not face the same types of threats: "Frontline combat conditions undoubtedly create memory traces with the highest negative emotional charge, leading to post-traumatic nightmares, but the threats

encountered in such conditions are hardly comparable to those in the human ancestral environment" (895). The modern war-related threats that trigger PTSD, according to Revonsuo, were not encountered in the ancestral environment and are therefore irrelevant to the TST.

He goes on to describe that apparently dysfunctional aspects of evolved mechanisms can occur naturally, so long as that mechanism is adaptive overall. Revonsuo compares sleep disruptions due to PTSD as comparable to "exaggerated or inappropriate" immune responses, such as autoimmunity of Type I hypersensitivity (896). The "negative side effects" of threat simulations may reflect an exaggerated response of a mechanism that is generally functional. Revonsuo indicates that the sensitivity of an individual's threat-simulation system may reflect genetic differences in the population. Some individuals may have threat-simulation mechanisms that are oversensitive and therefore less adaptive, but this reflects normal variation in the gene pool.

Finally, in his original TST, Revonsuo indicates the inconclusiveness of studies examining the effects of PTSD on sleep. He references a study by Hurwitz et al. (1998), in which veterans with PTSD who reported disturbed sleep did not manifest any significant sleep disorder in a clinical setting (896).

The three approaches that Revonsuo takes toward accounting for PTSD in his original TST do not present a consistent interpretation of the disorder's exact impact on sleep or on its evolutionary relevance. Rather, Revonsuo tries to cover his bases. This approach is replicated in subsequent publications of Revonsuo and his supporters. PTSD nightmares are alternatingly presented as: not necessarily maladaptive, evolutionarily irrelevant, or the manifestation of an over-vigorous threat-simulation mechanism, the

maladaptive effects of which can be dismissed through cost-benefit analysis. Although any of these three explanations is plausible, Revonsuo's wavering between them reflects the inconclusively of studies of PTSD's culture-boundedness and personal impact.

However, some evidence indicates that posttraumatic nightmares may eventually integrate trauma; it just takes a while. Barrett (1996) writes: "Several studies have delineated a pattern of post-traumatic nightmares in which the initial dreams are fairly close to literal reenactments of the trauma, sometimes with the twist that an additional horror, averted in real life, is added to the dream reenactment. Then, as time passes, and especially for those whose PTSD is gradually improving, the dream content begins to make the trauma more symbolic and interweave it with concerns from the dreamer's daily life" (3). Esposito et al. (1999) studied the dream content of 18 Vietnam combat veterans with PTSD and found that, while dreams were generally threatening (83%) and nearly half of them included combat elements, they inconsistently represented past trauma. Typical characterization of PTSD nightmares as exact reenactments (e.g. Hartmann 1998) may be inaccurate.

Theorists have not overcome the challenge that PTSD presents to TST, but there are other, even more complex challenges in the etiological function debate. Particularly: Is the basis of dream form enough to demonstrate dream function? As I have shown, theorists delineate dreaming and waking states according to wildly different criteria. Emphases include continuity with thought, exceptional variety, delusion, and selective reality, among others. Thus, an objective study of consciousness may be impossible. Simultaneously, a study of consciousness that does not attempt to address phenomenology is not actually a study of consciousness at all. Metzinger (2004) writes:

If it turns out that there are principled reasons why important features of subjective experience can never be grasped through" such an interdisciplinary research program, we must accept this result if our goal is truly epistemic growth (36). "For a philosopher, attempting to contribute to a reductive explanation of consciousness is never an ideology" (36). For a neuropsychological scientist, hopefully we can say the same. The etiological function debate and the between-state continuity debate must be recontextualized as inherently speculative.

Conclusion

This plurality of "dreaming" extends even to its definition: modern dream theorists accept that dreams consist both of subjective experience and neural representations. Each theory I have presented here defends a precise relationship between the physical and phenomenal components of dreaming, ranging from an unbridgeable gap to strict isomorphism. The new science of dreaming, despite such an ambiguous epistemic foundation, has, in recent years, taken on dream function, meaning, and character.

Before attempting to deconstruct these entrenched debates, we must assess the validity of a "science" of dreaming. Most importantly, a self-reflective dream science must recognize the speculative nature of its accounts. Second, it must attend to the interdependence of dream experience and interpretive contexts. Many of the dominant scientific constructions of dreaming, including A-S, AIM, and Domhoff's (2003) neurocognitive model, fail to address the variability of dream experience and the social factors influencing attributions of meaning. Given the interplay of biological dream mechanisms with cultural and individual factors, Bulkeley hedges his bets by relating dreaming, in both its neuropsychological and sociological properties, to the broader neurocognitive mechanisms of "creative play."

During waking, the manifestation of creativity in measurable behaviors with observable physical effects allows consciousness researchers to put aside some of the specific challenges of dream research. After all, philosophical and semantic ambiguity arise from every popular methodology in psychological dream study, whether it evaluates

putative cognitive processes, maps neurophysiological activations, or simply plots dream elements against demographic variables. Models that attend to dreaming's correspondence to certain waking experiences (e.g. play or symbolic thought) and to the distinct effects of cultural context on dream variables (e.g. frequency of threatening elements or salient dream "types"), give dream science new avenues for empirical research.

