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The prolonged effects of REM deprivation on sleep mentation

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City University of New York, 1993

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THE PROLONGED EFFECTS OF REM DEPRIVATION ON SLEEP MENTATION

by

Melissa L. Kresch

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York

1993

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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Abstract

THE PROLONGED EFFECTS OF REM DEPRIVATION ON SLEEP MENTATION

by

Melissa L. Kresch

Adviser: Professor Steven Ellman

The aim of this study is to examine whether there are changes in sleep mentation following REM deprivation and the nature of these changes if they exist. This research takes into account what interactions there might be between physiology (i.e. phasic activity) and a particular mental "state" (i.e. the presence or absence of a self observing capacity). The prediction is that the presence of higher levels of internal stimulation (in the form of phasic activity) following RD will trigger greater immersion in one's mentation.

This study tested the hypothesis that as RD continues, NREM mentation will more and more resemble phasic REM mentation. It was also hypothesized that REM tonic mentation will resemble REM phasic mentation as RD proceeds across nights.

I analyzed the responses to RD on the second and third nights of a RD experiment in terms of changes in REM and NREM mentation following REM deprivation vs. NREM deprivation as measured by 5 scales which assess a subject's absorption in his dreaming process: the Absorption In Mentation Scale ("AIM") - (1) Reality Scale (2) Global Scale (3) Self Representation Scale; and the (4) Foulkes DF Scale, and (5) Molinari and Foulkes SCE/PVE Scale.

The data were analyzed by means of a three-way analyses of variance in which the independent variables were experimental night, REM condition and phasic condition.

The results showed that with respect to the effect of experimental night, a significant main effect was observed only on the AIM Self Representation Subscale. No significant effects due to REM deprivation were observed when absorption in mentation was measured by the DF scale or by the SCE/PVE scale.

The findings suggest that self-reflection may be relatively independent of other aspects of the dream experience. This, in turn, suggests that sleep mentation measures must differentiate among the various attributes of dreaming, including loss of self reflection, the sense of reality of the experience, and the vividness of the experience.

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I am deeply grateful to my husband and son whose love, support and encouragement sustained me.

Finally this dissertation is dedicated to the loving memory of my father, Mr. Arthur Kresch. I wish to express my deepest appreciation for his love, tolerance and belief in me.

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Chapter I

INTRODUCTION AND STATEMENT OF PURPOSE

The aim of this study is to examine whether there are changes in sleep mentation following REM deprivation and the nature of these changes if they exist. Previous research in sleep and dreams has been based on models that postulate a direct translation of physiological phenomena into mental "content." This research is an extension of studies conducted by Arkin (1968), Ellman, Weinstein, and Schwartz (1988) that is based on alternative assumptions that takes into account what interactions there might be between physiology (i.e. phasic activity) and a particular mental "state" (i.e. the presence or absence of a self observing capacity). It is our assumption that the presence of phasic activity decreases ones self observing capacity and increases self participation in sleep. That is, the dreamer is involved in a mentation experience that is felt to be real, immediate and involving, i.e. more "dreamlike," when awakened from phasic intervals of sleep. Based on this model, we predict that the presence of higher levels of internal stimulation (in the form of phasic activity) following RD will trigger greater immersion in ones mentation.

No one has shown the prolonged effect of REM deprivation (RD) on sleep mentation (1) using scales which measure self participation in sleep with greater specificity than other scales (2) using scales that have been shown to be better discriminators of tonic phasic awakenings than previous scales used in sleep research (3) or using proper methodological criteria for awakenings in terms of time of night and time into the REM period.

This study tested the hypothesis that if you REM deprive people their NREM mentation will become more REM-like. That is, as RD continues, NREM mentation will more and more resemble phasic REM mentation (as indicated by mentation reports collected from either phasic or tonic intervals of REM and NREM sleep). It was also hypothesized that REM tonic mentation will resemble REM phasic mentation as RD proceeds across nights. The prediction is that the effect of RD on sleep mentation across nights will result in an increase in the "dreamlikeness" of NREM mentation as well as an increase in the "dreamlikeness" of REM mentation without phasic activity (REM tonic).

To investigate this, I analyzed the responses to RD on the second and third nights of a RD experiment in terms of changes in REM and NREM mentation following REM deprivation vs. NREM deprivation as measured by 5 scales which assess a subject's absorption in his dreaming process: the Absorption In Mentation Scale ("AIM") - (1) Reality Scale (2) Global

Scale (3) Self Representation Scale; and the (4) Foulkes DF Scale, and (5) Molinari and Foulkes SCE/PVE Scale.

Chapter II

HISTORY AND EVOLUTION OF THE THEORIES OF SLEEP MENTATION

Unitary vs Two-State Tonic Model of Sleep

Pivik's (1978) article provides a comprehensive review of the history and evolution of sleep mentation. Following Pivik's format, this literature review will summarize the changing theories and major research findings pertaining to the physiology and mental phenomena that occur during sleep. In his review Pivik (1978) describes how prior to Aserinsky and Kleitman's (1953) ground breaking discovery of rapid eye movements during sleep, sleep was conceived of as a unitary state. This monistic view of sleep was replaced by a dualistic notion which postulated two distinct kinds of sleep-rapid eye movement (REM) and nonrapid eye movement (NREM) periods of sleep. The REM/NREM dichotomy was further strengthened by evidence of signs of physiological activation in REM, other than rapid eye movements, that were thought to distinguish these states to an even greater degree (Dement & Kleitman, 1957; Aserinsky & Kleitman, 1953; Dement, 1955). In contrast to the activated REM periods of sleep, the state notion of sleep conceptualized NREM periods as a "static" state, qualitatively distinct from REM, and devoid of activity both physiologically and mentally (quiescent state)

Exploration of the physiological distinctions of REM and NREM sleep led to investigations regarding their psychological differences. The unique relationship of REM sleep to dreaming was first established in 1953 (Aserinsky & Kleitman, 1953; Dement, 1955; Dement & Kleitman, 1957) as a result of the findings which suggested a high incidence of dream recall from REM period awakenings as opposed to the negligible recall of dreams from NREM sleep awakenings. The investigators concluded that NREM sleep is characterized by little or no mental activity; it is a "relative mental void." REM sleep, however, was correlated with vivid dreaming thus demonstrating profound qualitative psychological differences between these two states.

Evidence supporting this distinction, particularly the findings supporting the paucity of mentation in NREM sleep, was soon replaced by data suggesting considerable amounts of NREM mentation (Goodenough, Shapiro, Holden, & Stenschriber 1959; Foulkes, 1962). Despite sound empirical evidence, however, the existence of NREM mentation was by and large ignored by the scientific community. The reasons for this could be explained by a variety of factors the first of which involved data collection procedures. The manner in which "dreams" were conceptualized and operationalized by each investigator determined what investigators were willing to accept as a dream and in turn affected the type of data collected. Whereas the early studies of dream recall demanded "coherent and fairly detailed" descriptions, Foulkes and his colleagues (1960, 1962) accepted more "fragmentary and less clear impressions of mentation as dreams" (Pivik, 1978, p. 247). This lack of definitional consistency among investigators accounted for the vast discrepancy of recall values from REM vs. NREM sleep states. And because recall values were typically presented in terms of averages, REM/NREM differences in recall were further dichotomized and exaggerated. This manner of data analysis served to mask the subject variability in recall that always existed in the REM sleep periods and accentuated the variability and hence the weaknesses and inconsistencies previously thought to exist in NREM sleep alone. Overlooking subject variability in REM recall was therefore a major obstacle responsible for most researchers reluctance to accept the data substantiating NREM mentation at this point in time in the history of sleep research.

In addition to empirically demonstrating the existence of cognitive processes in NREM sleep (Foulkes, 1962) Foulkes attempted to explicate the qualitative distinctions that were apparent in REM and NREM mentation. He found that NREM sleep mentation was more thought-like, and corresponded closely to waking types of mentation. REM sleep reports showed little resemblance to waking thought. These reports differed from NREM reports both in quality and quantity. There was a higher incidence of mentation reports from REM sleep. REM sleep reports tended to be longer, more embellished, hallucinatory and dramatic, in essence what is thought of as more "dreamlike" than "thought-like" mentation. REM sleep reports also showed that the individual was more fully immersed in the REM "dream" experience emotionally, physically, and perceptually.

Reports from other laboratories soon emerged (Goodenough, Lewis, Shapiro, Jaret, & Sleser, 1965; Bosinelli, Molinari, Bagnaresi, & Sarulo, 1968; Foulkes, 1960, 1962; Pivik, 1971; Pivik & Foulkes, 1968; Rechstschaffen, Vogel, & Shaikun, 1963; Zimmerman, 1968) which further countered the previous notions of a NREM mental void. NREM reports of dreaming were verified in addition to NREM reports of thinking. Although these investigators concluded that dreaming did exist in NREM as well as REM sleep states, the reports from the two states of sleep differed enough qualitatively, so that they were able to accurately identify dreams recalled from each kind of sleep. The REM/NREM dichotomy was therefore upheld as a result of these studies. That is, these findings continued to support a dualistic view of sleep, albeit an altered conception regarding the nature of these two states, particularly the NREM sleep state.

The idea of NREM mentation was challenged. Alternative theories explaining the prevalence of NREM reports were proposed. One explanation deals with the demand characteristics of the experiment. Perhaps the subjects fabricated NREM reports due to their desire to please the investigators. In addition to a social desirability factor, NREM mentation reports may have been memories of what was thought of or dreamt in previous REM periods and merely reported when awakened in NREM sleep. Lastly, REM reports could be explained as thoughts which emerged while the subject was in the semiconscious state that exists between the stages of sleep and awakening. NREM mentation reports would therefore be reflective of thoughts which characterize a hypnopompic state rather than NREM sleep state.

In 1967, Foulkes (1967b) addressed and disproved each of these arguments. Despite empirical evidence provided by Foulkes which countered the alternative explanations for the NREM mentation phenomena, his conclusions were disregarded. The reasons for this were due not only to the unique relationship already established between REM sleep and dreaming, but grew out of the Zeitgeist which was predominant in science at this time, that of psychophysiological parallelism. This philosophy was the main thrust for the skepticism surrounding the existence of NREM mentation and was based on the following assumptions: (1) The demand that physiological processes be consistent and coincident (parallel) with mental activity in order for mental experiences to be deemed real and verifiable. Any discrepancy in the patterning of physiology and mentation raised questions as to the reality of mental experiences in NREM sleep. (2) Because the EEG patterns of REM sleep are consistent with physiological patterns of waking mentation, and the physiological patterns of NREM sleep were considered to be inconsistent with thought processes, the existence of NREM sleep mentation and the empirical evidence proving otherwise was not readily accepted. (3) If REM sleep looks so different physiologically from NREM sleep it would be logical to conclude that gross psychological differences exist as well.

Based on the prevailing theoretical view, but including the new evidence obtained, investigators continued to look for physiological events that would correlate directly with the dream recall data (psychological data) derived from REM and NREM sleep. A serendipitous outcome of this search was a more complete description of sleep physiology.

Sleep Physiology and Sleep Cycle Changes

Dement and Kleitman (1957) observed varying patterns of brain activity, eye movements, and submentum (chin) muscular activity as people progressed from alert wakefulness to sound sleep across the night. These physiological activities were recorded by EEG, EOG, and EMG tracings, respectively. The qualitatively varying kinds of physiological sleep were then identified and classified into five stages of sleep.

The wakefulness pattern (AWAKE/STAGE 0) consists of rapid eye movements (REM) and a low voltage mixed frequency EEG pattern. Bursts of alpha rhythm activity are evident in "relaxed" wakefulness (8-12 cps) along with high muscle tonus in the submentum (chin muscle) as indicated by a highly activated EMG. The person enters Stage 1 as he falls asleep. The Stage 1 sleep pattern, (referred to as sleep onset or descending Stage 1) is also characterized by a low voltage, mixed frequency EEG pattern. It can be distinguished from wakefulness by the presence of slow, rolling eye movements, the reduction or disappearance of alpha rhythms, and a slight reduction in EMG activity.

In Stage 2 the EEG pattern is replaced by a sequence of spindle-shaped tracings and high voltage spikes. These two wave patterns, sleep spindles and K complexes, distinguish Stage 2 from Stage 1 and wakefulness. It is a clear sign that the subject has entered Stage 2 sleep if either of these wave forms appear. Sleep spindles occur at the frequency of 12-14 cps. K complexes are high amplitude waves which deflect in a sharp negative followed by a sharp positive direction. This pattern of activity is termed biphasic. Biphasic K complexes can be seen in both the EEG and EOG channels and are thought to be indicative of some external or internal stimuli.

The appearance of delta waves marks the onset of Stage 3 sleep. High amplitude, slow frequency delta wave activity (1-2 cps) is characteristic of both Stage 3 and Stage 4 sleep. What distinguishes these two stages from each other is the density of delta wave activity in each stage. As delta wave activity increases to the point where is makes up more than half of the EEG record, the individual is said to be in stage 4 sleep. The EMG pattern, as in stage 1, is reduced in comparison to the EMG pattern of wakefulness, but is not markedly inhibited until REM sleep appears.

It takes approximately 30 minutes to pass through stages 1-4 and 90 minutes in total to pass through one sleep cycle. The sequence of stages (from "quiet" to "active" sleep) is as follows; stage 1 > stage 2 > stage 3 > stage 4 > stage 3 > stage 2 > stage REM.

REM is a unique stage of sleep which occurs approximately 90 minutes after the onset of sleep. The low voltage desynchronized EEG activity of REM sleep looks similar to that of wakefulness, as does the EOG activity which is characterized by rapid, conjugate eye movements (REM's) Because these rapid eye movements so predominated this stage of sleep the stage was called REM (rapid eye movement) sleep. Another unique feature peculiar to the REM stage of sleep, is the marked drop in the EMG of the chin muscle as well as a generalized muscular inhibition of the head and neck.

As a result of the detailed description and classification of sleep physiology into discrete stages of sleep, variations within NREM sleep stages were demonstrated. Sleep researchers interest in NREM sleep was stimulated by these findings and no longer ignored. NREM sleep, formally considered a unitary state, was elevated to a more equal status with issues concerning REM/NREM discriminability. Researchers now concerned themselves with exploring the quality of sleep mentation as it relates to physiological variations within sleep stages, NREM as well as REM. This applied to mentation within NREM sleep stages as well as between REM/NREM sleep stages.

Models of Psychophysiological Parallelism

The physiological variations, based on EEG recordings, distinguishing sleep stages, were used as the "public event" needed to determine any psychological variations that may exist or correlate with the physiological sleep states. Questions were being generated as to what happens to the incidence and quality of sleep mentation as individuals progress through the various stages of sleep across the night. It was found that EEG recordings can give some broad clues as to the kind of mental activity being experienced at that point in time, and the likelihood of recalling the mentation that is activated. For example, mentation from low voltage, mixed EEG recordings were associated with greater recall and were described as having a more "dreamlike" quality, than from EEG recordings taken from slow wave, high voltage delta sleep. It was also found that conspicuous physiological differences in sleep states yield similar recall values of mentation (Pivik, 1971; Pivik & Foulkes, 1968). When EEG patterns are similar, however, noticeable differences in the quality of mentation are evident (Vogel, 1972).

Despite this active search for psychophysiological correlates in sleep (Rechtschaffen, 1973), rapid eye movements and dream content remained the most convincing of all the measures studied. The outcome of studies investigating the relationship between physiological events such as autonomic and motoric variables and mental activity proved to be disappointing. Heart rate, respiratory rate, electrodermal activity (GSR), penile erections etc. were all shown to be poor correlates of mental activity in both REM and NREM sleep states. What proved to be significant, however, were correlations between autonomic activity and mental activity during periods of rapid physiological change (phasic events) as opposed to correlations obtained in the tonic phase of these autonomic events. The same finding holds true when observing the relationship between motoric phenomena and sleep mentation. Although the best physiological (motoric) correlate of sleep mentation is rapid eye movements, additional motoric events were found to correspond to sleep mentation, particularly when the motor activity is rapid, discrete and noncontinuous. To illustrate this principle it is useful to discuss the findings of studies that contrasted tonic and phasic levels of muscular activity during various stages of sleep.

Throughout sleep, limb and trunk muscles are relatively inactive and remain so throughout sleep. This steady state of muscular inhibition is observed in NREM as well as REM sleep states, although just prior to and during REM, the muscles of the face and neck undergo a further decrease in activity. Despite this decrease in muscular activity, the tonic inhibition remains basically steady and constant throughout sleep.

Investigators searching for psychophysical correspondence between motoric events and sleep mentation were surprised to find evidence that not only failed to support, but was, in fact, in opposition to their initial predictions. Because REM sleep is characterized by a drop in EMG and a desynchronized EEG, it has been shown that there is a corresponding increase in recall as well as an increase in the dreamlikeness of the mentation recalled when these conditions are present (Dement, 1955; Foulkes & Vogel, 1965; Vogel et al., 1966). Due to the dramatic drop in the

EMG immediately preceding stage REM it was predicted that similar psychological phenomena would be observed in the pre-REM sleep period. Investigators, however, found inverse results when comparing the qualitative and quantitative aspects of mentation reports from pre-REM and NREM periods. That is, the incidence of recall of mentation from pre-REM, low EMG periods proved to be lower than the recall of mentation from NREM, high EMG periods. It was also found that the content of mentation reports collected from the pre-REM, low EMG periods was judged to be "less dreamlike" than material derived from NREM high EMG sleep periods (Larson & Foulkes, 1969; Pivik, 1971). However, when muscular activity is transformed from a tonic, continuous steady state of action to activity that is more distinct and sudden, psychophysical correspondence improves. For example, evidence was found that "discrete" body movements, or twitches of peripheral muscles directly corresponded to specific events or actions evident in dream reports. This type of peripheral muscle activity represents a change from a tonic, long lasting, sustained state to a more "discrete," short-lived, sporadic form of motor activity indicative of rapid physiological change. Although the findings were inconclusive, a "somewhat" better psychophysiological correspondence was obtained when phasic (short-lived) vs. tonic (sustained) motor activity and dream content were correlated.

Studies based on the "scanning hypothesis" proposed by Roffwarg, Muzio, and Dement (1962) illustrates an extreme attempt to demonstrate the direct relationship between mind and body. Based on the model of psychophysiological parallelism, these investigators hypothesized that for each physiological event there will be a corresponding psychological event. They proposed that there would be a precise relationship between the visual imagery the subject reports observing in his dream and the corresponding eye movements. A less extreme version of research that attempts to obtain psychophysiological correlations during periods of phasic motor activity (rapid burst of eye movement) is seen in the work of Berger and Oswald (1962). Their investigations of the eye-movement--dream content relationship led them to adapt a more general, nonspecific view in regard to the relationship between physiological events and psychological structures. Berger and Oswald (1962) found a significant but not perfect correlation between eye-movements and dream content by providing evidence which suggested that increases in eye movements are associated with active dreams as opposed to passive dreams. Hobson (1965) and Verdone (1963) correlated phasic events in the form of rapid eye movements to the vividness and emotionality of the dream. This differs from the scanning hypothesis in that each eye movement does not necessarily indicate activity that directly corresponds to scanning the dream imagery.

In light of the above controversy, and the inconclusive results which emerged from these studies, it was clear by the early 1960s that little headway was made in determining the physiological correlates of sleep mentation. The most robust finding which emerged from the previous 10 years of research was still the relationship correlating bursts of rapid eye movement and dream content in REM sleep. It was not until Moruzzi's reconceptualization of the nature of the REM sleep state in 1963 that a novel perspective regarding sleep events soon emerged.

