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INDIVIDUAL DIFFERENCES IN RESPONSE TO REM DEPRIVATION:
THE INTERACTION OF PHYSIOLOGY AND
PSYCHOLOGICAL FACTORS

by

LISSA WEINSTEIN

A dissertation submitted to the Graduate Faculty in Psychology
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Abstract

INDIVIDUAL DIFFERENCES IN RESPONSE TO REM DEPRIVATION: THE INTERACTION OF PHYSIOLOGY AND PERSONALITY VARIABLES

by

Lissa Weinstein

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This study was an attempt to examine how personality variables measurable by self report inventories about a subject's daydreaming patterns and characteristic modes of handling anxiety relate to the subject's response to REM deprivation. Twenty male subjects slept in the laboratory for 2 baseline nights, 3 REM deprivation nights and 1 recovery night and returned to the lab 3-8 days later for 2 additional baseline nights, 3 NREM control deprivation nights and 1 recovery night. Subjects received the two conditions in counterbalanced order. Sleep records were scored for the amount of increase in REM time from baseline to recovery nights. Nine dreams per night were collected from each of the 20 subjects. Dreams were collected from either phasic (bursts of rapid eye movements--REMs) or tonic (no REMs) intervals of REM and NREM sleep. Dreams were scored by two raters blind to subject characteristics and awakening condition on 8 scales which measured a subject's absorption in his dreaming process. Subjects were scored on a variety of personality measures. They were divided on the median of their personality scores in order to assess differences amongst subject groups in their response to

REM deprivation, both in terms of physiological compensation for lost REM sleep as well as changes in REM and NREM mentation. Dream scales were first analyzed on baseline nights so that scales which were good discriminators of phasic vs. tonic awakenings were chosen. It was predicted that only the scales that could discriminate phasic from tonic awakenings would be sensitive to changes following REM deprivation. No significant differences in subject groups were found in the amount of REM rebound following RD. All subjects showed an increase in the direction of greater involvement in their NREM mentation following RD, but did so only on scales which were better discriminators of phasic and tonic awakenings on baseline nights. There were individual differences in the patterns of REM mentation following REM deprivation such that subjects who tended to report or focus on anxiety producing thoughts did not show any changes following REM deprivation in their REM mentation. Subjects who tended to not report anxiety producing thoughts showed an enhancement of their perceived and rated absorption in their REM mentation on deprivation nights. They showed a decrease in the absorption in their REM mentation on recovery nights following REM deprivation, but not following NREM control deprivation. These results were shown only on scales which were good discriminators of phasic vs. tonic awakenings on baseline nights. Results were interpreted to mean that the patterning of phasic activation determines to some extent the corresponding dream mentation, but this is interfered with by a subject's mode of reporting anxiety producing thoughts. In addition, the project served to validate the ability of certain mentation scales as discriminators of phasic vs. tonic awakenings.

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Thanks also to my friends and to my parents whose support and kindness were invaluable. Finally, I wish to thank Dr. David Schwartz without whose companionship and aid in rating the mentation reports this project would never have come to fruition.

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Chapter I

INTRODUCTION

Ever since its origin in 17th century rationalism parallelism has been used as a convenient device for disposing of the mind-body problem, allowing one to account for both physical and mental events. Psychophysiological parallelism promises to help depict internal structures and relate them in a systematic way to observable behavior, as well as allow the prediction of new, as yet unobserved phenomenon. It was hoped that the investigation of psychophysiological correlations during sleep would provide further information on the relationship of mind and body. Sleep was a good arena for study, as it allowed the study of extremely variable phenomenon in a setting where external events could be maximally controlled.

There are, in fact, several models of psychophysiological parallelism. The most extreme version is that for each physiological event there will be a corresponding psychological event. An example of this model is the "scanning" hypothesis proposed by Roffwarg, Muzio and Dement (1962) where each eye movement represents the dreamer observing the visual imagery in his dream. A similar argument was made by Roffwarg for the relationship between auditory imagery and middle ear muscle contractions. Another, less extreme version of parallelism predicts a positive, but not perfect correlation between physiological events and psychological structures. This model underlies the work of Berger and Oswald (1962) who found that active dreams are associated with more eye movements than passive dreams, but each eye movement does not necessarily indicate activity. Little is said in either of these models about the psychology of the dreamer of what interactions there might be between physiology and intermediate variables such as reporting style, cognition, or defense and the ultimate production of a mentation report. A third model might attempt to systematically take into account such variables as cognitive style in the formation of a dream and attempt to make some predictions in terms of individual differences in the reaction to a particular physiological stimulus. In this model (which might more accurately be termed a multifactor model) physiology is seen as an instigator of a dream, but it is only the first step in a complex process which will ultimately produce a mentation report. While this model cannot predict with as much precision as the earlier ones to the specific content of a dream, it may point to other lines of investigation. For example, what might the continuous operation of a physiological event contribute to the formation of personality traits in the developmental history of an individual? How might the operation of defensive strategies affect an individual's reaction to, or recognition of, the underlying physiological stimulus? How might stress affect the formation of a dream report, and how would different subject groups handle a particular stress?