In contrast, constructing dreams as the phenomenal component of functional neural programs operates on several untested assumptions concerning the explainability of experience according to neural representations. Do we really know how the activations revealed by functional imaging relate to the content and experience of our dreams? In fact, we cannot demonstrate a causal relationship between neural and phenomenological dream events in either direction. Willingham and Dunn (2003) write:

> The fact that a construct can be decomposed does not necessarily mean that it is useful to do so. For example, one might propose that an attitude is composed of memory representations and affect. If one can localize memory and affect in the brain, should one jettison the construct "attitude" from social theories and replace it with memory and affect? (668).

The self, dissonance, attachment, reciprocity, and group contagion are examples of constructs in the social sciences that would not be easily localizable but that we should hesitate to break down into component processes.

Willingham and Dunn (2003) argue that theories in the social sciences have "integrity of their own" (668). In fact, the *biological* validity of some psychological constructs has been upheld by localization data, which has confirmed the neural basis of

processes such as *theory of mind* (e.g. Baron-Cohen, 1995) and certain emotions (e.g. Rozin and Royzmann 2001). In other cases, the psychological construct may be supported by behavioral evidence but not a specific neural representation.

Due to the difficulties of interpreting neurophysiological data, especially localization data, it may be simpler to use them to uphold a psychological construct than to diminish one. Cognitive science, in this way, is more strictly empirical than psychology. Freud's dream theory may have persisted, for example, because it cannot easily be falsified (Hobson 2000). Constructs including repression persist despite a vague biological basis.

Hobson contradicts himself, however, when he claims that localization results have unseated psychoanalytic and religious accounts of dreaming. Neuroscience may reveal material neural representations, but these cannot necessarily be mapped onto psychological processes, now or ever. Neuroscientific explanations should not simply replace psychological ones; they generally offer another level of explanation. When neuroscientists attempt to explain phenomenology with localization data, their work also enters the realm of theory. In this sense, neuropsychology sits on the border between natural and social science.

Whether or not a scientific community "understands" dreaming, or any other similarly complex mental phenomenon, depends upon what kinds of questions they are asking. Hobson frames his work as hard science when, in fact, his models speculate extensively about the emergence of consciousness from neural processes. Consciousness studies, including neuropsychological dream studies, is intrinsically subjective and uniquely challenging. We will never know whether dreaming and waking consciousness

are more similar or more different. Neither phenomenological analysis or neurophysiological data support such a specific relationship. For one thing, both states are highly variable. Beyond this, the fact that theorists have proposed wildly different accounts of across-state constancy demonstrates the complexity of the problem.

Our research questions may even indicate our existential insecurity: Dennett (1995) has proposed that our interest in adaptive explanations of consciousness may derive from our intuitions about free will. The "problem" of consciousness may accompany sophisticated scientific models and may not actually be an intrinsic human concern (Flanagan 2000). The attempts to make dream studies empirical may even reflect our overdependence on scientific models for self-understanding. The scientific community is told, again and again, "We're almost there. We've almost explained everything." The competition for funding and prestige, as well as personal motivations, may drive such implausible optimism.

Morton et al. (2006) describe that members of the scientific community may deride the public and the media for distortions of scientific findings, frequently attributed to lack of scientific knowledge. In their study, students with an art background were more likely to rely on stereotypes of what "real science" looks like than students with a science background, evaluating results from a hypothetical neuroscience study more positively than those from a social science study. However, when the researchers manipulated the experimental results to favor one sex over the other, science students were more likely than other students to prefer the findings that affirmed their gender identity. They conclude that "while specialist knowledge may ameliorate one type of bias (the reliance on a stereotyped image of science), it may not necessarily lead to judgments that are

entirely value free or unbiased" (834). A sociology of science approach may facilitate our understanding of the construction process for empirical "facts" both in the scientific community and the general public.

Of the Hobson-Solms debate, Schredl (2005) argues that the fact that "the same empirical data (brain lesion data, imaging studies) of a complex system (the sleeping brain) can be interpreted in very different ways... clearly indicates that there is still a lot of work to be done by future researchers" (65). This work not only consists of further neurophysiological or psychological studies, but also of thoughtful consideration of methods in consciousness studies, as Revonsuo has argued. The mind-body problem may be a construct of modern science, but that does not mean that we should suddenly explain mental phenomena in physical terms; such accounts commit a classic "category mistake"[6] (Revonsuo and Kamppinen 1994). Phenomenology requires a distinct level of explanation that neuroscience cannot provide. Bulkeley (2002) has described that our models of dreaming cannot simultaneously accommodate all the new data. Jules Henri Poincaré wrote: Science is just facts; just as houses are made of stone, so is science made of facts; but a pile of stones is not a house, and a collection of facts is not necessarily science (qtd. in Morton et al. 2006, 824).

The next step in integrating phenomenological and biological accounts of dreaming consists of recontextualizating dream studies as a speculative discipline, built on the a priori beliefs of the scientific community, and related to sociocultural variability. A sociological analysis can be applied to dream science in much the same way as it can be applied to the study of religious or social movements. Bulkeley (1999, 2002) poses

several important questions: How, in the past half century, has a supposedly empirical dream science been built? Who has developed the dominant conceptions of the dream state and according to which rationale? In such a framework, whether dream studies has achieved empiricism becomes a question of ideology or even faith.

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[6] A category mistake consists of ascribing a property to an item that the item could not possibly possess. For example, it is meaningless to explain the mind, an experienced entity, in terms of the brain, a physical one (Revonsuo 1995).

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