The Tonic-Phasic Model

Moruzzi (1963) modified the established view of REM sleep as a unitary state by postulating an alternative model of REM sleep; a dualistic sleep state composed of both tonic and phasic events. This distinction, first made by Moruzzi, between phasic and tonic events in REM sleep, was supported by results in animal sleep research which empirically supported his theory regarding the heterogeneity of the REM state. According to Moruzzi (1963), REM sleep alternates between these short-lasting and discontinuous (phasic) events which occur sporadically throughout REM and (tonic) long-lasting "background" events which are continuously maintained throughout the REM period. Tonic components include low-voltage desynchronized EEG, low or absent muscle potential (EMG activity), and brain temperature elevation. Phasic events include eye movements (EMs), middle ear muscle contractions (MEMAs), EMG hypersuppressions (sporadic activity of the small muscles in the face), rapid, sporadic movements of the small muscles in the extremities, cardiovascular irregularities (including sporadic changes in pulse, blood pressure, respiration and other autonomic activities) and ponto-geniculate "PGO" spike activity.

These tonic and phasic events, as described above by Moruzzi, were clearly different "kinds" of events, that could be qualitatively distinguished from one another. Therefore, Moruzzi's (1963) division of REM sleep into its tonic and phasic components differs dramatically from the earlier psychophysiological sleep research that based tonic/phasic distinctions solely on physiological "variability," that is, the length of time an event lasted (sporadic vs. long lasting autonomic or motoric changes) as well as the extent to which these variations correlated with sleep mentation.

In contrast, Moruzzi's (1963) tonic/phasic distinction suggests qualitative rather than quantitative differences between the phasic and tonic components of REM sleep. He postulated that phasic events are essentially unique kinds of events which intrude on a tonic "background" of relative "inactivity"; activity that is clearly different from these phasic eruptions. This distinction implies that there might be different neurological mechanisms and separate anatomical areas involved in generating the different types of physiological activity (phasic vs. tonic). If the previous assumptions are true, it would then follow that these two components (phasic/tonic) of REM sleep could be dissociated, thus proving empirically the independence of and hence qualitative distinction between tonic and phasic events.

Animal Sleep Research and the Phasic-Tonic Distinction

A great deal of work soon emerged supporting Moruzzi's tonic/phasic model in studies which demonstrated the separateness of tonic and phasic events via lesioning, behavioral, and pharmacological techniques (Delorme, Jeannorod, & Jouvet, 1965; Jouvet & Delorme, 1965; Morrison & Pompeiano, 1970; Cohen, Mitchell, & Dement, 1968; Ferguson & Dement, 1968; Ferguson et al., 1968, 1969: Dement, 1969). In 1965 Jouvet et al. performed vestibular lesion studies in the cat. Bilateral destruction of the locus coeruleus was responsible for eliminating the muscular paralysis associated with REM sleep. Characteristic patterns of REM sleep such as desynchronized EEG patterns, PGO spiking and eye movements, remained stable following this procedure, however, the elimination of the tonic muscular inhibition resulted in physical activity uncharacteristic of this state. The animal would leap and run about violently which suggested to the investigators that the cats were engaged in acting out events occurring in their "dreams." The elimination of a phasic component of REM sleep was achieved which provided further empirical support to the assumptions underlying Moruzzi's (1963) tonic/phasic model of sleep.

Lesioning studies designed to eliminate phasic components of REM sleep in animals were implemented by complete removal of portions of brain stem nuclei, specifically medial and descending vestibular nuclei (Morrison & Pompeiano, 1970; Pompeiano, 1967). Virtually all phasic events were abolished in REM sleep (PGO spiking, eye movements, autonomic changes, EMG hypersuppressions etc.) with only a trace of "sporadic" phasic activity remaining, i.e. PGO spikes and eye movements.

Another method utilized by researchers to test the validity of the tonic/phasic model and verify the separateness of these two events was a procedure which would demonstrate a dissociation of phasic and tonic activity. If tonic and phasic events differed merely in terms of intensity rather than quality (degree vs. kind) then the ability to tease them apart would be unlikely, if not impossible. However, this dissociation was accomplished by displacing phasic events from REM sleep into NREM sleep via behavioral and pharmacological manipulations. This was done by suppressing REM sleep either by biochemical means (Delorme, Jeannorod, & Jouvet, 1965; Dement et al., 1969;

Ferguson, Cohen et al., 1969) or "forced awakening" procedures (Fergusen & Dement, 1968; Fergusen et al., 1968) at the onset of each REM period. These experiments were also designed to explore the REM deprivation-compensation phenomena following deprivation procedures. That is, if REM sleep is suppressed the amount of REM sleep time lost will be compensated for, at least partially. This is the classical definition of REM rebound. (A review of the RD literature will follow in the next section).

What emerged from these RD studies was data that showed significant increases in PGO spike activity in NREM sleep and wakefulness following RD procedures. PGO spike activity is one type of phasic activity which is most prevalent in REM sleep, although it has been found to occur occasionally in NREM sleep and wakefulness. Michel (1964), however, found a more regular pattern to PGO spike activity in NREM sleep. He observed that PGO spike activity is most dense or intense 30-40 seconds preceding each REM period and concluded that spike activity regularly "anticipates" REM sleep onset.

Dement (1969) explored the nature of this seemingly "intimate" relationship between PGO spike activity and REM deprivation phenomena. He conducted several experiments, based on the belief that PGO spikes are the primary triggering event for phasic events in general (e.g. REM sleep etc.) but more specifically, for REM rebound. Based on this hypothesis and the assumptions of the tonic/phasic model he predicted that if an animal is deprived of REM sleep (where PGO activity is highly concentrated) phasic activity (PGO activity) will be dissociated and displaced into NREM sleep or wakefulness. If phasic events can be displaced or dissociated from tonic REM events, REM rebound will not occur. This reasoning implies that the crucial variable in REM rebound is phasic activity and not REM time as was thought earlier.

Dement et al. (1969) and Fergusen et al. (1969) demonstrated that a phasic event (PGO spike activity) could be dissociated from REM sleep. By administering biochemicals that suppressed REM sleep, it was found that PGO spike activity was not only evident in other sleep states, but increased significantly in slow wave NREM sleep as well as wakefulness.

Delorme, Jeannorod, and Jouvet (1965) also showed that phasic PGO spike activity could be dissociated from REM sleep. Biochemical REM deprivation procedures were utilized in cats who received high doses of reserpine (.5 mg/kg). Although the curtailment of REM sleep was achieved, these investigators reported the presence of continuous spike discharges throughout the period of RD. Delorme and his colleagues were therefore able to dissociate REM "phasic" (PGO spike) activity from "tonic" REM sleep activity. An additional finding was that the expected REM-deprivation-compensation phenomena was absent. REM deprivation was not followed by REM compensation.

These results not only provided evidence supporting the independence of tonic and phasic events, but suggested a strong relationship between phasic events, particularly PGO spike activity, and REM deprivation. Researchers began to take a special interest in PGO spike activity (for several reasons which will be discussed below) due to the above findings as well as the evidence provided by Fergusen and Dement (1968) who showed an increase in number of phasic events following prolonged REM deprivation. Results of experiments lent further support to Dement's initial assumptions that REM rebound is not just a function of the amount of REM time lost. Another way of making up for lost REM time may be to increase the frequency of phasic activity that was lost in the deprivation condition.

Additional studies designed to tease out the trigger for REM rebound were initiated. Instead of utilizing the standard REM deprivation procedures that requires awakenings solely with in the REM period, Fergusen and Dement (1968) modified this technique by awakening the animals seconds before the onset of REM sleep. Since PGO spike activity increases in density seconds before REM sleep onset, the animals were subject to spike deprivation in addition to REM deprivation. By behaviorally "lesioning" PGO spike activity as well as REM sleep, these investigators were able to regulate, and in this case increase the amount of PGO spike activity on recovery nights. In addition to the increased frequency of spike activity, the amount of time spent in REM also increased from baseline to recovery nights as a result of this REM-Spike deprivation procedure. Two modes of compensating for REM sleep were reported; (1) changes (an increase) in the frequency of phasic activity and (2) making up for lost REM time (the classical definition of REM rebound). Although the REM-Spike deprived group showed a larger REM rebound effect than the control group who were awakened by standard RD procedures, the results were inconclusive. It was unclear whether the deprivation of PGO spikes was responsible for the increased rebound or whether the results could be attributed to more efficient RD procedures.

Dement (1969) utilized another procedure for suppressing REM sleep and eliminating the compensation phenomena. REM deprivation was achieved by an arousal technique that required the experimenters to "gently," but only partially awaken the animals seconds before REM sleep onset. It was shown earlier that the period before REM sleep is characterized by an increase PGO spike activity (Michel, 1964). The "gentle awakenings" procedure further intensified spike activity thereby augmenting PGO spike discharges in NREM sleep, while simultaneously depriving the cats of REM sleep. No REM rebound was reported following this two day REM deprivation procedure.

Dement (1969) and his colleagues concluded that the presence of PGO spike activity eliminated the need for the "compensation phenomena" to take place; compensation in terms of making up for REM time lost in the experimental procedure. What was compensated for, however, were the number of PGO spikes eliminated during the experimental "deprivation" procedures. That is, the intensified NREM PGO spiking resulting from the "gentle awakening" technique, resulted in a nearly exact compensation for the spikes lost in the REM period as a result of the REM deprivation procedure. A count was made of the increased number of spikes in the experimental Pre-REM spiking period and was compared to the number of spikes evident in the recovery period within REM sleep. The frequency of PGO spike activity in each condition was nearly identical. This provided Dement (1969) with quantitative evidence which showed that the phasic activity that was lost in the deprivation condition was increased and compensated for in the NREM spiking period.

According to Dement (1969) and his colleagues, these findings proved that if phasic events are dissociated from tonic REM processes then REM rebound can be extinguished. For Dement, this evidence supported his original hypothesis that phasic activity (PGO spike activity) is the crucial variable in REM rebound; that is, PGO spike activity, rather than REM time, is the trigger for REM rebound. For Dement (1969), the functional significance of PGO spike activity was determined. However, the results of these studies are equivocal due to the fact that the gentle awakening technique has never been replicated. The compilation of Dement's (1969) studies do suggest additional possibilities regarding the homogeneity of the REM state itself. REM may not be a unitary state, but a state in which a number of physiological processes are activated and dissociated under specific conditions.

Certainly PGO spike activity proved to be a compelling area of study in terms of attaining a greater understanding of the physiology of sleep. At the psychological level, PGO spike activity proved to be of special interest as well. PGO spikes are one type of phasic activity that is associated with and highly concentrated in REM sleep. PGO spikes are bursts of monophasic sharp waves that represent the electrical activity occurring in the pons and are associated with similar discharges in the lateral geniculate nuclei, oculomotor nuclei and portions of the visual system including the visual cortex. The association of PGO spikes with the visual system prompted investigators to explore the relationship between the physiological manifestations of spike discharges and visual dreaming.

Is there a relationship between PGO spike activity in animals and sleep mentation in humans? REM sleep in humans has been thought of as a time when "dreaming" is most evident. As was described earlier in Jouvet and Delorme's (1965) vestibular lesioning studies in cats, PGO spikes were associated with hallucinatory-like behavior in the waking state of cats. Since dreaming is considered to be a highly visual, hallucinatory mental experience, the existence of a psychophysiological correspondence between spike activity in animals and dreaming in humans came into question.

Human Sleep Research and the Phasic-Tonic Distinction

A number of investigators attempted to empirically test assumptions based on the predicted correlation between PGO spike activity and REM sleep mentation. They anticipated that spike activity and dream content would undergo similar fates when subjected to experimentally controlled REM deprivation procedures. If humans were deprived of REM sleep, a corresponding intensification of REM dream content would be expected on recovery nights. This assumption was based on empirical evidence derived from the deprivation experiments performed on cats (Dement et al., 1969; Dement et al., 1969a; Dusan-Peyrethon, Peyrethon, & Jouvet, 1967; Ferguson et al., 1968). Following REM deprivation, the frequency of feline PGO spike activity on recovery nights increased significantly as did NREM spike activity during the experimental REM deprivation condition. It was therefore also predicted that NREM dream content would intensify in human subjects during the REM deprivation condition.

Contradictory findings of studies based on these hypotheses were reported. Some researchers confirmed the premise that REM deprivation would lead to an intensification of REM sleep mentation (dreaming) on recovery nights (Greenberg, Pearlman, Fingar, Kantrowitz, & Kawliche, 1970; Pivik & Foulkes, 1966). Other investigators findings were negative (Antrobus, Arkin, & Toth, 1970; Carroll, Lewis, & Oswald, 1969; Firth, 1972; Foulkes, Pivik, Ahrens, & Swanson, 1968). The second hypothesis which postulated an enhancement of NREM dream content during the REM deprivation manipulation met with more consistent, but negative results. However, the number of REM deprivation studies designed to test this prediction was small, and the results suspect due to significant flaws in their methodology (Antrobus et al., 1970; Arkin, Antrobus, Toth, & Baker, 1968; Foulkes et al., 1968)

These disappointing results led researchers to the conclusion that studies based on suppositions derived from the spike-dream content correlation were inadequate and limited in terms of proving or disproving the assumptions of Moruzzi's (1963) tonic-phasic model as it relates to sleep mentation. Weaknesses in the spike-content correspondence became apparent when Pivik et al. (1969) observed a lack of correspondence between pre-REM mental content in humans and pre-REM spike activity in cats. The increased density of PGO spikes evident in animals preceding REM sleep did not correlate with the quality of mental activity observed in human subjects 30-40 seconds prior to REM sleep. In fact, mental activity in ascending stage 2 sleep, a time when spike activity in the cat increases, is qualitatively inferior to (i.e. less dream-like) the mental content of descending (post REM) stage 2, a time when there is an absence of spike activity in the cat. In order to support the spike-content relationship, one would expect enhanced mental activity at a time when PGO spike activity was most prominent. However, the spike-content correspondence is reversed. This is also true for sleep onset, a time when PGO spike activity is absent in animals and mental activity in humans is reported to be more dream-like (Foulkes & Vogel, 1965; Foulkes et al., 1966; Vogel et al., 1966; Vogel et al., 1972).

It is unclear whether these observations disprove the spike-content correspondence or point to a need for better measures and methodological procedures. What was clear however, was the need for a better test of tonic/phasic model of sleep. Subsequent investigations did, in fact, succeed in supporting one aspect of Moruzzi's (1963) model which was founded on the assumption that a phasic event is qualitatively different than the tonic activity which surrounds.

In 1967 a new direction in research was presented by Aserinsky who proposed a more adequate and direct test of Moruzzi's tonic-phasic model. He postulated that if dream reports were collected from subjects within phasic (ocular motility) and tonic (ocular quiescence) periods of REM sleep and were compared with mentation reports obtained from NREM phasic and NREM tonic awakenings, there would be a greater similarity in tonic vs. phasic dream content reports, regardless of sleep state. This implies that REM phasic dream reports and NREM phasic dream reports are more alike in content than reports obtained from the tonic and phasic periods of the same stage of sleep (e.g. REM tonic vs. REM phasic).

Aserinsky's conceptualization made it possible for researchers to operationalize and empirically test Moruzzi's tonic/phasic model at the psychophysiological level. The crucial physiological measure of phasic events in REM sleep was still the presence or absence of eye-movements, as originally suggested by Aserinsky et al. (1953). The critical psychological factor differentiating phasic from tonic events in REM sleep was not yet determined, however, until Molinari and Foulkes launched the first of many experiments designed for this purpose (Molinari & Foulkes, 1969; Pivik et al., 1969).

Researchers attempts to test the efficacy of the tonic-phasic model as it relates to mental activity in REM sleep, resulted in outcomes that at times contradicted previous empirical findings and theoretical assumptions. For example, the quality of mentation reports elicited from phasic awakenings in REM sleep was not positively correlated with visual imagery. The lack of a significant relationship between phasic activity and visual imagery (visual dreaming) was unexpected in light of previous studies that demonstrated an increased incidence of phasic activity with in the visual system at the physiological level. Furthermore, and contrary to expectations, features of mentation which were expected to differentiate tonic from phasic activity failed to discriminate between phasic and tonic dream reports. The nondiscriminating features were as follows; the emotional (Pivik, 1971) or hallucinatory quality of mentation (Molinari & Foulkes, 1969; Pivik, 1971) as well as subjective depth of sleep or felt bodily presence (Molinari & Foulkes, 1969; Pivik, 1971). In addition, the presence of phasic activity was found to be a weak predictor of enhanced dream recall, although recall is enhanced to some extent, but not significantly (Pivik et al., 1969; Molinari & Foulkes, 1969; Medoff & Foulkes, 1972; Pivik, 1971; Foulkes et al., 1972; Watson, 1972; Foulkes & Pope, 1973; Bosinelli et al., 1973). Features of mentation that were found to significantly and positively discriminate phasic from tonic dream reports were the increased incidence of hostility, self participation, and movement and the decreased incidence of conceptual thought-like material in the content of dream reports.

In 1969 Molinari and Foulkes developed a measure based on specific features of mentation that could discriminate between mentation reports collected during tonic vs. phasic awakenings in REM sleep. Mentation reports were categorized into two groups; reports which represented mental activity depicting either primary visual experiences (PVE) or secondary cognitive elaborations (SCE). PVE's were associated with phasic REM mentation reports and SCE's were correlated with tonic REM mentation reports as well as reports elicited from NREM awakenings (sleep onset stages 1 and 2 and pre-REM ascending stage 2). Reports were scored as PVE if conceptual activity was absent and SCE if conceptual activity was present. That is, a report rated as PVE would be dominated by visual "thoughtless" imagery in the absence of active conceptualizations. SCE's could include visual imagery but have the added dimension of conceptual activity in the form of thoughts, ideas, or verbalizations. A PVE mentation report as one in which the subject passively visualizes an experience, like watching a clock. In order for the dream to be rated as SCE the subject would need to report an additional cognitive activity, like thinking or wondering about the time (with or without the imagery of the clock) (Pivik, 1969).

The numerous methodological problems associated with this study shed a dubious light on the findings; findings proving a direct correlation between physiological events and the quality of mentation. Experimenter bias could have been one factor influencing this outcome. Two of the raters were not blind to the awakening condition that was being scored. In addition, a post hoc analysis of the data was employed. The authors constructed their PVE/SCE scale following data collection. Thirdly, the statistical procedures utilized by the authors may have erroneously contributed to the positive results obtained. For example, the use of a one tailed test substantially increases the probability of finding significant results. Also, as Ellman points out, a better statistic for post hoc analyses in this study would have been the Sheffé test (Ellman-unpublished).

The final methodological flaw evident in Molinari and Foulkes' (1969) study was their failure to control for two variables: time into REM sleep and phasic vs. tonic awakenings. Confounding these two events makes it difficult to tease out the crucial variable underlying variations in the quality of sleep mentation.

Were the differences in mentation the result of increasing phasic activation associated with time into REM sleep? Because phasic activity increases with time into the

REM period, it is easier to obtain REM-M (phasic) awakenings later in REM sleep. REM-Q (tonic) periods are more prominent in the early phase of REM. REM-Q awakenings are therefore made earlier in the REM period while REM-M awakenings occur later on in REM sleep. Kramer, Czaya, Arand, and Roth (1974) found that dream content tends to change over time within the REM period. This finding lends further support to the need for better methodological procedures.