The present study is an attempt to apply a multifactor model to the response to REM deprivation (RD), both in terms of physiological rebound following RD, as well as any changes in sleep mentation. It is part of an investigation of the tendency of individuals to confine the physic activity of REM sleep within the REM period proper, and the concomitant correlates of this tendency with personality. It is assumed that the tendency to confine phasic activity to the REM period (eye movement, middle ear muscle activity, for example) is one aspect of a trait which may have wide reaching implications for the personality functioning of an individual. It is hypothesized that this trait corresponds to an aspect of ego functioning which is involved with the regulation of internal fantasy life. It is an aspect of reality testing which enables a person t differentiate internal cognitive construction from information which is the product of external stimuli. It is the capacity to have a vivid cognitive experience and at the same time to be aware that the experience is a fantasy and under some volitional control. During some portion of daydreaming and during a good deal of night dreaming most people experience this capacity as being temporarily suspended. Schaefer (1968) refers to this as the suspension of reflective self representation. When reflective self representation is suspended it is not clear to the individual that his cognition is his own creation with no referents in the real world, but it seems as if the thoughts and images are happening externally and must be dealt with or responded to with the anxiety or satisfaction appropriate to their content. The chronic suspension of reflective self representation constitutes a break in reality testing. This, is the process hypothesized by Freeman, Cameron and McGhie (1958) to be central to schizophrenia. Schaefer (1968) asserted that the ability to temporarily suspend reflective self representation varies among the normal population as well.

It is hypothesized that phasic activity lowers the threshold to the suspension of reflective self representation. The work on mentation correlates of phasic activity has been reviewed by Pivik (1978) who felt that the results of the research at that point had been meager, although a number of studies did show a statistically significant difference between phasic and tonic awakenings (e.g. Ellman, Antrobus, Arkin, Luck, Bodnar, Sanders, & Nelson, 1974; Molinari and Foulkes, 1969). In addition, the pessimism Pivik expresses should be tempered when one considers that a number of studies suggest that one construct underlying the contribution of phasic activity to mentation is that phasic activity is correlated with the sense that the experience is "real." Pivik was working within the first model of parallelism which ignores psychological factors which might mediate between physiology and the dream report. Schwartz (1979) looked at baseline mentation in relation to waking personality measures and found that subjects who were adaptively absorbed in positively toned daydreaming during the day showed less suspension of reflective self representation in REM sleep and significantly more in NREM sleep. These subjects showed less qualitative difference between REM and NREM dream reports. He also showed that a number of scales were useful in distinguishing REM phasic as opposed to REM tonic awakenings, and that REM phasic intervals were significantly associated with the suspension of reflective self representation. In addition, one intermediate process which obscured phasic--tonic differences in mentation was social desirability response bias. Subjects who were able to answer the question "How real did the dream feel?" so that judges were able t distinguish phasic from tonic awakening reports were more likely to endorse bizarre self reports during waking. Thus, a broader personality construct, such as social desirability response bias, which spans differing arousal states may be involved in the final production of a dream report.

Our interest in looking at the vicissitudes of the suspension of reflective self representation following REM deprivation came from three sources. One of the major findings of sleep research to date is that in a number of mammals the systematic deprivation of REM sleep will result in a compensatory increase in that state along several parameters when the organism is subsequently allowed to sleep undisturbed (Dement, 1969). Despite replications of the REM deprivation phenomenon, some intriguing evidence has accumulated showing subject variability in response to REM deprivation amongst normal subjects, e.g. Pivak and Foulkes (1968), Cartwright, Monroe and Palmer (1967). Rather than treat these findings as chance, or relegate subject differences to the category of error variance, it seems that both sleeping and waking responses to REM deprivation may be related to personality characteristics. Specifically, subjects who did not show a rebound tended to be more sensitive to their internal experience as measured by waking personality traits. In addition, acute schizophrenics, a group high in suspension of reflective self representation do not show REM rebound. We were impressed by Dement's (1969) finding that following REM deprivation phasic activity is displaced into NREM sleep and by his assertion that phasic activity is the trigger for REM rebound. These findings, in conjunction with our belief that phasic activity lowered the threshold to the suspension of reflective self representation suggested that there might be changes in NREM mentation in the direction of a greater suspension of reflective self representation following RD. These changes in mentation would be significant for a certain subgroup of subjects--those who tended to be more involved in their internal experience. Changes would be most evident on scales which measured the suspension of reflective self representation, and were shown to be able to distinguish phasic from tonic awakenings. Secondly, the extent of the dissociation of phasic activity eventuating in more suspension of reflective self representation in NREM dreaming would correlate positively with the absence of physiological REM rebound. Another implication is that subjects who do not tend to confine phasic activity to the REM period during baseline sleep may show less effect of RD in terms of a compensatory increase in REM time following RD.