Although Foulkes and Pope (1973) were able to replicate these findings and confirmed the relationship between REM phasic activity and PVE type material, they refuted Molinari and Foulkes contention that REM phasic content is devoid of thought-like mentation. Foulkes and Pope (1973) demonstrated the existence of conceptual activity within REM phasic sleep periods by expanding and thereby modifying their methodology. Molinari and Foulkes' (1969) original method of data collection was based on subject's spontaneous dream reports rather than on direct inquiries regarding the quality of their mentation. In the replication studies (Foulkes & Pope, 1973; Medoff & Foulkes, 1972), subjects confirmed the presence of conceptual activity if asked directly about evidence of material characteristic of SCE mentation. This direct inquiry followed the collection of spontaneous mentation reports. Although they found that spontaneous reports of PVE did discriminate between REM phasic and REM tonic awakenings, their use of additional methods of scaling dreams resulted in findings that were nonsignificant. In addition to a scale of dream bizarreness and the PVE/SCE measure, they used a five point rating scale which measured sensory and conceptual material in gradations (greater to lesser) rather than in terms of the presence or absence of these two variables. By scaling rather than dichotomizing the SCE/PVE measure, differences among the three awakening conditions could not be discriminated. Despite their efforts to compensate for the methodological problems inherent in the previous study (Molinari & Foulkes, 1969), they failed to control for time into the REM period.

Investigators continued to search for phasic events other than eye movements which would differentiate phasic from nonphasic periods in REM sleep. The relationship between additional measures of phasic activity (MEMA's, sawtooth waves, PIP's) and dream content were explored. Investigators of one study reported finding a strong, positive correlation between phasic activity in the auditory system (MEMA's--middle ear muscular activity) and auditory imagery (Roffwarg, Adrien, Herman, Lamstein, Pessah, Spiro, & Bowe-Anders, 1973). In Foulkes and Pope's (1973) replication study they constructed a third awakening condition with in REM that was independent of eye movement activity (ocular quiescence or ocular motility). This condition included a different measure of phasic activity, namely sawtooth waves. Subjects were awakened upon appearance of saw-tooth waves. This wave pattern (2-3 Hz notched waves) is closely associated with eye movements and generally occurs before REM bursts. Saw tooth waves are linked to REM sleep and under "normal conditions" are not found outside of the REM period.

The quality of mentation associated with sawtooth waves was found by Foulkes and Pope (1973) to consist of PVE-type material, like REM phasic mentation, but was also described as more "fragmented" and discontinuous in relation to the content of the material immediately preceding it. The PVE/SCE distinction, however, was not confirmed when sawtooth waves were independent of eye movements in the awakening condition.

Although Foulkes and Pope (1973) found that spontaneous reports of PVE did discriminate between REM phasic and REM tonic awakenings, their use of additional methods of scaling dreams resulted in findings that were nonsignificant as well. In addition to a scale of dream bizarreness and the PVE/SCE measure, they used a five point rating scale which measures sensory and conceptual material in gradations (greater to lesser) rather than in terms of the presence or absence of these two variables. By scaling rather than dichotomizing the SCE/PVE measure, differences among the three awakening conditions could not be discriminated.

Subsequent investigations designed to study the relationship between REM phasic events (PIP's) and REM sleep mentation were implemented. Watson (1972) found that PIPs (Periorbital Integrated Potential), another form of phasic activity, were associated with more bizarreness and discontinuity in the dream report. These results, however, were not replicated by Foulkes and Pope's (1973) study. Again, the lack of consistent results may reflect methodological difficulties (e.g. experimenter bias, failure to achieve adequate levels of inter-rater reliability on bizarreness scale, or the use of instruments that proved unreliable) rather than true differences.

In sum, it can be seen from the empirical evidence gathered thus far, that studies exploring the effects of phasic activity on sleep mentation have supported Moruzzi's (1963) tonic-phasic model. All REM sleep studies report significant differences in sleep mentation reports obtained from tonic vs. phasic periods of sleep. Significant correlations were found between bursts of rapid eye movement and (1) increased activity in the dream (Berger & Oswald, 1962; Dement & Wolpert, 1958; Pivik & Foulkes, 1969) (2) increased "dreamlike" quality of mentation reports as measured by Foulkes DF scale (Ellman et al., 1974) (3) increased vividness and emotionality (Hobson, Goldfrank, & Snyder, 1965; Verdone, 1963) and (4) increased self participation (Bosinelli et al., 1973) etc. However, none of the previous studies was able to identify the crucial factor or an "enduring" psychological characteristic differentiating phasic from tonic content. The accumulated empirical knowledge derived from these studies failed to establish a unified conception of what the phasic event adds to sleep mentation.

Testing the tonic-phasic model as it applies to NREM sleep required researchers to identify physiological measures of phasic activity other than rapid eye movements. Physiological indices other than rapid eye movements were needed due to the relative absence or intermittent, but decreased frequency of rapid eye movements present in NREM sleep, which made it difficult to measure outside of the REM period. Studies attempting to relate measures of phasic activity to mental activity in NREM sleep focused on NREM phasic events such as K complexes, PIPs, theta bursts and phasic reflex inhibition.

K complexes were theorized to represent an analogue of PGO spike in the human due to their temporal distribution (they are most prominent in NREM stage 2 sleep and precede REM periods), and their response to experimental manipulations. The similarity of K complexes to PGO spike activity prompted Pivik et al. (1969) to explore the effect of this kind of NREM phasic activity on the quality of sleep mentation. The authors found that increased frequencies of K complex activity were associated with either a complete absence of recall or with mentation that was considered "more dreamlike." When the density of K complexes was reduced, the quality of mentation varied as well. Mentation reports were described as more thought-like and conceptual, and lacked the hallucinatory perceptual features of mentation derived from high-K complex rates. Mentation from low K complex frequencies could fluctuate in quality from the bizarre to the mundane.

Results of several studies investigating mentation correlates of K complex "phasic activity" found no difference between phasic and nonphasic mentation reports (Weisz, 1972; Antrobus, Ezrachi, & Arkin, 1973; Ellman et al., 1974). Investigators who conducted studies relating PIPs to mental activity reported more positive results (Rechtschaffen, Watson, Wincor, & Molinari, 1972). NREM PIP activity was assessed in four awakening conditions: (1) No PIPs and no tonic periorbital activity (2) PIPs with tonic eye movement activity (3) No PIPs, with bursts of tonic activity (4) PIPs alone. Awakenings during condition 2 (PIPs with tonic activity) and condition 4 (PIPs alone - phasic condition) resulted in mentation reports that were longer and subject to more distortion. Pivik et al. (1971) found differences in mentation associated with awakenings made during the inhibition (phasic) or absence of inhibition of the spinal monosynaptic H reflex (tonic). This resulted in mentation reports that revealed increased hostility and an increased presence of auditory imagery during the phasic awakening condition.

Pope (1973) investigated mentation correlates of a phasic activity known as "theta bursts." Theta waves are low voltage, irregularly patterned waves of 4-6 cps that replace alpha waves in descending stage 1 sleep. Descending stage 1 sleep, or sleep onset, is distinguished from ascending stage 1 sleep by the absence of REM's. REM's are rarely observed in sleep onset whereas the predominance of REM's in ascending stage 1 sleep defines this stage 1 phase as REM sleep. Pope was the first to study the relationship between phasic activity and mentation in the sleep onset phase. The results showed that all three awakening periods (post-alpha, theta burst, post-theta) yielded a high incidence of recall. Furthermore, mentation reports obtained from high amplitude theta bursts were judged to be more "discontinuous" than reports from low-amplitude theta categories. The results of studies attempting to understand the effect of phasic activity on the quality of sleep mentation in NREM sleep were less robust than the results obtained from the REM phasic studies. The NREM studies distinguished some positive but weak phasic-tonic discriminators in NREM sleep mentation such as increased reports of hostility, SCE, auditory imagery and discontinuity. Stronger phasic-tonic discriminators at the psychological level were discovered for REM phasic events;

increases in dreamlike quality, bizarreness, PVE, self-participation, discontinuity, vividness, emotionality and decreases in thought like properties.

What accounts for the discrepancy in the REM and NREM phasic studies may be differences in intensity of REM vs. NREM phasic activity as well as differences in the physiological context in which the phasic events occur (e.g. EEG background activity). It would not be surprising then, for qualitative and quantitative differences in REM vs. NREM mentation to exist as well. In light of the differences in REM vs. NREM phasic intensity relative to "background activity," it may be reasonable to assume that in order for NREM phasic activity to produce any psychophysiological effects, NREM phasic events would have to interact with additional "background" variables (such as frequency of phasic activity, underlying tonic activity, arousal levels etc.) rather than stand alone.

There is one type of "background activity" that is less predictable than the variations that occur in the "predictably" varied patterning of EEG sleep stages. Researchers have, for the most part, overlooked systematic sources of variation that come from individual differences based on ones physiological and psychological make-up, with the exception of a few studies (Schwartz, 1979; Weinstein, 1981). The impact that these variables may have on experimental outcomes was left largely unexplored with the exception of investigations that addressed this problem at the physiological level (Hauri & Van de Castle, 1973; Monroe, 1967; Pope, 1973; Pivik, 1971; Zimmerman, 1970).

Discrepancies in the outcome of studies attempting to examine psychological correlates of phasic activity in REM and NREM sleep may also be attributed to their basic premise which assumes a direct correlation between specific mental content and phasic activity. This may be misleading. New directions in research (Schwartz, 1979; Weinstein, 1981) have indicated that broader, more encompassing psychological constructs are needed which can account for and unify the varied psychological components of dream reports that have been identified thus far (e.g. discontinuity, vividness, bizarreness etc). This issue will be explored in greater depth in the following section; a comprehensive review of the REM deprivation literature. However, whether the tonic/phasic model has outgrown its value or can still function as an explanatory model in light of the new data being generated has not yet been determined. This is an empirical question that can only be answered as the result of further investigations exploring its relevancy.

Chapter III

REVIEW OF THE REM DEPRIVATION LITERATURE

Methodology for RD Studies

In a comprehensive review of the REM deprivation literature Ellman and his colleagues (Ellman, Spielman, Luck, Steiner, & Halperin, 1978) provide a thorough critique of the methodological problems evident in REM deprivation (RD) studies. I will summarize their conclusions in the following sections.

Since the first RD study by Dement (1960), subsequent researchers have adapted a pre-post design as the model for the basic methodology applied to RD research. Dement's (1960) "pre-post design" consisted of several components. (1) Subjects were used as their own controls. That is, each subject underwent the experimental (RD) and control conditions. (2) For the first five nights, subjects were asked to sleep in the lab with out being interrupted during the night. These nights of uninterrupted sleep are referred to as baseline (BL) nights. Dement's (1960) rationale for this procedure was to obtain a stable and standardized "baseline" level of the subject's general sleep patterns (Pre-measure) (3) The experimental RD or control condition came next. In the RD condition, awakenings were performed every time the subject was judged to be in REM sleep. In the control condition, awakenings were performed during NREM sleep. The number of NREM awakenings had to equal the number of awakenings in RD condition. (4) Recovery (R) nights followed the experimental or control condition and were identical to BL night procedure. Subjects were again required to sleep uninterruptedly (Post-measure). (5) Since subjects were used as their own controls, a break of 7-14 days between the RD and control conditions was suggested.

Subsequent researchers have utilized this design and have instituted a number of variations on Dement's original model such as (1) variations in the number of baseline or recovery nights or (2) variations regarding the total amount of time asleep (TST) for each subject. Should the time vary or be held constant?

A number of investigators sought answers to these methodological questions; answers based on empirical evidence from studies designed to determine the specific criteria necessary for RD studies. As a result of these investigations several basic methodological criteria were established for RD experiments.

Criteria for RD Studies

1. It was found that a minimum of three BL nights are required in a pre-post design for RD studies. In order to

establish an adequate and stable "pre-measure" of a subjects sleep patterns, three nights are required to ensure this type of adaptation. It was demonstrated (Agnew, Webb, & Williams, 1966; Dement, Kahn, & Roffwarg, 1965; Rechtschaffen & Verdone, 1964) that the amount of REM sleep is lower on the first BL night than on the following BL nights. In essence, these subjects have been REM deprived to a minor extent. This REM deprivation effect does not stabilize until the third night in the lab (Kales et al., 1969; Ellman, 1969; Fiss & Ellman, 1873). Therefore, by the third BL night a true pre-measure (BL measure) can be obtained. Based on this evidence, Ellman points out that BL values obtained before the third BL night should not be used for statistical comparisons.

2. A minimum of two R (recovery) nights is necessary in RD studies that deprive the subject of REM sleep for as many as 4 nights. The rationale for this number is based on studies that have demonstrated a loss of Stage 3 and Stage 4 delta sleep along with REM sleep deprivation. Agnew et al. (1967) and Ellman (1969) found that depending on the amount of delta sleep lost, a delta rebound could supercede a REM rebound. These investigators demonstrated that a delta rebound was evident on the first R night thus delaying the REM rebound effect until the second R night.

3. Total sleep time (TST) in both BL and R conditions should be held constant. The reason for this is that often

in a pre-post design these two conditions are the basis for comparisons. If the TST in each condition is allowed to vary, it would follow that the amount of REM time would vary as well. As was discussed earlier, as TST increases, so does REM time, since most REM sleep occurs in the second half of the night. If TST was not held constant, comparisons between values obtained on BL and R nights would be spurious due to the confounding of these two variables (TST and REM time).

4. EMG measures should be employed in RD studies. Failure to consistently utilize EMG recordings that measure a drop in muscle tone, can result in subjects accruing several minutes of REM sleep before an awakening. It has been shown that a marked decrease in EMG levels often signals the onset of a REM period.

5. Experimental (RD) and control conditions should be counterbalanced on order to control for "order effects."

6. The final methodological criteria for RD studies is the inclusion of a REM density measure. As was discussed earlier, another measure of REM rebound (aside from the amount of REM time evident on R nights) is the density (number) of eye movements "per unit time." A REM density measure should therefore be used in conjunction with a REM time measure on R nights for assessing REM rebound.

The Effects of RD in Humans

Sleep Cycle Changes and the REM Rebound Phenomenon

Several studies investigated the effect of RD on the sleep cycle. A number of changes in the patterning of sleep became evident to Dement (1960) following his first RD study. The first obvious effect was the presence of a compensation or rebound phenomena evident in the sleep cycle subsequent to RD. That is, subjects displayed increased amounts of REM on R nights (REM rebound). Dement concluded that this suggested a "need" for REM sleep. He based this claim on data that demonstrated a tendency to make up for lost REM sleep on R nights subsequent to RD. This REM rebound effect (increased levels of REM sleep on R nights) was not evident in the NREM control condition. He also found that rebound effects (compensation for lost REM sleep) could extend over a 4-5 day period on R nights. During the RD condition, Dement (1960) observed increases in REM density measures, as well as a need to awaken subjects more frequently in order to prevent then from lapsing into REM sleep. As the person progressed through each night of RD, the number of awakenings needed to accomplish RD increased. Dement (1960) found additional changes in subjects' sleep cycle patterns (following RD). The time span from sleep onset to REM sleep (REM latency) was also altered following RD. Dement discovered that REM latency, the time it takes to enter the first REM period of the night following sleep onset, decreased following RD.

A number of investigators replicated Dement's (1960) study (Kales, Hoedemaker, Jacobson, & Lichtenstein (1964) and were able to demonstrate and verify several of his findings such as (1) the REM rebound phenomena and (2) increased number of awakenings on progressive nights of RD. Elevated amounts of REM sleep on R nights (first or second) were obtained on 19 out of 20 subjects in four separate studies (Snyder, 1963; Kales et al., 1964; Sampson, 1965; Dement, Greenberg, & Klein, 1966;). These studies along with Agnew, Webb, and Williams' (1967) study (comparing REM deprivation to Stage 4 sleep), supported Dement's findings and reported an increase in the number of awakenings necessary for the deprivation of REM sleep. The number of awakenings increased on each additional night of RD in all five studies as well.

Despite these studies unanimous demonstration of the REM rebound phenomena, the methodological and design difficulties evidenced in each experiment bears mentioning at this juncture. For instance, Sampson (1965) questioned Dement's (1960) design by postulating the confounding of two variables in his study; dream (REM) interruption vs. REM deprivation. Were Dement's results due to the effects of dream interruption or RD? Sampson attempted to isolate and compare these two factors in a method he termed "partial sleep deprivation" (PSD). Individuals who were subject to the partial sleep deprivation condition in Sampson's experiment slept 2.5 hours a night for five consecutive nights, thus REM depriving (and NREM depriving) subjects without interrupting REM periods. Since there is a substantial increase in REM time after the fourth hour of sleep, only 10-15 minutes of REM would be lost in the first 2.5 hours of sleep. Subjects in the control condition (dream interruption) were awakened at each REM period (REMP) onset (standard RD procedure). Sampson did not use a NREM deprivation control condition. He found that all 6 subjects experienced a REM rebound following Dement's (1966) standard RD procedure and 4 out of 6 subject experienced the rebound effect as a result of PSD.

Although the methodological problems evident in Dement's (1966) study in which subjects were "partially REM deprived" were discussed earlier the implications of their findings are still significant and should be underscored. Dement and his colleagues found that partially REM depriving subjects over a period of 19 nights resulted in higher REM levels on R night than on BL nights (REM rebound). Aside from demonstrating REM rebound, these investigators concluded that the effects of partial RD accumulate over time and can be stored over time. Subjects who were REM deprived for 5 nights showed these same effects and the same conclusions were drawn. They surmised that the function of

REM rebound then, is to reduce the elevated amounts of REM, which were increased as a direct result of the deprivation of REM sleep. And the only way to reverse RD effects which produce "excess REM" is by REM rebound.

Agnew and his colleagues compared NREM stage 4 deprivation to stage REM deprivation and found that RD leads to REM rebound and stage 4 deprivation leads to a stage 4 rebound. However, one interesting finding emerged. Following the first R night in the Stage 4 deprivation condition a REM rebound effect was evident. Ellman (1978) explains these results as being attributed to a "partial REM deprivation effect" that the investigators failed to account for in their results. He postulated that during the Stage 4 deprivation nights the subjects may have been deprived, inadvertently, of small amounts of REM sleep in addition to stage 4 sleep, as a result of the Stage 4 deprivation procedures utilized in this study. According to Ellman, even a 2% loss of REM sleep, each night, over a 7 night period, would accumulate to 40-50 minutes of lost REM sleep. A loss of this magnitude could account for the REM rebound phenomena in Stage 4 deprivation condition, since 40-50 minutes of REM is equivalent to one half night of RD. REM rebound effects would be expected following such a substantial amount of lost REM time. Ellman's (1978) hypothesis was not able to be verified, however, because Agnew reported only group data. In addition, presenting sleep data in terms of percentages makes it difficult to determine whether TST on BL and R nights was held constant. If subjects were allowed more sleep on R nights as compared with BL nights, then the stage 4 rebound effect could be accounted for by this discrepancy. As was demonstrated earlier, as TST increases so does REM time. Therefore, their REM rebound findings in the NREM sleep condition may be confounded by the failure to hold these two variables constant.

Aside from the methodological limitations noted in the previous studies cited, the cumulative results clearly demonstrate (1) the presence of a REM rebound phenomena following RD as well as (2) an increase in the number of awakenings needed to needed to accomplish RD as RD proceeds across nights (from first RD night to the last RD night). It should be noted that individuals who fail to compensate for lost REM sleep by making up for lost REM time on R nights, are not necessarily "nonrebounders." As Ferguson and Dement (1968) showed, REM rebound is not just a function of the amount of REM time lost. Another way to make up for lost REM time is to increase the frequency of phasic activity that was lost in the deprivation condition. Despite the difficulties inherent in generalizing from animal to human studies, it is logical to assume that if an essential feature of the REM rebound phenomena is phasic activity, then a measure of phasic activity must be included when evaluating REM rebound. REM rebound in this sense, would be defined as the amount of phasic activity per unit time, and could stand alone as a measure of REM rebound without the added presence of increased REM time.

Personality Variables and Individual Responses to RD

The question arises as to whether there are differences in responses to RD that can be systematically accounted for by an independent variable other than RD. For instance, studies have demonstrated variations and inconsistencies in the number of awakenings necessary to awaken subjects in order to accomplish RD as well as variations among subjects in the amount of time spent in REM sleep on R nights (Witkin 1970). Although differences among subjects are expected, investigators wondered if there were systematic differences that could be attributed to psychological variables.

A number of studies looked at individual differences in REM rebound in order to explore the connection between personality variables and an individual's response to REM deprivation (Pivik & Foulkes, 1966; Cartwright, Monroe, & Palmer, 1967; Cartwright & Ratzel, 1972; Nakasawa, Kotorii, Tachibana, & Nakano, 1975; Jovanovic, 1978). Pivik and Foulkes were the first to study this relationship; the correlation between defensive style and individual responses to RD. Their results will be discussed in another section (RD and sleep mentation).

Cartwright and her colleagues (1967) discussed several types of physiological and psychological response patterns to RD. They categorized subjects who showed a REM rebound following RD into the "compensation group" and subjects who did not show a rebound effect (defined as an increase in REM time or a shortened latency to the first REMP) were classified as "substitutors and placed into the "substitution group." Although substitutors did not respond to RD by demonstrating REM rebound effects, subjects in the substitution group reported more "dream-like" mentation on the Foulkes DF scale than the compensation group, when awakened at REM onset during RD. "Substitutors" ability to have more "dreamlike" fantasies seemed to somehow take the place of or "substitute" for REM rebound. Although no REM rebound effects were demonstrated in this group, their tendency to obtain higher (DF) mentation scores shortly after REM onset during RD (i.e. High Onset Fantasizer or HOF's) led Cartwright and Ratzel (1972) to conclude that the crucial psychological variable in determining an individual's response to RD is the extent to which "dream-like mentation is confined to REMPS. "Compensators" who demonstrated REM rebound tended to score lower on DF mentation measures and were classified as "Low Onset Fantasizers." The investigators also found marked changes in the waking mentation of these subjects. LOF's became more responsive to their internal fantasies in their waking state following RD procedures (as measured by a rise on WAIS scores and 2 Rorschach measures) than they were previous to RD. LOF's, who were initially more responsive to external stimulation showed greater increases in their scores than HOF's, who tended to have higher scores and thus, according to these investigators, higher access to their fantasies initially. That is, HOF's who were initially sensitive to their internal fantasy scored high to begin with and showed no changes in their waking mentation following RD. Nakasawa et al. (1975) also found a relationship between personality variables and an individual's response to RD. These authors reported that introverted neurotic subjects showed almost no increase in REM sleep on R nights whereas extroverted nonneurotic subjects demonstrated more REM rebound than introverted subjects.

As Ellman (1978) points out, these studies were replete with methodological difficulties including failure to control for TST, inadequate number of BL nights, lack of REM density measures etc. Their findings are therefore inconclusive in that these investigators were unable to determine to any significant degree "systematic" psychological variations in an individuals' responses to RD. However, they were seminal in laying the foundation for further investigations examining the interaction of physiology and psychological variables in subjects' responses to RD. These studies were successful in suggesting possible factors inherent in personality measures of subjects who did not show a REM rebound following RD. "Nonrebounders" tended to (1) be more responsive to internal fantasy (2) and were influenced more by internal percepts than the external environment. It follows that subjects who are more responsive to their internal world would score higher on tests that measure these variables such as Rorschach M responses (which reflect responsiveness to inner vs. outer stimulation), Maudsely Introversion Scales, measures of field dependence, and sensitization scores on the Byrne R-S scale.

In a well controlled study, Weinstein (1981) was able to demonstrate individual differences in the patterns of REM mentation following REM deprivation. By systematically evaluating variables such as a subject's mode of reporting anxiety producing thoughts (i.e. reporting style in their waking state) Weinstein concluded that a subjects reporting style is one factor among many that determines the quality of the mentation report. She disputes the idea of a strict psychophysiological correspondence, as do the previous researchers who investigated individual differences (Pivik & Foulkes, 1966; Cartwright et al., 1967; Cartwright, 1972; Nakasawa et al., 1975), and provides data supporting a multifactor model which views physiology as only one "instigator" of a mentation report. Her findings suggest that a personality variable such as reporting style is a crucial "intermediate variable" that comes between physiological contributions to mentation and the resulting mentation report.

Weinstein found that (1) subjects who focused on or reported anxiety producing thoughts (High Access Fantasizers = HAF's) in their waking state failed to show changes in REM mentation subsequent to RD and (2) the tendency of subjects not to report anxiety producing thoughts (Low Access Fantasizers = LAF'S) resulted in decreased levels of absorption in REM mentation on R nights following RD and an increase in the subjects level of absorption in their REM mentation on deprivation nights. The latter effect was not observed in the NREM deprivation condition. Weinstein (1981) was able to discriminate differences among subject groups (HAF's and LAF's) only by applying scales that measured the extent to which a subject was able to lose himself in a mentation experience resulting in a loss of reflective awareness. Previous investigators have utilized scales that measure aspects of self-observation. Weinstein (1981) demonstrated that varying operational definitions of self-participation and variations in the rating of this construct can explain the contradictory results obtained among studies. The loss of reflective self representation as defined by Schwartz (1978) and Weinstein (1981) and the corresponding scales designed to measure the degree of absorption in mentation were demonstrated to be more sensitive in discriminating this critical aspect of sleep mentation than other scales used in sleep mentation studies. Weinstein also demonstrated a correspondence between a physiological event (phasic activity) and psychological construct (self-participation) via these scales. Weinstein's methods and findings will be discussed in greater depth in Chapter 4 (methodology).

RD in Schizophrenia and Depression

Presently, there has been a great deal of research investigating the relationship between personality variables and an individual's response to RD in populations with psychopathology. The populations which have been investigated include patients with schizophrenia and patients with endogenous depression. Schizophrenic populations were of particular interest in light of early comparisons of schizophrenic forms of thought to mentation evident in the dream process (Bleuler, 1890). With the advent of the discovery of REM sleep, researchers wondered whether this population was suffering from abnormalities in REM sleep. Initially they posited that in the active stage of the illness schizophrenics would not display REM rebound whereas once the illness was in remission, schizophrenics would have larger than normal REM rebound (Azumi, 1967; Zarcone et al., 1968, 1969; Gillin, 1974; Zarcone, 1975). Despite several studies exploring this hypothesis, only one study yielded solid evidence supporting this theory (Gillin, 1974). However, serious methodological flaws rendered the findings of this study questionable.

Depressive populations were studied to determine whether RD was effective in lessening endogenous depression. It was demonstrated that a subgroup of endogenous depressives clinically improved after a period of RD, leading researchers to conclude that they had successfully identified one mechanism for treating a subgroup of depressives (Vogel & Traub, 1968; Vogel, Thurmond, Gibbons, Sloan, Boyd, & Walker, 1975). Interestingly, the rate of improvement observed in REM deprived patients was similar to the rate of improvement observed in patients treated with imipramine, a REM suppressing agent. However, these results should be interpreted with caution since many of the conclusions were based on a small N and post hoc analysis.

RD and Waking Fantasy

Previous research has made it difficult to properly evaluate the effects of RD on psychological variables due to the neglect of investigators to isolate specific questions that were formerly fused and thereby confused. Ellman divided these issues as follows; (1) Can REM deprivation result in psychosis or "regressive" behavior? That is, what, if any, are the harmful psychological effects of RD? (2) Can RD effect fantasy and waking behavior?

Studies have shown that RD is in no way harmful to one's mental health. Although studies in the early 1960's (Dement, 1960; Dement & Fisher, 1963; Rechtschaffen & Maron, 1964) attempted to demonstrate that RD resulted in increased anxiety and irritability, decreased ability to concentrate, and evidence of psychotic-like symptoms such as increases in bizarre behavior and suspiciousness, subsequent investigations refuted these findings based on flaws in their methodology (Vogel, 1975; Albert, 1975; Dement, 1969). These studies failed to use proper controls (e.g. no NREM control awakenings was used; experimenters and subjects were aware of the purpose of the experiment and were not "blind" to the experimental condition), utilized amphetamines which confounded RD effects with drug effects, and reported data in an unsystematic way (used anecdotal data vs. psychometric data).

Three studies investigating changes in fantasy and waking behavior following RD reported contradictory findings. Kales et al. (1964) study which explored the effects of RD on motor performance found no behavioral changes on performance subscales of the WAIS (digits forward and backward) as well as other tests such as the Stroop color work test, word association test MMPI, Clyde mood scale etc. Agnew, Wilse, Webb, and Williams (1967) support these findings and report no significant effects on motor behavior following RD. In contrast, Sampson (1966) found behavioral changes which he concluded could be attributed to the effects of RD. Sampson's subjects showed a general increase in "oral" needs such as hunger and smoking as well as changes in their sense of reality following prolonged RD. However, Sampson failed to explain his measure of "orality." In addition, no control group was utilized by Sampson. In a 6 day RD study it was found that subjects showed an increased tendency to focus on internal rather than external events in response to RD procedures (Clemes & Dement, 1967). Tests that measure fantasy production such as a projective story-like TAT test and the Holtzman Ink Blot, detected increases in the intensity of need and feeling as well as increased "pathognomonic verbalizations." Clemes and Dement (1967) interpreted these responses as reflective of an increase in internal stimulation or "drive" as a result of RD. They concluded that increases in drive result in concomitant increases in "fabulized responses." These type of verbalizations are indicative of an increased sensitivity to internal feelings as well an increased ability to allow these feelings into awareness. In addition, the authors reported that the effects of RD (increased drive) manifests itself in (1) fewer movement responses (2) and decreases in form appropriateness on the Holtzman. Since the ability to perceive movement on this test is indicative of good "ego control" according to Holtzman, then a decrease in movement responses represents a decrease in the ability to control internal perceptions following RD. A decrease in form appropriateness, according to the authors represented the subject's increased tendency to deflect attention away from external events toward internal events as a result of increased "drive" following RD. Although a NREM condition was used and conditions were counterbalanced, only 6 subjects participated in this study. These results should be interpreted cautiously until a replication study is completed.

Ellman (1978), in part, attributes contradictory findings in studies that explore the effects of RD on psychological variables in the waking state, to the different measures used in these studies. For example, Lerner (1966), in contrast to Clemes et al. (1967) reported an "increase" in human movement responses on the Rorschach as well as an increase in body dissolution imagery following RD. Lerner's study (cited in Ellman, 1978) reported findings that suggest certain aspects of REM (dreaming) enhance appropriate body image. Therefore, the deprivation of REM (dreaming), according to Lerner, not only yields increased amounts of projected movement, but results in distortions in the percept that is projected. This is seen in the form of more disintegrated body percepts. Appropriate RD control procedures were absent in this study. Subject groups were not matched properly and the data was not scored by "blind raters." The author confounded her results further by using amphetamines to REM deprive subjects, and by using barbiturates to help them sleep, thus confusing RD effects with drug effects.

Feldstein (1972) and Cartwright and Ratzel (1972) support Lerner's findings (increased M+) and contradict Clemes and Dement's findings (cited in Weinstein, 1981). Cartwright et al. (1967) report an increase in movement responses on the Rorschach, and explain their results in terms of subjects' increased responsiveness to inner vs. outer stimulation following RD, as do Clemes and Dement's study (as cited in Weinstein, 1981) who report opposite findings; a decrease in human movement responses on the Holtzman Inkblot test following RD. Since Clemes and Dement (1967) view the ability to perceive movement as indicative of "good ego control" then fewer movement responses following RD reflects a reduction in the "ability to control internal perceptions." This is in line with Greenberg et al. (1970) who demonstrated disruptions in subjects' ego defense structures following RD. Although both studies (Greenberg et al., 1970; Clemes & Dement, 1967) support "classical Freudian" drive theory, Greenberg explains his results via an information processing model rather than a discharge model of sleep where REM is associated with "primary process" thought and can function as a "vehicle for the discharge of drives" (Weinstein, 1981).

Clemes and Dement (1967) attribute subjects' increased focus on internal events following RD to "increased drive," whereas, Cartwright and Ratzel (1972) link their findings to subject variables. Cartwright and Ratzel (1972) report increased responsiveness to internal stimulation following RD (increased M+) only for particular subject "types." RD effects (increased movement responses) were seen only in LOF's, that is, only in subject's who demonstrated a REM rebound.

Ellman (1978) suggests that the disparate results may be attributed not only to the use of different measures, but to the interaction between subject variables and the amount of RD. Perhaps Dement's subjects were equivalent to the HOF's in Cartwright's study who failed to show an increase in movement responses or a REM rebound. Since Clemes and Dement's (1967) subjects participated in a 6 day RD study in contrast to Cartwright and Ratzel's (1972) subject's who underwent 3 days of RD, the amount of RD may be a crucial variable in accounting for the opposite effects in these studies.

Despite the contradictions evident in these studies, it is clear from the data presented that subject variables are fundamentally related to physiological and psychological responses to RD in the waking state and should be accounted for when looking at the effects of RD on waking psychological variables. Few studies of these studies have considered individual differences when looking at RD effects. In addition, the number of subjects used in these studies was small and the measures and procedures implemented varied from study to study (e.g. type of measures, scoring procedures, number of RD nights). This makes comparisons among these studies difficult, if not impossible. Although comparisons are difficult, and explanatory models of sleep differed in each of these studies, neither discharge models or information processing models (Lerner & Glaubman, 1975; Glaubman, Orbach, Aviram, Freider, Freeman-Pelled, & Glaubman, 1978) took into account the question of individual differences as it relates to modes of thinking and a physiological process. As Weinstein (1981) suggests "modes of cognition may be tied to a physiological parameter to a varying degree for different individuals." It follows that baseline measures of a subject's ability to access certain types of cognition (fantasy, primary process thinking etc.) are crucial and were left unexamined in these studies. However, these studies do suggest directions for further research by demonstrating that tests that measure fantasy or "imaginal processes" are better than tests which assess motor functioning as a measure of RD effects on waking variables. Subsequent researchers (Schwartz, 1979; Weinstein, 1981; Weinstein & Schwartz, 1988) have attempted to examine and specify particular psychological constructs that underlie fantasy material which changes following RD (e.g. reflective self representation). Specific changes in fantasy material in the sleep state following RD will be discussed in greater depth below.

RD and Sleep Mentation

Few studies to date have investigated the psychological function, if any, of the dream experience; that is, is there a psychological "need" for vivid dreaming as Freud contends (1905) and if so, how could it be empirically investigated? Dement (1960) as well as subsequent researchers demonstrated a "physiological need" for REM sleep by demonstrating a REM rebound phenomena (the tendency to compensate for lost REM sleep following RD), but few researchers have explored the issue of compensation for the dream experience following deprivation of REM sleep.

Previous research has shown that physiological events associated with REM (specifically manifestations of phasic activity) such as penile erections (Fisher, 1966), REM bursts (Sampson, 1965), PGO spiking (Ferguson & Dement, 1969) etc. can be dissociated from REM sleep into NREM sleep. If certain aspects of REM associated physiological activity can be detached from specific physiological states (REM), and intrude into other states of sleep (Sampson, 1966; Barros-Ferreira, Goldsteinas, & Lairy, 1973) to what extent are different psychological experiences inextricably linked to specific physiological states? In other terms, would RD also result in increases of REM-type mentation in NREM sleep?

In contrast to early conceptions of sleep which associated REM periods with dreaming and assumed a NREM "mental void," current research has demonstrated that dreaming is not limited to REM sleep alone (Foulkes, 1967; Schwartz, Weinstein, & Arkin, 1978). Not only have significant amounts of dreaming been observed in Stage 2 and Stage 1 NREM (sleep onset), but investigators have also reported "dream-like" (i.e. hallucinatory or regressive) mentation in subjects who were "awake" as determined by EEG, EOG and subjective criteria (Foulkes & Fleisher, 1975). Foulkes and Fleisher's study supports the notion that brief intrusions of vivid and bizarre mentation into waking thought occurs as well, even without specific deprivation procedures.

Since dreaming has been shown to occur in REM as well as NREM sleep, the question as to whether REM deprivation is equal to dream deprivation is "obsolete." The more relevant issue, as Arkin points out (Arkin, 1978), is the extent to which "REM deprivation equals deprivation of REM-associated dreaming." Under RD conditions, will the psychological experience of vivid dreaming which is normally associated with REM sleep become dissociated from this sleep state, as was demonstrated physiologically, and occur in other psychological states? And will sleep mentation become more intense when increased levels of physiological activity are present, (particularly phasic events) as a result of RD?

As was discussed earlier, the results of previous research suggesting the intensification of REM or NREM sleep mentation following RD were equivocal. Several studies reported negative findings (Antrobus, Arkin, & Toth, 1970; Carroll, Lewis, & Oswald, 1969; Firth, 1972; Foulkes, Pivik, Ahrens, & Swanson, 1968). Pivik and Foulkes (1966) were the first to examine the question of whether dream content would intensify following RD. I will review their methods and results in some depth since their methodological procedures were inadequate in assessing the effects of RD on REM sleep mentation.

Pivik and Foulkes (1966) deprived 20 subjects of REM sleep. Five RD awakenings were performed on the same night that mentation report awakenings were obtained. These 20 subjects were chosen on the basis of their scores on the Bryne Repression-Sensitization scale of the MMPI. They selected 10 subjects who scored on the repression end of the scale and 10 subjects who scored on the "sensitization" end of the scale.

Pivik and Foulkes (1966) found that an individual's style of defense in response to anxiety producing thoughts as measured by the Byrne Repression-Sensitization scale of the MMPI, determined the level of absorption in their internal experience. Subjects who were referred to as "sensitizers" reacted to anxiety producing thoughts by focusing in on them. They were considered by Pivik and Foulkes (1966) to be individual's who were, in general, more focused on their internal life. Sensitizers showed no "significant" response to RD where as subjects who were categorized as "repressors" and who attempted to keep anxiety producing thoughts out of awareness, showed a REM rebound and a "significant" increase in their fantasy activity in REM sleep on R nights.

Ellman's analysis of the data revealed that when sensitizers and repressor groups were evaluated together, statistical significance was obtained on these combined scores. In addition, the measure used to score dream content may have been insensitive to REM mentation reports. Their measure, the Foulkes DF scale (Foulkes, 1965) was developed to rate NREM mentation, not REM mentation, and as such, may not be constructed in a way that can adequately assess the distinct or more detailed characteristics of REM dream content. Furthermore, "sensitizers" tended to have higher REM reports (as measured by the DF scale) to begin with than "repressors." This being the case, perhaps this scale was unable to detect heightened dream intensity due to the scales initial lack of sensitivity to REM reports. That is, the Foulkes DF scale has a "low ceiling" for REM reports.