However, the idea that each occurrence of phasic activity outside of the REM sleep gives rise to a corresponding loss of reflective self representation ignores a number of factors. An alternate hypothesis is that over time an individual might adjust to the loss of reflective self representation following the occurrence of phasic activity, and that this adjustment might be reflected in such structures as defense or cognitive style. Further, how one handled the occurrence of phasic activity could itself be dependent on a number of interacting factors. These factors might be the amount of phasic activity, the ability to confine phasic activity to REM sleep and the availability of other resources in emotional development such as maternal sensitivity or tolerance for fantasy. Thus, the response of an individual to RD would be a combination of their sensitivity to internal events, their developmental history, the stability of their inhibitory mechanisms and their ability to handle stress.

The following study was designed to provide information on the interactions between sleep variables, mentation and personality. A second purpose was the validation of scales developed by Schwartz (1979) which were able to distinguish phasic from tonic awakenings during baseline sleep. It was hypothesized that if these scales were able to distinguish phasic from tonic arousals, they would be sensitive to changes in the quality of sleep mentation following RD.

The review of the literature centered around an attempt to critically assess the RD studies to date in order to examine their limitations. Following this there will be a review of the influences of animal sleep research, which was briefly alluded to above, on the development of a model of sleep and personality, and a review of the literature on the mentation correlates of phasic activity. The theoretical interest in pursuing these ideas, their significance for the study of sleep research and psychopathology, as well as a specific rationale for this study will be further explicated.

Chapter II

REVIEW OF THE REM DEPRIVATION LITERATURE

Methodology

Ellman, Spielman, Luck, Steiner and Halperin (1978) have thoroughly discussed the methodological issues relevant to RD studies, and their conclusions will simply be excerpted here. The basic design of RD studies has been a "pre- post" design, following Dement (1960). Subjects are allowed to sleep uninterrupted in the lab for several nights to get a baseline (BL) measure of their sleep patterns. Subjects then undergo RD, where they are awakened whenever they enter REM sleep. Following RD the subjects are again allowed uninterrupted sleep during recovery (R) nights. Using each subject as his own control, subjects are usually awakened during NREM sleep the same number of times they were awakened during REM sleep. There have been many variations on the original paradigm with changes in the number of nights in baseline, deprivation and recovery condition, as well as variations in total sleep time (TST). The basic methodological criteria for RD studies are as follows:

1. There must be at least 3 BL nights, since only by the third BL night can stable sleep values be obtained (Ellman, 1969; Fiss & Ellman, 1969; Kales, Hoedemaker, Jacobson, & Lichtenstein, 1969). On the first night in the lab REM sleep values are lower in absolute and percent terms than on subsequent BL nights (Agnew, Webb & Williams, 1966; Dement, Greenberg, & Klein, 1965; Rechtschaffen &

Verdone, 1964). The second BL night may serve as a recovery night for the (slight) REM deprivation of the first night. The mean of the third and all subsequent BL nights should be used for all statistical comparison, since it is only by the third BL night that one can get true baseline measures.

2. At least two R nights are needed to assess the effects of RD in studies using 4 RD nights or less. As Agnew, Webb, & Williams (1967) show, during RD subjects are deprived of delta sleep as well, and if this delta deprivation is considerable, a delta rebound may displace a REM rebound on the first R night.

3. TST should be kept constant in BL and R conditions because REM time is directly related to the amount of TST. Most REM sleep occurs in the second half of the night; the longer a person is allowed to sleep, the more REM time he has.

4. Control and RD conditions should be counterbalanced.

5. Criteria for RD awakenings should include a drop in muscle tone. Kales et al. (1964) have shown that studies not using an EMG criterion may allow a subject several minutes of REM sleep before an awakening.

6. A REM density measure (i.e. eye movements/unit time) should be used, since high REM density might substitute for overall REM time as a measure of REM rebound (Ferguson and Dement, 1968).