Foulkes and Pivik (1968) in an attempt to replicate and extend the findings of the previous study, used a cross-night rather than with-in night design. The investigators examined the effects of RD on REM sleep mentation on the night subsequent to the RD night. Only "repressor" subjects participated. The findings were negative in that intensification of the dream experience was not reported in either REM or NREM sleep following RD. No significant differences in the quality of mentation reports were found between the experimental REM deprivation condition and the NREM deprivation control condition on R nights. REM rebound effects following RD were absent as well as a reported lack of a shortened latency to the REMP. These results can be explained by several factors; failure to use BL measures, thus enhancing first night effects, and failure to use sufficient number of R nights, as well as the reduction of TST to 6 hours thereby eliminating a significant amount of REM time. These methodological inconsistencies contributed to the limitations of this study because it was not clear whether the effects were due to the independent variable being manipulated (RD) or to the aforementioned confounding variables.

Dement (1969) REM deprived 6 subjects for 6 consecutive nights and analyzed R night mentation reports for both deprivation conditions; REM and NREM conditions. He found that mentation reports elicited from the RD condition were "more active" than reports obtained from the NREMD control condition. Dement performed a preliminary analysis on this data and discontinued the study without reporting any methodological information.

Studies that investigated enhanced NREM dream content during RD reported consistent but negative results (Antrobus et al., 1970; Arkin, Antrobus, Toth, & Baker, 1968; Foulkes et al., 1968). Arkin and his colleagues (1968) explored the effects of RD on NREM mentation and refuted the hypothesis that RD effects sleep mentation. Twenty subjects judged to be good dream recallers and light sleepers participated in this well controlled study. Arkin's methodological procedures will be outlined in detail in Chapter 4 (Methodology). His findings revealed that there were no significant differences between the two deprivation conditions: i.e. REM and Stage 2 deprivation nights. The comparisons of mean ratings showed no significant effects of these experimental conditions on sleep mentation.

Arkin's "negative" findings can be explained by several factors that were not taken into consideration in this study; individual differences and choice of scales used to measure the dependent variable. Data currently exists which strongly suggests that individual differences should be taken into account when examining the effects of RD on sleep mentation (Schwartz, 1979; Weinstein, 1981). In addition, Arkin's use of the DF scale may have been inadequate in measuring the effects of RD on sleep mentation since the DF scale combines several elements of a dream report into a single score. The failure of the DF scale to consider separately such components as how real the dream felt, hallucinatory elements, bizarreness, and conceptual vs. perceptual aspects of mentation, can partially explain Arkin's results, or lack of them. Vogel, Foulkes, and Trosman (1966) showed that these components of dream reports do not necessarily correlate with one another. For example, a sleep onset mentation report that is bizarre or regressed and dreamlike in some ways, was found to be less dreamlike in another way; e.g. the dream experience was judged to feel less real. As Schwartz (1979) demonstrated subsequent to Arkin's (1978) findings, one component of the dream report, how real the dream feels, is subject to variation from person to person and varies between sleep stages. We have also seen in our review of the phasic/tonic model of sleep that there is an increase in phasic activity outside of REM following RD (Rechtschaffen & Chernick, 1972; Roffwarg, 1975). Preliminary data strongly suggests that mentation scales which are able to differentiate phasic vs. tonic arousals are better at detecting the effects of RD on sleep mentation in REM as well as NREM sleep (Schwartz, 1979; Weinstein, 1981). Therefore, the lack of such scales in Arkin's study may account for the nonsignificant findings obtained since the "choice of task" has been found to be crucial in RD studies.

In 1979, Schwartz (1979) attempted to study the effects of phasic activity on the quality of sleep mentation. He demonstrated that phasic activity correlates with a specific quality of sleep mentation, referred to by Schafer (1968) as the suspension of reflective self representation. Schwartz (1979) hypothesized that phasic activity contributes to the loss of reflective self representation; that is, the loss of the ability to perceive oneself as the thinker of ones thoughts or fantasies. The concept of reflective self representation and its concomitant loss during REM phasic events could, according to Schwartz (1979), account for the varied psychological components of dream reports that have not yet been unified. Schwartz (1979) reasoned that if the loss of reflective self representation contributes to a greater immersion in ones thoughts or fantasies to the point of perceiving them as "real" events with "real" consequences, then this type of mentation would in turn be (1) more emotional (2) more vivid (3) more bizarre (4) involve more self participation (5) less conceptual (6) more dreamlike. Mentation that is reacted to as if it is external and "really happening" is the sine qua non of the loss of reflective self representation and would therefore include these diverse qualities of mentation. The author posited that the loss of reflective self representation could, in fact, function as an overriding concept that would account for and unify the seemingly broad array of psychological variables (e.g. bizarreness, vividness etc.) that are considered to be manifestations of phasic activity.

In a 4 baseline night study using 20 subjects, Schwartz (1979) collected 715 mentation reports from phasic and tonic awakenings in REM and NREM phases of sleep. Mentation reports were rated on 7 scales thought to measure the suspension of reflective self representation. In addition, personality traits were assessed utilizing the MMPI and Imaginal Processes Inventory as measure of social desirability response bias and daydreaming patterns of subjects. He was able to demonstrate that the suspension of reflective self representation was significantly related to (1) REM sleep as opposed to NREM sleep (2) and more specifically phasic intervals as opposed to tonic periods with in REM sleep. These findings were significant only on scales that were more sensitive in discriminating the degree of absorption in mentation (AIM scales) than scales used in previous sleep mentation studies (Foulkes DF scale, SCE/PVE scale).

In support of Schwartz's (1979) findings, but in contrast to Arkin's (1978) initial results which found no effects of RD on sleep mentation, Weinstein (1981) was able to demonstrate significant positive effects in an extension study based on Arkin's original data. Weinstein analyzed data obtained from the first night of a 3 deprivation night study. She found a correspondence between phasic activity and the loss of reflective self representation by utilizing scales that measured the loss of reflective awareness with greater specificity than scales (e.g. DF scale, SCE/PVE scale) that merely alluded to some partial aspect of this psychological construct. Both the DF scale and the SCE/PVE scale failed to discriminate phasic from tonic awakenings within REM when the proper controls were instituted; i.e. time into the night and time into the REM period. Weinstein reasoned that Arkin's (1978) failure to find significant results was based on a combination of factors; using less sensitive measures and instituting proper controls, which further weakened the discriminating power of the DF and SCE/PVE scales.

Weinstein (1978) found that out of the five (AIM's) scales developed to measure what was considered to be the principal aspect of the dream experience, self participation (Schwartz, 1979) only three were able to discriminate phasic from tonic awakenings; the Global scale, the Self Representation scale and the Reality scale. In addition, the Global and Reality scales were able to discriminate both REM from NREM awakenings as well as phasic from tonic awakenings, although the Reality scale was a good phasic/tonic discriminator for a subgroup of subjects only. According to Weinstein, these two scales can distinguish a variety of conditions because they are sensitive to both the intensity of the dreamers absorption in the mentation experience (which includes how real the experience felt to the dreamer, vividness etc.) as well as the loss of self-reflection. However, the Self Representation scale only discriminated REM phasic awakenings. The unique variance displayed in this scale suggested to Weinstein that the loss of self reflection is a factor that is "independent from the more general category of "dreamlikeness" that distinguishes REM from NREM" (Weinstein, 1988). The Self Representation scale was particularly sensitive to decreased levels of self reflection hypothesized to correlate with REM phasic activation.

Rationale, Hypotheses and Predictions

Although researchers have investigated the effects of RD on sleep mentation, no one has replicated Weinstein's (1981) findings using the AIM scales (which measure the theoretical construct of reflective self representation) or using comparable methodological procedures. It is only by employing well controlled and comparable methodological procedures that certain aspects of sleep mentation can hope to be explained, and meaningful comparisons among studies can be made. Although other investigators have obtained results that support the assumption that self participation is a fundamental component of the dream experience

(Bosinelli, Cicogna, & Molinari, 1974; Foulkes & Schmidt, 1973; Purcell, Mullington, Moffitt, Hoffmann, & Pigeau, 1986), the different scales used by investigators to rate self participation makes comparisons among studies impossible. Each of the studies cited operationalized the concept of self participation in different ways and employed different methodological procedures which further compromised a unified working definition of the psychological construct of self reflection.

Weinstein (1981) based her results on data obtained from night 1 (Early and Late) and night 2 (Early) of a 3 night RD study. However, what is the effect of RD on sleep mentation (REM and NREM) as RD continues across nights? To date, no one has explored the prolonged effects of RD on sleep mentation in a well controlled study utilizing scales that have been shown to discriminate phasic from tonic awakenings and are sensitive to the loss of reflective awareness. The question arises as to whether prolonged RD will lead to greater absorption in sleep mentation as a result of the decreased self reflection that is hypothesized to correlate with increased levels of phasic activity evident following RD. Stated more simply, will the prolonged effect of RD on mentation across nights result in an increase in the "dreamlikeness" of REM and NREM mentation as measured by scales which assess a subject's absorption in his dreaming process? The following study addressed these questions, and may shed light on the crucial role that phasic activity plays both physiologically in response to RD and psychologically in its contribution to mentation qualities. Examining how these two functions are related may broaden our understanding and contribute to the study of psychophysiology and the field of sleep research.

I attempted to examine the response to RD in terms of changes in REM and NREM mentation following RD. Changes in the quality of sleep mentation were assessed in terms of a specific psychological construct, reflective self representation as defined by Schafer (1968). It is the "suspension" or loss of this ego function that leads to the feeling of reality in dreams and allows the dreamer to view his thoughts as concrete reality. It has been shown that phasic activity is correlated with the suspension of reflective self representation in dream reports obtained during BL nights and the first night of RD (Schwartz, 1979; Weinstein, 1981). More specifically, the suspension of reflective self representation was significantly related to REM (vs. NREM) sleep on BL nights and to phasic intervals with in REM sleep on BL nights. It has also been shown that phasic activity is displaced into NREM sleep during RD.

Since phasic activity increases ones susceptibility to the loss of reflective self awareness, it is my hypothesis that the occurrence of phasic activity will lead to progressive decreases in self reflection as RD proceeds across nights. I assessed mentation reports obtained from the second (Late) and third (Early and Late) RD nights and compared them to mentation reports collected on control (NRD) nights.

RD effects on mentation were expected only on scales which were shown to be good discriminators of phasic vs. tonic activity during RD; AIM scale (Global, Reality and Self Representation scale). The Foulkes DF scale (1965) and the Molinari and Foulkes (1969) SCE/PVE scales are included because they have been frequently used in previous sleep mentation studies and were cited as discriminating phasic from tonic awakenings. However, based on Schwartz (1979) and Weinstein's (1981) findings, these scales are able to distinguish REM vs. NREM dream reports but are not expected to discriminate phasic vs. tonic awakenings following RD. They are being used in this study for validation and comparison purposes only. My predictions are as follows:

HYPOTHESES I: REM deprivation will make REM tonic mentation look more like REM phasic mentation as measured by scales (AIM) that measure a subject's suspension of reflective self representation.

Empirical Prediction

Ia. Tonic REM mentation reports from the second (late) and third (early and late) RD nights (RD2 (L) and RD3 (E&L)) will be scored higher on the AIM scale than tonic REM mentation reports from the second (L) and third (E&L) NRD nights (control nights).

Ib. Phasic REM mentation reports from both RD2 (L) and RD3 (E&L) nights will be scored higher on the AIM scale than phasic REM mentation reports from control nights (NRD2 (L) and NRD3 (E&L)). Due to ceiling effects, this outcome will be demonstrated only in a subgroup of subjects, who were judged to be Low Access Fantasizers (LAF's) as determined by scores on a scale (Imaginal Process Inventory - "IPI") that measures waking patterns of mentation (i.e. waking fantasy).

Ic. For 1b. and 1c., AIM scales will make the hypothesized discriminations significantly better than will other mentation scales (e.g. DF scale and SCE/PVE scale).

HYPOTHESIS II: REM deprivation will significantly increase the REM-like aspects of NREM mentation on scales that measure a subject's loss of reflective self representation.

Empirical Predictions

2a. NREM mentation reports from experimental nights (RD2 (L) and RD3 (E&L)) will be scored higher on the AIM scale, than NREM mentation reports from control nights (NRD2 (L) and NRD3 (E&L).

HYPOTHESIS III: The AIM scale will discriminate these differences (NREM mentation in RD vs. NRD), better than the other two scales; the DF scale and the SCE/PVE scale.

Chapter IV

METHODOLOGY

The data used in this study was generated from the Arkin, Antrobus, and Ellman research project (1978). It was made available for purposes of analyzing raw data that has remained unexamined since the completion of the project. Arkin's et al. (1968) experimental paradigm is summarized below, along with mentation collection procedures and statistical treatment of the data. A more detailed description of the experimental paradigm (including deprivation criteria) and procedures used in the collection of raw data are contained in the appendix.

Arkin's et al. (1978) RD study was designed to correct for the methodological limitations evident in previous RD research projects. Unlike other investigators (Molinari & Foulkes, 1969; Foulkes & Pope, 1973), Arkin et al. (1978) controlled for time into the REM period and instituted adequate BL measures. The RD procedures were successful as evidenced by the decline in REM sleep percentages from 20-28% range seen in a normal nights sleep, to the 3-4% range displayed on RD nights. This represents an improvement over previous investigations (Foulkes, Pivik, Ahrens, & Swanson, 1968).

Experimental Procedures

The purpose of Arkin's (1978) study was to assess the effects of RD on NREM mentation. Twenty male undergraduate students who were judged to be light sleepers and good dream recallers participated in this investigation at the CUNY-CCNY Psychobiological and Sleep Laboratory. Each subject was administered four personality tests; the basic clinical and validity scales of the MMPI, 2 subscales from the Imaginal Processes Inventory (Singer & Antrobus, 1972), the Maudsley Personality Inventory, and the Witkin Rod and Frame Test. Items which make up the two subscales of the IPI (Acceptance of Daydreaming and Guilty Daydreams scales) are contained in the appendix.

Subjects were used as their own controls and were required to undergo both the experimental (RD) and control (NRD) conditions. Both conditions were counterbalanced for the purposes of controlling for order effects. Two unrecorded and one recorded adaptation night as well as two BL nights were used initially and mentation reports were obtained on all nights subjects slept in the sleep laboratory beginning with the first recorded adaptation night. No mentation reports were collected during the 3-8 day rest period separating experimental from control conditions. The experimental schedule is outlined in the chart below.

	UNRECORDED	RECORDED			
[Schedule]	Adaptation	Adaptation	BL	RD	R
[Night]	1 2	3	4 5	6 7 8	9

[Schedule]	Rest Period	Mid.Bl	NRD	R	Term.Bl
[Night]	3 8 days	10 11	12 13 14	15	16 17

Mentation Report Schedule

Nine mentation reports were collected for each subject for 17 nights (17 nights excludes the rest period). The first mentation report was obtained during the first sequence of rolling eye movements (i.e. sleep onset NREM report). The subject was then allowed a "silent interval" and was not awakened again for 70-90 minutes.

Following this period of uninterrupted sleep, the remainder of the night was divided into 2 equal "active" intervals during which time 8 additional mentation reports were collected. During each of these 2 "active" intervals (early vs. late), 1 REM and 3 stage 2 mentation reports were obtained. The collection of REM and Stage 2 reports were counterbalanced in each interval (See appendix). REMP reports were obtained by awakening subjects 2-4 minutes after REMP onset. One REM report was obtained from a phasic REM period (REMP) and one REM report was collected from the tonic phase of REM sleep. Phasic REM was defined as three rapid eye movements within a 4 second interval. Tonic REM was defined as the first 30 second interval following 1 1/2 minutes of the REM period without REM's. Mentation reports collected from each stage 2 awakening were spaced 15 minutes apart and were elicited from the subject at least 15 minutes after the termination of the last REMP. Equal numbers of stage 2 mentation reports were collected from both tonic and phasic periods of stage 2 sleep. Phasic NREM periods included the presence of phasic EMG suppressions and/or K complexes. Tonic NREM was defined as at least one minute after any EMG suppression, or 20 seconds after any K complex.

Mentation Report Selection

Mentation reports were selected from 2 RD nights (i.e. the second (Late) and third (Early & Late) RD nights in the experimental condition) and 2 NRD nights (the second (L)and third (E&L) NRD nights in the control condition). NRD nights were selected as a comparison group to RD nights. On NRD nights, time of night and time into Stage 2 were controlled for as compared to the experimental condition which controlled for time of night and time into the REM period. In this study, mentation scores from the second (L) and third (E&L) NRD nights were compared to scores from the second (L) and third (E&L) RD nights in an attempt to assess an increase in the "dreamlikeness" of REM and NREM mentation across nights following RD.

Mentation Report Scoring Procedures

Schwartz (1979) and Weinstein (1981) demonstrated that AIM's subscales when factored together or taken separately, discriminate tonic and phasic awakenings. Strong intercorrelations exist among these subscales. Each mentation report was assessed for "self participation" on three Absorption In Mentation subscales--the Reality scale, Global scale and Self Representation scale (Schwartz, 1979). Two additional scales were used to provide comparisons for Hypothesis IC and III; the Foulkes DF scale, and Molinari and Foulkes (1969) SCE/PVE scale.

Arkin's (1984) study produced 1,600 mentation reports in total. Two hundred and twenty five mentation reports were collected from the second (L) and third (E&L) nights of RD and 226 mentation reports were collected from the second (L) and third (E&L) nights of NRD. A number of reports were discarded from the data analysis and were classified as "no report" on the AIM scale and SCE/PVE scale if the subject was unable to recall what was going through his mind when awakened. Fifty-four mentation reports were rated as having no content for the Reality Scale, 39 reports were rated as having no content for the Global Scale, 27 reports were classified as "no report" on the Self-representation scale, and 51 reports were rated as having no content on the SCE/PVE scale. The DF scale scoring system, however, includes a rating for "no content" reports. Therefore, all mentation reports for the DF scale were included in the data analysis. The 225 RD mentation reports were shuffled into an approximation of a random order along with 226 mentation reports collected from the second (L) and third (E&L) nights of the NRD condition and 250 sleep onset mentation reports.

For the purposes of this study, mentation reports were scored the same way as in Schwartz (1979) and Weinstein's (1981) studies. Mentation reports were scored by two independent judges who were blind to night, subject characteristics and condition. Interrater reliability for each of the 5 scales was assessed via product-moment correlations for the continuous scales (Reality scale, DF scale) and by tetrachoric correlations for the dichotomous scales (Global scale, Self Representation scale and SCE/PVE scale). This was done for 30 randomly selected mentation reports obtained from BL, R, RD1 and NRD1 nights (i.e. nights other than the ones used in the present study). Reliability data are contained in Table 1.

Mentation reports were collected in the manner outlined previously (specific scoring procedures are contained in the appendix) and were recorded and transcribed verbatim. Subjects were asked 5 questions when awakened.

1. What was going through your mind just before you were awakened?

2. Any more to this?

Table 1

Interrater Reliabilities

	Rater #1 with Rater #2	Rater #1 with Previous 2 Raters	Rater #2 with Previous 2 Raters
Reality	.95*	.93*	.93*
Self-Rep	.94*	.95*	.94*
Global	.99*	.89*	.89*
DF	.95*	.89*	.93*
SCE/PVE	.99*	.97*	.99*

Note. Rater #1 - M.L.K.
Rater #2 - T.T.G.
Previous Two Raters - D.G.S. and L.N.W.

N = 60 for all.

*$p < .001$.

3. How vivid and clear was it?

4. What feelings or emotions did you have?

5. How real was the experience you had immediately before being awakened?

A brief description of each scale is taken from Schwartz (1979) and Weinstein (1981) and is outlined below.

1. Reality Scale (AIM): This 7 point scale (based on a subject's answer to question 5 "How real was the experience you had immediately before being awakened?" was designed to rate the subject's self evaluation of the extent to which the dream seemed to be happening in reality as opposed to being a thought or a product of this mind.

2. Suspension of Self Representation Scale (AIM): This is a dichotomous rating which attempted to assess whether the subject experienced himself as the thinker or dreamer of his experience. This was judged by the grammatical form of this replies to question 1 and 2 ("What was going through your mind just before you were awakened?" and "Any more to this?"). This rating was independent of the subject's own judgement.

3. Global Scale (AIM): This dichotomous scale was designed to assess the subject's actual loss of reflective self representation and consequent immersion in a primarily sensory experience during the preceding mentation. This scale is based on the first three question of the mentation interview ("What was going through your mind?," "Any more to

this?" and "How vivid and clear was it?"). The Global scale is relatively independent of the subject's own judgement.

4. Foulkes DF scale (1966): This is an 8 point scale which attempts to assess the "dreamlikeness" of a mentation experience. It is based on questions 1,2,3, and 5 of the mentation interview. Reports during which the subject could not report a dream were scored either 1 - "no recall - the subject feels mind was blank" or 2 - "no recall - subject feels he was experiencing something but forgets what." As specified by Foulkes (1966), these reports were included in the data analysis. The DF scale is relatively independent of the subject's own judgement.

5. SCE/PVE SCALE (Molinari and Foulkes, 1969): This rating was based on subject's answers to questions 1 and 2 of the mentation interview. Primary Visual Experience is visual imagery apprehended in a direct unreflective way; Secondary Cognitive Elaboration is active thinking or reflecting about sensory imagery or the absence of sensory imagery. This dichotomous rating scored each report as either SCE or PVE; PVE was a residual score. This rating was independent of the subject's evaluation of the sensory vs. conceptual nature of the mentation experience.

Data Analysis

The prolonged effects of RD on sleep mentation were investigated by analyzing changes in REM and NREM mentation during RD as compared to NRD nights. The analysis of sleep mentation from the second (Late) and third (Early & Late) RD and NRD nights were done using three-way analyses of Variance (ANOVA) with repeated measures. This involved looking at each dependent variable in relation to three independent variables: experimental night (RD vs. NRD) type of sleep (REM vs. NREM) and type of activity (phasic vs. Tonic).

Chapter V

RESULTS

The criterion measures employed in this study were the three subscales of the AIM scales (Reality, Global, and Self Representation), the DF scale, and the SCE/PVE scale. These measures were analyzed by means of three-way repeated measures analyses of variance in which the independent variables were REM condition (REM vs. NREM), experimental night (REM deprivation vs. NREM deprivation) and Phasic condition (Phasic vs. Tonic). Such ANOVAS were carried out for each measure for several data sets: (1) A set in which scores combine nights 2 (Late) and 3 (Early and Late) (2) a set in which scores on night 2 (L) were analyzed alone, and (3) a set in which scores on night 3 (E&L) were analyzed alone. Also, separate analyses were carried out for the total subject pool and for a subgroup of subjects - Low Access Fantasizers (LAF). The various analyses are presented as the hypothesis to which each analysis pertains is discussed.

The Effect of REM Deprivation on Phasic and Tonic REM Mentation Reports

Hypotheses 1a and 1b concerned differences on the AIM subscales between REM deprived and NREM deprived experimental nights. Hypothesis 1a concerned these differences in REM tonic mentation reports and hypothesis 1b concerned these differences in REM phasic mentation reports.

Tables 2 through 7 present the results of the analyses of variance of the three AIM subscales where scores have been averaged across night 2 (L) and night 3 (E&L) and the entire subject pool has been included. The effects relevant to these hypotheses include the main effect due to experimental night (REMD vs. NREMD nights), the two-way interactions of experimental night by type of phasic activity (tonic vs. phasic) and the three-way interaction effect.

The data in Table 3 indicate that with respect to the AIM Reality scale there was no significant main effect due to experimental night, no significant experimental night by Phasic condition interaction, and no significant three-way interaction. Thus it cannot be concluded that REM deprivation results in higher scores on the AIM Reality subscale, either in tonic REM mentation reports (Hypothesis 1a) or in phasic REM mentation reports (Hypothesis 1b). The only significant result in Table 2 was the main effect due to REM condition (REM vs. NREM; $\underline{F} = 16.55$, $\underline{df} = 1$ and 357, $\underline{p} = .001$). The means in Table 2 indicate clearly that the Reality subscale scores were higher for REM mentation than for NREM mentation.

Table 2

Reality Scale Averaged across Nights 2 (Late) and Night 3 (Early and Late) by Experimental Night, REM Condition, and Phasic Condition

		Tonic	Phasic
NRD			
	REM	4.81 (26)	5.11 (28)
	NREM	4.38 (39)	3.95 (88)
RD			
	REM	5.45 (29)	5.32 (25)
	NREM	4.60 (43)	3.82 (87)

Note. Number in parenthesis indicates number of observations in that cell.

Table 3

Analysis of Variance for Reality Scale Averaged across Night 2 (Late) and Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	76.662	1	76.662	16.55	.001	S
EXPNIGHT (REMD night vs NREMD night)	1.030	1	1.030	.22	.638	NS
PT (Phasic vs Tonic)	12.583	1	12.583	2.72	.100	NS
Cond X EXPNIGHT	2.682	1	2.682	.58	.447	NS
Cond X PT	8.756	1	8.756	1.89	.170	NS
EXPNIGHT X PT	3.00	1	3.00	.65	.422	NS
Cond X EXPNIGHT X PT	.022	1	.022	.005	.945	NS
ERROR	1653.71	357	4.63			

Table 4

Global Scale Averaged for Nights 2 (Late only) and 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	.85 (26)	.93 (28)
NREM	.56 (39)	.68 (88)
RD		
REM	.90 (29)	1.00 (25)
NREM	.58 (43)	.59 (87)

Note. Number in parenthesis indicates number of observations in that cell.

Table 5

Analysis of Variance for Global Scale Averaged across Nights 2 (Late only) and Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	7.30	1	7.30	38.22	.001	S
EXPNIGHT (REMD night vs NREMD night)	.054	1	.054	.281	.597	NS
PT (Phasic vs Tonic)	.400	1	.400	2.092	.149	NS
Cond X EXPNIGHT	.211	1	.211	1.103	.294	NS
Cond X PT	.019	1	.019	.099	.753	NS
EXPNIGHT X PT	.099	1	.099	.520	.471	NS
Cond X EXPNIGHT X PT	.081	1	.081	.426	.514	NS
ERROR	68.181	357	.191			

Table 6

Self Representation Scale Averaged for Nights 2 (Late Only) and Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	.46 (26)	.43 (28)
NREM	.33 (39)	.35 (88)
RD		
REM	.62 (29)	.64 (25)
NREM	.47 (43)	.48 (87)

Note. Number in parenthesis indicates number of observations in that cell.

Table 7

Analysis of Variance for Self Representation Scale Averaged across Nights 2 (Late only) and Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	1.192	1	1.192	4.888	.028	S
EXPNIGHT (REMD night vs NREMD night)	1.969	1	1.969	8.072	.005	S
PT (Phasic vs Tonic)	.008	1	.008	.032	NS	
Cond X EXPNIGHT	.060	1	.060	.244	NS	
Cond X PT	.011	1	.011	.046	NS	
EXPNIGHT X PT	.005	1	.005	.022	NS	
Cond X EXPNIGHT X PT	.013	1	.013	.053	NS	
ERROR	87.074	357	.244			

The data in Table 5 indicate similar findings with respect to the AIM Global subscale. There was no significant main effect due to experimental night, no significant experimental night by REM condition interaction and no significant three-way interaction. Thus it cannot be concluded that REM deprivation results in higher AIM global subscale scores in either tonic or phasic REM mentation reports. The significant main effect due to REM condition (F = 38.22, df = 1 and 357, p = .001) and the means in Table 4 indicate that the AIM Global subscale scores were higher in REM mentation than in NREM mentation.

Results obtained for AIM Self-Representation subscale scores were different. The findings reported in Table 7 include a significant main effect due to experimental night (F = 8.07, df = 1 and 357, p = .005). In the absence of any significant interactions involving the experimental night, the significant main effect may be interpreted as indicating a general tendency for Self-representation scores to be different for REM deprived and NREM deprived nights. The means presented in Table 6 indicate that for both REM tonic and REM phasic awakenings (and for NREM tonic and NREM phasic awakenings) the mean Self-representation scores were higher on REM deprived than on NREM deprived nights. For REM tonic awakenings, the mean Self-representation score was .62 on RD nights, compared to .46

on NRD nights. For REM phasic awakenings, the mean RD Self-representation score was .64, compared to a mean of .43 for NRD nights.

Thus, the results of these ANOVAS yielded mixed results with respect to hypotheses 1a and 1b. The hypotheses were not confirmed for the Reality or Global AIM scales, but were confirmed for the Self-representation scale.

Several other analyses are pertinent to hypotheses 1a and 1b. Tables 8 through 19 present the corresponding analyses for scores obtained on night 2 (L) only (Tables 8 through 13) and night 3 (E&L) only (Tables 14 through 19). The noteworthy findings in these tables are a main effect due to experimental night in Table 13 that approached significance ($\underline{F}$ = 3.29, $\underline{df}$ = 1 and 115, $\underline{p}$ = .072) and a significant main effect due to experimental night in Table 19 ($\underline{F}$ + 4.44, $\underline{df}$ = 1 and 234, $\underline{p}$ = .036). These findings both pertain to the AIM Self-representation scale. They suggest that the difference in Self-representation scale scores between the RD and NRD nights was stronger on night three than on night 2.

Hypothesis 1b suggested further that the anticipated effect of experimental night (RD vs. NRD) might be demonstrated only by Low Access Fantasizers (LAFs) in phasic REM mentation reports. Accordingly, the analyses reported in Tables 2 through 19 for the entire sample were replicated

Table 8

Reality Scale for Night 2 (Late Only)

	Tonic	Phasic
NRD		
REM	4.83 (12)	4.17 (67)
NREM	4.86 (14)	4.25 (32)
RD		
REM	4.92 (13)	4.50 (4)
NREM	4.31 (13)	3.41 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 9

Analysis of Variance for Reality Scale - Night 2 (Late Only)

	SS	df	MS	F	p	
Condition (REM vs NREM)	2.609	1	2.609	.552	.459	NS
EXPNIGHT (REMD night vs NREMD night)	7.495	1	7.495	1.585	.211	NS
PT (Phasic vs Tonic)	13.184	1	13.184	2.787	.098	NS
Cond X EXPNIGHT	3.804	1	3.804	.804	.372	NS
Cond X PT	.160	1	.160	.034	.854	NS
EXPNIGHT X PT	.131	1	.131	.028	.868	NS
Cond X EXPNIGHT X PT	.356	1	.356	.075	.784	NS
ERROR	543.941	115	4.730			

Table 10

Global Scale Averaged for Night 2 (Late Only)

	Tonic	Phasic
NRD		
REM	.92 (12)	.83 (6)
NREM	.50 (14)	.78 (32)
RD		
REM	.85 (13)	1.00 (4)
NREM	.46 (13)	.52 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 11

Analysis of Variance for Global Scale Night 2 (Late Only)

	SS	df	MS	F	p	
Condition (REM vs NREM)	2.437	1	2.437	12.249	.001	S
EXPNIGHT (REMD night vs NREMD night)	.582	1	.582	2.926	.090	NS
PT (Phasic vs Tonic)	.413	1	.413	2.076	.152	NS
Cond X EXPNIGHT	.117	1	.117	.589	.445	NS
Cond X PT	.128	1	.128	.644	.424	NS
EXPNIGHT X PT	.064	1	.064	.324	.570	NS
Cond X EXPNIGHT X PT	.271	1	.271	1.360	.246	NS
ERROR	22.883	115	.199			

Table 12

Self Representation Scale for Night 2 (Late Only)

	Tonic	Phasic
NRD		
REM	.42 (12)	.17 (6)
NREM	.29 (14)	.28 (32)
RD		
REM	.46 (13)	.50 (4)
NREM	.38 (13)	.48 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 13

Analysis of Variance for Self Representation Scale - Night 2 (Late Only)

	SS	df	MS	F	p	
Condition (REM vs NREM)	.026	1	.026	.107	.744	NS
EXPNIGHT (REMD night vs NREMD night)	.790	1	.790	3.287	.072	NS
PT (Phasic vs Tonic)	.000	1	.000	.000	.992	NS
Cond X EXPNIGHT	.002	1	.002	.008	.931	NS
Cond X PT	.135	1	.135	.564	.454	NS
EXPNIGHT X PT	.150	1	.150	.623	.431	NS
Cond X EXPNIGHT X PT	.044	1	.044	.182	.671	NS
ERROR	27.625	115	.240			

Table 14

Reality Scale for Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	4.79 (14)	5.36 (22)
NREM	4.12 (25)	3.79 (56)
RD		
REM	5.88 (16)	5.48 (21)
NREM	4.73 (30)	4.02 (58)

Note. Number in parenthesis indicates number of observations in that cell

Table 15

Analysis of Variance for Reality Scale - Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	84.352	1	84.352	18.355	.000	S
EXPNIGHT (REMD night vs NREMD night)	9.740	1	9.740	2.120	.147	NS
PT (Phasic vs Tonic)	6.348	1	6.348	1.381	.241	NS
Cond X EXPNIGHT	.148	1	.148	.032	.858	NS
Cond X PT	4.333	1	4.333	.943	.333	NS
EXPNIGHT X PT	4.492	1	4.492	.977	.324	NS
Cond X EXPNIGHT X PT	1.055	1	1.055	.230	.632	NS
ERROR	1075.354	234	4.596			

Table 16

Global Scale for Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	.79 (14)	.95 (22)
NREM	.60 (25)	.63 (56)
RD		
REM	.94 (16)	1.00 (21)
NREM	.63 (30)	.62 (58)

Note. Number in parenthesis indicates number of observations in that cell

Table 17

Analysis of Variance for Global Scale - Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	4.993	1	4.993	26.557	.000	S
EXPNIGHT (REMD night vs NREMD night)	.063	1	.063	.333	.565	NS
PT (Phasic vs Tonic)	.087	1	.087	.463	.497	NS
Cond X EXPNIGHT	.073	1	.073	.388	.534	NS
Cond X PT	.139	1	.139	.742	.390	NS
EXPNIGHT X PT	.049	1	.049	.260	.611	NS
Cond X EXPNIGHT X PT	.014	1	.014	.075	.785	NS
ERROR	43.996	234	.188			

Table 18

Self Representation Scale for Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	.50 (14)	.50 (22)
NREM	.36 (25)	.39 (56)
RD		
REM	.75 (16)	.67 (21)
NREM	.50 (30)	.48 (58)

Note. Number in parenthesis indicates number of observations in that cell.

Table 19

Analysis of Variance for Self Representation Scale - Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	1.393	1	1.393	5.643	.018	S
EXPNIGHT (REMD night vs NREMD night)	1.096	1	1.096	4.441	.036	S
PT (Phasic vs Tonic)	.005	1	.005	.022	.883	NS
Cond X EXPNIGHT	.101	1	.101	.409	.523	NS
Cond X PT	.030	1	.030	.122	.727	NS
EXPNIGHT X PT	.050	1	.050	.204	.652	NS
Cond X EXPNIGHT X PT	.003	1	.003	.013	.908	NS
ERROR	57.767	234	.247			

for the subset of participants who were classified as LAFs based on their scores on the IPI. The results of these analyses are presented in Tables 20 through 37. Contrary to expectation, these analyses yielded no significant main effects due to experimental night (RD vs. NRD) and no significant interactions involving experimental night. Therefore, it cannot be concluded that LAFs are more likely to score higher on the AIM subscales on RD nights than on NRD nights.

Hypothesis 1c suggested that the AIM scales would make the discriminations hypothesized in hypotheses 1a and 1b better than previously used mentation scales (the DF and the SCE/PVE scales). Tables 38 through 49 present the results of the three-way analyses of variance of DF and SCE/PVE scales, based on the full sample and scores averaged over nights 2 and 3. The data reported in Table 39 indicate no significant main effect and no significant interactions involving the experimental night (RD vs. NRD) in the case of the DF scale. The ANOVA on SCE/PVE scores presented in Table 41 indicated a significant main effect due to experimental night (F = 3.97, df = 1 and 357, p = .047). However, the means presented in Table 40 indicate that scores on the SCE/PVE were higher on the NRD nights than on the RD nights. This finding is contrary to the expectation embodied in hypotheses Ia and Ib. Thus the results of these analyses are in line with hypothesis Ic, since the AIM

Table 20

Reality Scale Averaged across Nights 2 (Late) and Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	4.82 (11)	4.56 (16)
NREM	5.13 (24)	4.42 (50)
RD		
REM	5.43 (14)	5.23 (13)
NREM	5.37 (27)	4.39 (44)

Note. Number in parenthesis indicates number of observations in that cell.

Table 21

Analysis of Variance for Reality Scale Averaged across Nights 2 (Late) and 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition						
(REM vs NREM)	1.872	1	1.872	.417	.519	NS
EXPNIGHT						
(REMD night vs						
NREMD night)	2.279	1	2.279	.508	.477	NS
PT (Phasic						
vs Tonic)	21.050	1	21.050	4.692	.032	S
Cond X EXPNIGHT	2.989	1	2.989	.666	.415	NS
Cond X PT	3.641	1	3.641	.812	.369	NS
EXPNIGHT X PT	.384	1	.384	.086	.770	NS
Cond X EXPNIGHT						
X PT	.268	1	.268	.060	.807	NS
ERROR	856.843	191	4.486			

Table 22

Global Scale Averaged Across Night 2 (Late) and Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.91 (11)	.88 (16)
NREM	.58 (24)	.80 (50)
RD		
REM	.86 (14)	1.00 (13)
NREM	.59 (27)	.68 (44)

Note. Number in parenthesis indicates number of observations in that cell

Table 23

Analysis of Variance for Global Scale Averaged across Nights 2 (Late) and 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	2.093	1	2.093	11.665	.001	S
EXPNIGHT (REMD night vs NREMD night)	.083	1	.083	.460	.498	NS
PT (Phasic vs Tonic)	.698	1	.698	3.892	.050	S
Cond X EXPNIGHT	.121	1	.121	.676	.412	NS
Cond X PT	.087	1	.087	.486	.486	NS
EXPNIGHT X PT	.019	1	.019	.103	.748	NS
Cond X EXPNIGHT X PT	.219	1	.219	1.220	.271	NS
ERROR	34.271	191	.179			

Table 24

Self Representation Scale Averaged across Night 2 (Late) and Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.55 (11)	.38 (16)
NREM	.29 (24)	.42 (50)
RD		
REM	.71 (14)	.69 (13)
NREM	.33 (27)	.45 (44)

Note. Number in parenthesis indicates number of observations in that cell.

Table 25

Analysis of Variance for Self Representation Scale Averaged across Nights 2 (Late) and 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	1.355	1	1.355	5.607	.019	S
EXPNIGHT (REMD night vs NREMD night)	.460	1	.460	1.905	.169	NS
PT (Phasic vs Tonic)	.161	1	.161	.665	.416	NS
Cond X EXPNIGHT	.449	1	.449	1.858	.175	NS
Cond X PT	.456	1	.456	1.889	.171	NS
EXPNIGHT X PT	.016	1	.016	.067	.796	NS
Cond X EXPNIGHT X PT	.057	1	.057	.237	.627	NS
ERROR	46.151	191	.242			

Table 26

Reality Scale for Night 2 (Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	4.60 (5)	3.25 (4)
NREM	5.56 (9)	4.76 (17)
RD		
REM	4.71 (7)	3.50 (2)
NREM	5.13 (8)	3.40 (15)

Note. Number in parenthesis indicates number of observations in that cell.

Table 27

Analysis of Variance for Reality Scale for Night 2 (Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	6.333	1	6.333	1.485	.228	NS
EXPNIGHT (REMD night vs NREMD night)	8.592	1	8.592	2.014	.161	NS
PT (Phasic vs Tonic)	25.590	1	25.590	6.000	.017	S
Cond X EXPNIGHT	2.704	1	2.704	.634	.429	NS
Cond X PT	.030	1	.030	.007	.934	NS
EXPNIGHT X PT	1.643	1	1.643	.385	.537	NS
Cond X EXPNIGHT X PT	.787	1	.787	.185	.669	NS
ERROR	251.635	59	4.265			

Table 28

Global Scale for Night 2 (Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.80 (5)	.75 (4)
NREM	.56 (9)	.88 (17)
RD		
REM	.86 (7)	1.00 (2)
NREM	.50 (8)	.53 (15)

Note. Number in parenthesis indicates number of observations in that cell.

Table 29

Analysis of Variance for Global Scale for Night 2 (Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	.618	1	.618	3.005	.088	NS
EXPNIGHT (REMD night vs NREMD night)	.340	1	.340	1.654	.203	NS
PT (Phasic vs Tonic)	.252	1	.252	1.228	.272	NS
Cond X EXPNIGHT	.269	1	.269	1.310	.257	NS
Cond X PT	.081	1	.081	.393	.533	NS
EXPNIGHT X PT	.110	1	.110	.533	.468	NS
Cond X EXPNIGHT X PT	.163	1	.163	.791	.377	NS
ERROR	12.127	59	.206			

Table 30

Self Representation Scale for Night 2 (Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.60 (5)	.25 (4)
NREM	.33 (9)	.47 (17)
RD		
REM	.57 (7)	.00 (2)
NREM	.25 (8)	.47 (15)

Note. Number in parenthesis indicates number of observations in that cell.

Table 31

Analysis of Variance for Self Representation Scale for Night 2 (Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	.022	1	.022	.084	.773	NS
EXPNIGHT (REMD night vs NREMD night)	.008	1	.008	.032	.859	NS
PT (Phasic vs Tonic)	.004	1	.004	.016	.900	NS
Cond X EXPNIGHT	.012	1	.012	.047	.829	NS
Cond X PT	1.065	1	1.065	4.152	.046	S
EXPNIGHT X PT	.000	1	.000	.000	.986	NS
Cond X EXPNIGHT X PT	.062	1	.062	.243	.624	NS
ERROR	15.133	59	.256			

Table 32

Reality Scale for Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	5.00 (6)	5.00 (12)
NREM	4.87 (15)	4.24 (33)
RD		
REM	6.14 (7)	5.55 (11)
NREM	5.47 (19)	4.90 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 33

Analysis of Variance for Reality Scale for Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	9.552	1	9.552	2.143	.146	NS
EXPNIGHT (REMD night vs NREMD night)	14.845	1	14.845	3.330	.070	NS
PT (Phasic vs Tonic)	8.094	1	8.094	1.815	.180	NS
Cond X EXPNIGHT	.097	1	.097	.022	.883	NS
Cond X PT	.502	1	.502	.113	.738	NS
EXPNIGHT X PT	.128	1	.128	.029	.866	NS
Cond X EXPNIGHT X PT	.622	1	.622	.140	.709	NS
ERROR	552.805	124	4.458			

Table 34

Global Scale for Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	1.00 (6)	.92 (12)
NREM	.60 (15)	.76 (33)
RD		
REM	.86 (7)	1.00 (11)
NREM	.63 (19)	.76 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 35

Analysis of Variance for Global Scale for Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	1.469	1	1.469	8.607	.004	S
EXPNIGHT (REMD night vs NREMD night)	.002	1	.002	.014	.907	NS
PT (Phasic vs Tonic)	.376	1	.376	2.201	.140	NS
Cond X EXPNIGHT	.001	1	.001	.004	.953	NS
Cond X PT	.069	1	.069	.406	.525	NS
EXPNIGHT X PT	.012	1	.012	.071	.790	NS
Cond X EXPNIGHT X PT	.099	1	.099	.578	.448	NS
ERROR	21.166	124	.171			

Table 36

Self Representation Scale for Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.50 (6)	.42 (12)
NREM	.27 (15)	.39 (33)
RD		
REM	.86 (7)	.82 (11)
NREM	.37 (19)	.45 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 37

Analysis of Variance for Self Representation Scale for Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	1.688	1	1.688	7.138	.009	S
EXPNIGHT (REMD night vs NREMD night)	.798	1	.798	3.377	.069	NS
PT (Phasic vs Tonic)	.106	1	.106	.450	.504	NS
Cond X EXPNIGHT	.644	1	.644	2.723	.101	NS
Cond X PT	.159	1	.159	.673	.413	NS
EXPNIGHT X PT	.004	1	.004	.016	.901	NS
Cond X EXPNIGHT X PT	.013	1	.013	.053	.818	NS
ERROR	29.316	124	.236			

Table 38

DF Scale Averaged across Night 2 (Late) and Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	6.35 (26)	6.79 (28)
NREM	5.54 (39)	5.49 (88)
RD		
REM	6.34 (29)	6.56 (25)
NREM	5.53 (43)	5.10 (87)

Note. Number in parenthesis indicates number of observations in that cell.

Table 39

Analysis of Variance for DF Scale Averaged across Night 2 (Late) and Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	92.785	1	92.785	30.849	.000	S
EXPNIGHT (REMD night vs NREMD night)	4.486	1	4.486	1.492	.223	NS
PT (Phasic vs Tonic)	.305	1	.305	.101	.750	NS
Cond X EXPNIGHT	.146	1	.146	.049	.826	NS
Cond X PT	5.870	1	5.870	1.952	.163	NS
EXPNIGHT X PT	2.256	1	2.256	.750	.387	NS
Cond X EXPNIGHT X PT	.112	1	.112	.037	.847	NS
ERROR	1073.758	357	3.008			

Table 40

SCE/PVE Scale Averaged across Night 2 (Late) and Night 3 (Early and Late)

		Tonic	Phasic
NRD			
	REM	.92 (26)	.79 (28)
	NREM	.90 (39)	.85 (88)
RD			
	REM	.72 (29)	.72 (25)
	NREM	.74 (43)	.84 (87)

Note. Number in parenthesis indicates number of observations in that cell.

Table 41

Analysis of Variance for SCE/PVE Scale Averaged across Night 2 (Late) and Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	.190	1	.190	1.305	.254	NS
EXPNIGHT (REMD night vs NREMD night)	.578	1	.578	3.970	.047	S
PT (Phasic vs Tonic)	.002	1	.002	.010	.919	NS
Cond X EXPNIGHT	.045	1	.045	.308	.579	NS
Cond X PT	.166	1	.166	1.140	.286	NS
EXPNIGHT X PT	.393	1	.393	2.695	.102	NS
Cond X EXPNIGHT X PT	.000	1	.000	.001	.970	NS
ERROR	51.996	357	.146			

Table 42

DF Scale for Night 2 (Late Only)

	Tonic	Phasic
NRD		
REM	6.75 (12)	7.17 (6)
NREM	5.50 (14)	5.47 (32)
RD		
REM	6.00 (13)	6.50 (4)
NREM	4.85 (13)	4.90 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 43

<u>Analysis of Variance for DF Scale Night 2 (Late Only)</u>

	SS	*df*	*MS*	*F*	*p*	
Condition (REM vs NREM)	41.133	1	41.133	12.257	.001	S
EXPNIGHT (REMD night vs NREMD night)	12.662	1	12.662	3.773	.055	NS
PT (Phasic vs Tonic)	.460	1	.460	.137	.712	NS
Cond X EXPNIGHT	.048	1	.048	.014	.905	NS
Cond X PT	1.030	1	1.030	.307	.581	NS
EXPNIGHT X PT	.043	1	.043	.013	.910	NS
Cond X EXPNIGHT X PT	.000	1	.000	.000	.999	NS
ERROR	385.934	115	3.356			

Table 44

SCE/PVE Scale for Night 2 (Late Only)

	Tonic	Phasic
NRD		
REM	.92 (12)	.67 (6)
NREM	.86 (14)	.75 (32)
RD		
REM	.77 (13)	.50 (4)
NREM	.85 (13)	.90 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 45

Analysis of Variance for SCE/PVE Scale - Night 2 (Late Only)

	SS	df	MS	F	p	
Condition (REM vs NREM)	.192	1	.192	1.252	.265	NS
EXPNIGHT (REMD night vs NREMD night)	.030	1	.030	.195	.660	NS
PT (Phasic vs Tonic)	.202	1	.202	1.315	.254	NS
Cond X EXPNIGHT	.224	1	.224	1.460	.229	NS
Cond X PT	.251	1	.251	1.638	.203	NS
EXPNIGHT X PT	.077	1	.077	.502	.480	NS
Cond X EXPNIGHT X PT	.040	1	.040	.257	.613	NS
ERROR	17.654	115	.154			

Table 46

DF Scale for Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	6.00 (14)	6.68 (22)
NREM	5.56 (25)	5.50 (56)
RD		
REM	6.63 (16)	6.57 (21)
NREM	5.83 (30)	5.21 (58)

Note. Number in parenthesis indicates number of observations in that cell.

Table 47

Analysis of Variance for DF Scale - Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition						
(REM vs NREM)	53.333	1	53.333	18.640	.000	S
EXPNIGHT						
(REMD night vs						
NREMD night)	.024	1	.024	.008	.927	NS
PT (Phasic						
vs Tonic)	1.204	1	1.204	.421	.517	NS
Cond X EXPNIGHT	.772	1	.772	.270	.604	NS
Cond X PT	5.106	1	5.106	1.785	.183	NS
EXPNIGHT X PT	5.256	1	5.256	1.837	.177	NS
Cond X EXPNIGHT						
X PT	.085	1	.085	.030	.863	NS
ERROR	669.509	234	2.861			

Table 48

SCE/PVE Scale for Night 3 (Early and Late)

	Tonic	Phasic
NRD		
REM	.93 (14)	.82 (22)
NREM	.92 (25)	.91 (56)
RD		
REM	.69 (16)	.76 (21)
NREM	.70 (30)	.81 (58)

Note. Number in parenthesis indicates number of observations in that cell.

Table 49

Analysis of Variance for SCE/PVE Scale - Night 3 (Early and Late)

	SS	df	MS	F	p	
Condition (REM vs NREM)	.102	1	.102	.722	.396	NS
EXPNIGHT (REMD night vs NREMD night)	1.130	1	1.130	8.000	.005	S
PT (Phasic vs Tonic)	.056	1	.056	.397	.529	NS
Cond X EXPNIGHT	.005	1	.005	.033	.856	NS
Cond X PT	.054	1	.054	.381	.537	NS
EXPNIGHT X PT	.270	1	.270	1.910	.168	NS
Cond X EXPNIGHT X PT	.013	1	.013	.090	.765	NS
ERROR	33.056	234	.141			

Self-representation scale did yield significant differences between RD and NRD nights as predicted, while the DF and SCE/PVE scales did not.

Tables 42 through 49 present the results of analyses of the DF and SCE/PVE scales based on scores from night 2(L) only (Tables 42 through 45) and night 3 (E&L) only (Tables 46 through 49). The data in Table 49 indicate that the significant effect due to experimental night reported in Table 41 was due primarily to differences on night 3. Again, scores were significantly higher on NRD nights than on RD nights.

Tables 50 through 61 present the results of the analyses of variance of the DF and SCE/PVE scales for the LAF subjects only. These analyses yielded no significant main effects due to experimental night, no significant experimental night by REM condition, and no significant three-way interactions.

The Effect of REM Deprivation on NREM Mentation Reports

The second research hypothesis stated that REM deprivation would increase the REM-like aspects of NREM mentation on the AIM subscales. Specifically, it was predicted that AIM subscale scores for NREM tonic awakenings and for NREM Phasic awakenings would be significantly higher on RD nights than on NRD nights. As noted above, the

Table 50

DF Scale Averaged Across Nights 2 (Late) and Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	6.36 (11)	6.38 (16)
NREM	5.67 (24)	5.88 (50)
RD		
REM	6.50 (14)	6.46 (13)
NREM	5.74 (27)	5.48 (44)

Note. Number in parenthesis indicates number of observations in that cell.

Table 51

Analysis of Variance for DF Scale Averaged across Nights 2 (Late) and Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	20.618	1	20.618	6.911	.009	S
EXPNIGHT (REMD night vs NREMD night)	.996	1	.996	.334	.564	NS
PT (Phasic vs Tonic)	.038	1	.038	.013	.911	NS
Cond X EXPNIGHT	.899	1	.899	.302	.584	NS
Cond X PT	.002	1	.002	.001	.979	NS
EXPNIGHT X PT	1.450	1	1.450	.486	.487	NS
Cond X EXPNIGHT X PT	.431	1	.431	.144	.704	NS
ERROR	569.802	191	2.983			

Table 52

SCE/PVE Scale Averaged across Night 2 (Late) and Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.82 (11)	.75 (16)
NREM	.88 (24)	.84 (50)
RD		
REM	.57 (14)	.85 (13)
NREM	.85 (27)	.84 (44)

Note. Number in parenthesis indicates number of observations in that cell.

Table 53

Analysis of Variance for SCE/PVE Scale Averaged across Nights 2 (Late) and Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition						
(REM vs NREM)	.434	1	.434	2.922	.089	NS
EXPNIGHT						
(REMD night vs						
NREMD night)	.028	1	.028	.186	.667	NS
PT (Phasic						
vs Tonic)	.010	1	.010	.070	.792	NS
Cond X EXPNIGHT	.017	1	.017	.114	.736	NS
Cond X PT	.157	1	.157	1.056	.305	NS
EXPNIGHT X PT						
Cond X EXPNIGHT						
X PT	.240	1	.240	1.616	.205	NS
ERROR	28.396	191	.149			

Table 54

DF Scale for Night 2 (Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	7.00 (5)	6.75 (4)
NREM	5.89 (9)	5.71 (17)
RD		
REM	6.00 (7)	5.50 (2)
NREM	5.25 (8)	5.20 (15)

Note. Number in parenthesis indicates number of observations in that cell.

Table 55

Analysis of Variance for DF Scale for Night 2 (Late) - LAF's Only

	SS	df	MS	F	p	
Condition						
(REM vs NREM)	8.726	1	8.726	2.554	.115	NS
EXPNIGHT						
(REMD night vs						
NREMD night)	7.740	1	7.740	2.265	.138	NS
PT (Phasic						
vs Tonic)	.366	1	.366	.107	.745	NS
Cond X EXPNIGHT	.757	1	.757	.222	.640	NS
Cond X PT	.149	1	.149	.044	.835	NS
EXPNIGHT X PT	.005	1	.005	.002	.969	NS
Cond X EXPNIGHT						
X PT	.101	1	.101	.030	.864	NS
ERROR	201.568	59	3.416			

Table 56

SCE/PVE Scale for Night 2 (Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.80 (5)	.50 (4)
NREM	.89 (9)	.76 (17)
RD		
REM	.57(7)	1.00 (2)
NREM	1.00 (8)	.93 (15)

Note. Number in parenthesis indicates number of observations in that cell.

Table 57

Analysis of Variance for SCE/PVE Scale for Night 2 (Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	.666	1	.666	4.680	.035	S
EXPNIGHT (REMD night vs NREMD night)	.183	1	.183	1.284	.262	NS
PT (Phasic vs Tonic)	.063	1	.063	.440	.510	NS
Cond X EXPNIGHT	.015	1	.015	.106	.746	NS
Cond X PT	.034	1	.034	.240	.626	NS
EXPNIGHT X PT	.185	1	.185	1.302	.258	NS
Cond X EXPNIGHT X PT	.310	1	.310	2.176	.146	NS
ERROR	8.395	59	.142			

Table 58

DF Scale for Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	5.83 (6)	6.25 (12)
NREM	5.53 (15)	5.97 (33)
RD		
REM	7.00 (7)	6.64 (11)
NREM	5.95 (19)	5.62 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 59

Analysis of Variance for DF Scale for Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	11.164	1	11.164	3.932	.050	S
EXPNIGHT (REMD night vs NREMD night)	.502	1	.502	.177	.675	NS
PT (Phasic vs Tonic)	.033	1	.033	.012	.914	NS
Cond X EXPNIGHT	3.583	1	3.583	1.262	.263	NS
Cond X PT	.005	1	.005	.002	.967	NS
EXPNIGHT X PT	4.421	1	4.421	1.557	.214	NS
Cond X EXPNIGHT X PT	.000	1	.000	.000	.990	NS
ERROR	352.107	124	2.840			

Table 60

SCE/PVE Scale for Night 3 (Early and Late) - LAF's Only

	Tonic	Phasic
NRD		
REM	.83 (6)	.83 (12)
NREM	.87 (15)	.88 (33)
RD		
REM	.57 (7)	.82 (11)
NREM	.79 (19)	.79 (29)

Note. Number in parenthesis indicates number of observations in that cell.

Table 61

Analysis of Variance for SCE/PVE Scale for Night 3 (Early and Late) - LAF's Only

	SS	df	MS	F	p	
Condition (REM vs NREM)	.080	1	.080	.522	.472	NS
EXPNIGHT (REMD night vs NREMD night)	.253	1	.253	1.650	.201	NS
PT (Phasic vs Tonic)	.049	1	.049	.321	.572	NS
Cond X EXPNIGHT	.003	1	.003	.018	.892	NS
Cond X PT	.087	1	.087	.568	.453	NS
EXPNIGHT X PT	.029	1	.029	.187	.666	NS
Cond X EXPNIGHT X PT	.098	1	.098	.636	.427	NS
ERROR	19.016	124	.153			

analyses of variance of the AIM Reality subscale (Table 3) and the AIM Global subscale (Table 5) yielded no significant main effect due to experimental night (RD vs. NRD), and no significant interactions. Thus it cannot be concluded that either NREM tonic awakenings or NREM phasic awakenings are characterized by higher Reality or Global subscale scores on RD nights than on NRD nights.

However, the analysis of variance of the AIM Self-representation scores (Table 7) did yield a significant main effect due to experimental night, with no significant interactions. This implies that for NREM awakenings as for REM awakenings, Self Representation scores were higher on RD nights than on NRD nights for both tonic and phasic awakenings. With respect to NREM tonic awakenings, the mean Self-representation score was .47 for RD nights and .33 for NRD nights. With respect to NREM phasic awakenings, the corresponding means were .48 for RD nights and .35 for NRD nights. Therefore, hypothesis II was confirmed in part.

Hypothesis III suggested that the AIM subscales would demonstrate the relationships envisioned in Hypothesis II better than the DF scale or the SCE/PVE scale. As noted above, no significant main effects due to experimental night (RD vs. NRD) and no significant interactions involving experimental night were obtained for either the DF of the SCE/PVE scales. Thus it cannot be said that these scales yielded the expected difference between RD nights and NRD nights on either NREM tonic or NREM phasic awakenings. Since one of the three AIM subscales did yield the expected results, it may be concluded that the AIM scales do discriminate these differences better than the DF or the SCE/PVE scales. Thus, hypothesis III is confirmed.

Summary

Hypothesis I was confirmed in part. Scores on the AIM Self-representation scale for REM tonic and REM phasic awakenings were higher on REM deprivation nights than on Non-REM deprivation nights. No such differences were found for the Reality or Global AIM scales. No significant differences between RD and NRD nights were obtained for the DF scale. On the SCE/PVE scale, scores were higher on NRD nights than on RD nights.

Hypothesis II was also confirmed in part. Scores on the AIM Self-representation subscale for NREM tonic and for NREM phasic awakenings were higher on RD nights than on NRD nights. No such differences were obtained for the Global or Reality subscales.

Hypothesis III was confirmed. Whereas one of the three AIM subscales yielded significant differences in the expected direction between RD and NRD nights, neither the DF nor the SCE/PVE scale did so.

Chapter VI

DISCUSSION

The study reported here was designed to investigate the effects of REM deprivation on sleep mentation during the second (Late) and third (E&L) NRD/RD nights of a 17 night study. Data obtained on the first NRD/RD night and first half of the second NRD/RD night of the study had been analyzed and reported previously by Weinstein (1981). The measures of sleep mentation included the Reality, Global, and Self-representation scales of the Absorption in Mentation Scale (Schwartz, 1979; Weinstein, Schwartz, & Ellman, 1988), the DF Scale (Foulkes, 1965), and the SCE/PVE Scale (Molinari & Foulkes, 1969).

Prior research concerned with the intensification of REM and NREM mentation following RD has yielded inconsistent findings (Antrobus, Arkin, & Toth, 1970; Foulkes, Pivik, Ahrens, & Swanson, 1968). As discussed in Chapter 2 of this dissertation, these inconsistent findings may be attributed to methodological issues, especially to the use of less than adequate measures. The studies reported by Schwartz (1979) and Weinstein (1981) suggested that the AIM subscales were more sensitive than the previously developed DF and SCE/PVE scales in discriminating the degree of absorption in mentation.

Accordingly, in this study it was hypothesized that scores on the AIM subscales for tonic and phasic REM mentation would be higher on RD nights than on NRD nights. It was hypothesized further that the AIM scales would discriminate between RD and NRD nights better than either the DF scale of the SCE/PVE scale. A second hypothesis tested in the study was that REM deprivation would increase the REM-like aspects of NREM mentation. Thus it was anticipated that on RD nights, AIM subscale scores for NREM mentation would be higher than they would be on NRD nights. This effect was expected to be stronger on the AIM subscales than on the DF or SCE/PVE subscales.

These hypotheses were confirmed in substantial measure, although not in total. In this chapter the results will be discussed in relation to previous research, and implications for future studies will be enumerated. The discussion has been organized under headings corresponding to the specific research hypotheses.

The Effect of REM Deprivation on Tonic and Phasic REM Mentation

The first research hypothesis stated that tonic and phasic REM mentation reports from REM deprived experimental nights would be scored higher on the AIM subscales than reports from NRD nights. The findings of the study showed the expected differences between RD and NRD nights on REM mentation for the AIM Self-representation subscale, but not for the Reality or Global subscales. Self-representation scores for REM mentation awakenings were higher for both tonic and phasic REM mentation on RD nights than on NRD nights. Moreover, Self-representation scores for NREM mentation awakenings were higher for both tonic and phasic NREM mentation on RD nights than on NRD nights. When scores on Self-representation for the second (L) and third (E&L) nights of the study were analyzed separately, it was found that this effect was stronger for night three than for night two.

These findings suggest that REM deprivation has the effect of intensifying both REM and NREM sleep mentation, as suggested by Arkin (1978). The findings also suggest that the effects of REMD may be cumulative, in that the intensity of REM and NREM sleep mentation increases with the number of nights of REM deprivation.

In an earlier study by Arkin and his associates (1968), the hypothesized relationship between REMD and intensification of sleep mentation was not obtained. It is possible that the lack of significant results in that study was the result of the use of the DF scale to measure mentation. The DF scale combines several different elements of the dream report into a single score. It does not consider separately such aspects as how real the dream felt, hallucinatory elements, bizarreness, and conceptual vs. perceptual aspects of mentation. The AIM subscales do differentiate among various aspects of the dream experience.

In the context of this difference between the AIM scale and the DF scale, it should be stressed that no effects due to REMD were obtained using the Reality or the Global AIM subscales. The AIM Self-representation subscale is a specific measure of loss of reflective self-representation. The Reality and Global AIM subscales assess the degree to which the dream is experienced as vivid and real, as well as the loss of self reflection. It would appear that the effect of REMD is to intensify loss of reflective self-representation, and that to detect this loss a scale specific to that particular aspect of the dream experience is required.

Weinstein (1981) also reported differences between results obtained with the Self-representation scale and those obtained with respect to the Global and Reality subscales. Weinstein (1981) reported that the Global and Reality subscales differentiated REM from NREM awakenings as well as phasic from tonic awakenings. In contrast, the Self-representation scale discriminated only REM phasic awakenings. Weinstein (1981) interpreted her findings as suggesting that self reflection was an aspect of dreaming that was independent of the more general characteristic of "dreamlikeness" that differentiates REM from NREM, and she suggested that the Self-representation scale was particularly sensitive to the loss of self-reflection associated with REM phasic activation.

The results of the present study are consistent with the notion that self reflection may be relatively independent of other aspects of the dream experience, but the results do not support the notion that loss of self-reflection is particularly likely during REM phasic mentation. In this study, RD nights and NRD nights produced significantly different self-representation scores for both phasic and tonic REM mentation. It may be that the cumulative effect of REM deprivation was sufficiently great by the second (Late) and third (E&L) nights of the study to manifest itself in tonic as well as phasic REM activity. Weinstein (1981) based her results on the data obtained during NRD/RD night one and night two (E) of the study only.

The findings of the present study do not support Schwartz's (1979) hypothesis that REM phasic activity contributes to the loss of reflective self representation. Schwartz suggested that the suspension of self reflection that occurred during REM phasic events could also account for other characteristics of the dream experience. He argued that the loss of reflective self representation could lead one to become more immersed in one's fantasies, so that they were perceived as real. This in turn could lead to the dream being perceived as more real and more vivid. But Schwartz's (1979) hypothesis would imply that loss of self representation should be found correlated with the other dreamlike qualities such as reality and vividness. Self representation should not be, as suggested by Weinstein (1981), relatively independent of the qualities.

In this study, REM deprivation affected scores on the Self-representation subscale, but not the Reality or Global subscales. This is not what one would expect, if loss of self reflection is the basis for these other aspects of the dream experience, as Schwartz (1979) suggests. Moreover, in this study scores on the DF scale and the SCE/PVE scale were not higher on RD nights than on NRD nights. As the DF and SCE/PVE scales do not differentiate loss of self-reflection from other aspects of the dream experience, it could be argued that these findings are also inconsistent with Schwartz's (1979) position. If the loss of self-reflection as measured by the AIM Self-representation scale leads to the other aspects of the experience, then one might expect that the more general DF and SCE/PVE scales would yield higher scores as well on RD nights.

Another subhypothesis within hypothesis 1 stated that for phasic REM mentation reports, the difference between RD and NRD nights might not emerge for the total sample, but would emerge for Low Access Fantasizers (LAFs). The reasoning behind this hypothesis was that the AIM scales would be subject to ceiling effects in REM phasic mentation. That is, High Access Fantasizers (HAFs) were expected to have high AIM scores for all REM phasic mentation, so the effect of REM deprivation was not expected to manifest itself.

This subhypothesis was not confirmed. Differences on the Self-representation subscale between RD and NRD nights for REM phasic awakenings were slightly greater among LAFs than among the total sample, but the effect of experimental night (RD vs. NRD) was not significant for the LAF group, and there were no significant interactions. Moreover, the means for the LAF group on all three AIM subscales were quite similar to the means for the total sample. Thus, status as a Low or High Access Fantasizer as measured by the IPI appears to have little impact on measures of sleep mentation.

The final subhypothesis under hypothesis 1 stated that the differences between RD and NRD nights would be significantly greater on the AIM subscales than on the DF or the SCE/PVE scales. This subhypothesis was confirmed, since the only scale on which scores for RD nights were significantly higher than scores for NRD nights was the AIM Self-representation subscale. It seems clear that sleep mentation measures must differentiate between the various attributes of dreaming, including loss of self reflection, the sense of reality of the experience, and the vividness of the experience.

The Effect of REM Deprivation on Tonic and Phasic NREM Mentation

The second research hypothesis stated that REM deprivation would significantly increase the REM-like aspects of NREM mentation on scales that measure a subject's loss of self-reflection. This hypothesis was confirmed by the findings obtained on the AIM Self-representation subscale. The analysis of variance carried out on that subscale yielded a significant main effect due to experimental night (RD vs NRD) and no significant interactions. Thus, the effect of REM deprivation was consistent over phasic and tonic awakenings and over REM condition (REM vs. NREM). In short, for NREM mentation as well as for REM mentation, REM deprivation resulted in a greater loss of self reflection.

Previous research has shown that under conditions of REM deprivation certain physiological events associated with REM sleep can be dissociated from REM sleep into NREM sleep (Ferguson & Dement, 1968; Fisher, 1966; Sampson, 1965). The results of the present study suggest that this may be true of certain aspects of sleep mentation as well. Arkin (1978) suggested that "REM deprivation equals deprivation of REM-associated dreaming." The results of the present study suggest that the loss of self-reflection associated with REM sleep will, under conditions of REM deprivation, become dissociated from REM sleep and occur in NREM sleep as well. Whatever the function of the loss of self-reflection, it appears to be sufficiently important that sleepers who have been deprived of REM sleep will experience loss of self-reflection in NREM sleep as well.

At this point it is not clear why REM deprivation had such a clear impact on Self-representation subscale scores, but no significant impact on scores on the Global and Reality subscales of the AIM. Further research will be required to determine whether the reality and vividness of dream mentation serves a different psychological function from that served by the loss of self reflection. The apparent need to recover from a deficit in this area caused by REM deprivation suggests that the loss of self reflection does serve an important psychological function. However, it is not clear what this function may be. In order to determine what the function of the loss of self reflection in dream mentation may be, new experimental paradigms will be required. Perhaps such studies might involve the administration of psychological tests, mental status examinations, or open-ended interviews to subjects following REM deprivation and again following sleep mentation accompanied by loss of self reflection.

Limitations

The primary limitation of the data set was the unavailability of sleep records to verify the accuracy of phasic vs. tonic awakenings. This may account for differences between the findings of the present study and those reported by Weinstein (1981), who found effects of REM deprivation on the Self-representation subscale for REM phasic mentation alone.

Another limitation of the present study was the fact that the study was originally designed to study changes in NREM mentation following REM-deprivation, and three times as many observations were employed for NREM mentation than for REM mentation. Given the unequal number of observations for REM and NREM phasic and tonic awakenings, scores were averaged within each combination of REM condition (REM vs. NREM) and Phasic condition (phasic vs. tonic). This averaging removed the capability to partition variability in individual reports within the awakening categories. This limitation had the effect of limiting the power of the statistical tests employed, since variability in individual reports is relegated to the error term. This limitation may have had a particular impact on tests for phasic versus tonic mentation, several of which approached, but did not reach, statistical significance.

Appendix A

RULES FOR SCORING AIM SCALES

(Schwartz, 1979)

AIM SCALE

1. Reality Scale: Using the following scale, rate how real the subject reports his experience to have seemed from his response to question # 5 alone:

a. Not real at all
b. Not real, but some doubt is expressed
c. Somewhat real
d. Moderately real
e. Pretty real
f. Real
g. Very Real

For this item a score of 1 is reserved for reports for which the subject clearly states with no doubt that he was aware that the mentation was not objectively real. A score of 7 is reserved for occasions when the subject is emphatic about the feeling of reality in the mentation experience. The literal report of the subject determines the score. In cases where the literal response is equivocal or non-responsive to the question, the rater is to infer a score considering the whole response.

2. Self Representation Scale: For question #1 and #2 only, judge whether the subject employs a grammatical reflective self representation, e.g. "I was dreaming, thinking, in my mind, etc.".

YES = 0 NO = 1

3. Global Scale: On the basis of questions #1, #2 and #3, score 1 if the person seems to be immersed in the experience. Score 0 if the subject is not immersed in the experience.

Appendix B

RULES FOR SCORING THE FOULKES DF SCALE

(Foulkes, 1965)

For questions #1, #2, #3, and #5 of mentation interview:

1.	No recall	Feels mind was blank
2.	No recall	Feels he was experiencing something but forgets what
3.	Recall	Conceptual (No sensory imagery) - Everydayish content
4.	Recall	Conceptual, bizarre content
5.	Recall	Perceptual (Sensory imagery) Everydayish content, non-hallucinatory, Bizarre content
6.	Recall	Perceptual, non-hallucinatory, Bizarre content
7.	Recall	Perceptual, hallucinatory (believed events he imagined to be really happening) Everydayish content
8.	Recall	Perceptual, hallucinatory, bizarre content

Appendix C

RULES FOR SCORING MOLINARI AND FOULKES SCE/PVE SCALE

(Molinari & Foulkes, 1969)

Secondary Cognitive Elaboration (SCE) was defined in terms of three categories:

<u>Category A:</u> Reports with evidence of active intellectual processes within the experience such as thinking, being aware, recognizing or interpreting.

1. purely conceptual reports - lacking in visual imagery
2. reports containing imagery plus evidence of a thinking process
3. awareness of one's mental processes as an object of consciousness (e.g. "I knew I was wondering about").

<u>Category B:</u> Reports containing conceptual relationships, alternatives, or comparisons.

1. two apparently parallel dream thoughts or events seen in some relationship to one another
2. the conception of opposite possibilities or alternatives
3. a comparison with concern over deciding or choosing

<u>Category C:</u> Reports with verbalization or explanation

1. S himself talking
2. Any dream character using words for the explicit purpose of explanation

Reports were examined for evidence of Secondary Cognitive Elaboration. If none was present in the dream report, it received a score of Primary Visual Experience.

ORDER OF DREAM MENTATION SCORING:
For a given packet of mentation (i.e. for one subject) rate all the reports on the Reality Scale, then go back and rate the Self Representation scale. In the third pass through the mentation packet, rate the Global scale. The DF scale and the SCE/PVE scale are rated individually as well.

Appendix D

PROCEDURES FOR THE COLLECTION OF MENTATION

(Arkin, 1968)

Method: Twenty "normal" college men who were light sleepers and good dream recallers were paid subjects. They were run in accordance with the schedule described below. Each initially acceptable applicant was required to satisfy the following criterion on a trial laboratory night: reports of some clear mentation with at least one specific item of content in 2 or more of 8 NREM reports elicited throughout the night. Suitable subjects were then asked to stabilize their sleep cycles for 5 to 7 nights at home and to keep standardized daily sleep logs for the remainder of the experiment. Then, they spent three consecutive adaptation nights in the laboratory, the first two of which merely provided the subject with an opportunity to accustom himself to the laboratory bedroom. Thus, electrodes were not attached, no wake-ups were performed and they were permitted to sleep from 11 to 7 or 12 to 8. On the third adaptation night, however, electrodes were attached and 6 stage 2 and 2 stage REM mentation reports were obtained. After the adaptation series was completed, the experimental schedule proper was carried out as follows:

Nights 1, 2	Initial baseline
Nights 3, 4, 5	REMP Deprivation
Nights 6	Recovery

a. REMP reports were elicited between 2 to 4 minutes after REMP onset and equal numbers were obtained in close association with and remote from REM bursts.

b. Stage two mentation reports were elicited at least 15 minutes after a previous REMP termination and equal numbers obtained in close association with, and remote from, phasic events (phasic EMG suppression and K-complexes occurring together or separately).

The technique of mentation report elicitation involved an initial neutral question as to what had been going through the subjects' minds just prior to awakening and was followed by a standardized interview program to obtain descriptions of the vividness of clarity of the sleep experience, its emotional content, and feeling of reality.

Phasic Rem was defined as 3 rapid eye movements within a 4 second interval.

Tonic REM was defined as the first 30 second interval following 1 1/2 minutes of the REM period without REMs.

Phasic NREM was defined as 5 to 10 seconds or less after an abrupt EMG suppression in combination with a K complex, <u>or</u> if that is unavailable, an EMG suppression alone, <u>or</u> a K complex alone.

Tonic NREM was defined as at least 5 minutes after a preceding REM period, in stage 2 and at least 1 minute after any EMG suppression, or 30 seconds after any K complex.

Then, after a rest period at home for 3 to 8 nights, the subject continued in the laboratory as follows:

Nights 7, 8	Middle Baseline
Nights 9, 10, 11	NREM Control Deprivation
Night 12	Recovery
Nights 13, 14	Terminal Baseline

<u>The Mentation Report Schedule</u>

The schedule was devised so as to enable us to test whether dreaming during sleep onset, stage 2 or REMP sleep is increased by REMP deprivation. Thus, on each experimental night, the same typical ground plan was employed as follows:

1. A sleep onset mentation report was elicited during the first sequence of rolling eye movements against a stage 1 NREM EEG background.

2. As a rule, no additional mentation reports were obtained until 70 to 90 minutes of sleep time had elapsed.

3. The remainder of the night was divided into two approximately equal intervals. During each of these, one REMP and 3 stage 2 mentation reports were elicited, all in counterbalanced order, yielding a total of 9 mentation reports per night (including the sleep onset report).

Appendix E

THE ACCEPTANCE OF DAYDREAMING SCALE

Scale Item #	Scoring Direction	Item
1	-	Daydreaming in an adult is really childish.
2	-	I feel badly about daydreaming because it might indicate a weakness in character.
3	+	A really original idea can sometimes develop from a really fantastic daydream.
4	-	Daydreams are unreal and seldom come true.
5	-	I feel guilty about my daydreams.
6	-	Because my daydreaming often takes me away from my work, I try to avoid it even when I have no specific task to complete.
7	-	The fewer daydreams one has, the more time there is to really "live".
8	-	Daydreams accomplish nothing more than a temporary escape, and just avoid things that must be done.
9	-	Daydreaming never solves any problems.

Scale Item #	Scoring Direction	Item
10	+	Daydreaming is a common experience for great scientists and artists as well as for the average person.
11	+	Daydreaming is normal for adults as well as for adolescents and children.
12	+	I find my daydreams are worthwhile and interesting to me.

Appendix F

ITEMS COMPRISING THE GUILT DAYDREAMS SCALE

Scale Item #	Scoring Direction	Item
1	+	In my daydreams, I am caught after stealing something very expensive.
2	+	I daydream about having been caught in a crime and sentenced to jail for a long time.
3	+	In my fantasies, a friend discovers that I have lied.
4	+	I often feel tortured by the images of the sins I have committed.
5	+	I daydream about taking advantage of someone less fortunate than I and feeling guilty about it afterward.
6	+	I often imagine that someone else knows of the things I've done wrong and holds them against me.
7	+	In my daydreams I feel guilty for having escaped punishment.
8	+	I imagine myself running away from someone who is going to punish me.
9	+	I feel guilty in a daydream because of my cheating in a game or contest.

Scale Item #	Scoring Direction	Item
10	+	In my daydreams, I an always afraid of being caught doing something wrong.
11	+	In my daydreams, I feel guilty because I have done something which is not in accord with my religious beliefs.
12	+	I imagine myself borrowing something dear from a friend and damaging it.

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