Sleep Cycle Changes

Dement (1960) found that following RD a number of things occurred. On R nights, subjects showed elevated amounts of REM sleep

(REM rebound), while this did not happen following NREM control deprivation (NRD). Progressively more frequent awakenings were required to prevent subjects from entering REM sleep on RD nights. Later studies showed other results of RD: REM rebound can last more than one night. There is a shortened REM latency on the first R night. Finally, during RD, REM density (eye movement/unit time) increases (Dement et al., 1970; Ferguson & Dement, 1968).

Kales et al. (1964) REM deprived 2 subjects for 6 nights and showed REM elevated 40 to 70% over BL during R nights. A 10 night study using the same 2 subjects showed an even greater rebound. Subjects showed a nonmonotonic increase in the number of awakenings needed to accomplish RD. It is difficult to evaluate these studies because the number of BL nights was unspecified, no statistical analysis was done on the data, and RD and NRD conditions were not counterbalanced. Also it is not mentioned if TST was kept constant from BL to R nights. Snyder (1963) reported similar results to Kales et al. (1964) in two subjects.

Sampson (1965) attempted to separate "dream deprivation" as opposed to RD by utilizing partial sleep deprivation (PSD) where subjects could sleep 2½ hours for 3 nights. Since very little REM sleep occurs during the first 2½ hours of the night, this procedure served to deprive subjects of REM sleep as well. As a comparison, he awakened subjects at REM onset for 3 nights. In both conditions subjects received three nights of deprivation. Subjects averaged 17% of their usual baseline REM during the three PSD nights. However, while standard RD procedures produced a REM rebound in all six subjects, PSD produced a rebound in only four subjects. There was no NRD control awakening group used.

Dement et al. (1966) demonstrated that extended partial RD has a cumulative effect, and that this effect is only reversed by REM rebound. Two subjects were deprived of about 23% of their REM sleep each night for 19 nights, after an initial 10 BL nights. On the first R night both subjects showed REM time elevated over BL, although the effect was small for one of them. However, because there was no statistical treatment of the data, apart from a probability statement, one cannot generalize from their results. In a second study, after 10 BL nights, 2 subjects underwent 5 nights of RD, then had 5 nights where they were allowed their BL levels of REM sleep. Following this, there were 5 regular R nights. Both subjects showed REM rebound. The authors concluded that RD effects can be stored over time and that only REM rebound can dissipate excess REM.

Agnew, Webb, and Williams (1967) attempted to compare the effects of Stage 4 and Stage 1 REM sleep deprivation. Twelve subjects were given 4 nights of BL sleep followed by 7 nights of either Stage 1 REM or Stage 4 deprivation, followed by 3 R nights. Subjects were given a brief (200 msec) but strong shock in order to accomplish stage specific deprivation. Deprivation procedures were successful, resulting in a reduction from 19% to 1% delta deprivation, and a change from 22% to 1% REM sleep. Stage 4 deprivation had only a limited effect on the proportion of Stage 1 REM but sharply increased Stage 2 sleep. RD showed a limited effect on the proportion of Stage 4, reduced Stage 2 somewhat, and sharply increased Stage 1 without REM. In both RD and Stage 4 deprivation, the stimulation requirements increased across nights. However, the number of epochs during which shock was required to reduce Stage 4 was four times as great as the number of epochs when shock was required to achieve RD. On R nights subjects showed an increase in Stage 1 REM ($p \leq .01$) on the first R night and REM continued to be elevated above BL on the third R night ($p \leq .05$). Stage 4 deprivation also showed a rebound effect on the first night ($p \leq .05$) but this recovery was complete after one night. There was also a Stage 1 rebound effect following Stage 4 deprivation, even in the absence of any significant Stage 1 REM deprivation ($p \leq .05$). Ellman (1978) suggests that this finding might be explained as a partial RD effect, where over seven nights of Stage 4 deprivation, a small amount of REM was lost per night, and cumulated to a significant amount which then led to a REM rebound. Although this study is intriguing, it remains difficult to evaluate because all sleep data is presented in percentages, and there is no way to tell if TST was held constant on BL and R nights. REM rebound levels might be spuriously high if TST was higher on R than on BL nights, since REM time varies directly with TST (Verdone, 1968).

To sum up quickly the preceeding studies, REM rebound is a well demonstrated phenomena. Of the 20 subjects in the 4 preceeding studies (excluding Agnew et al., 1967, as they present group data) 19 show elevated REM levels on either the 1st or 2nd R nights. There was in all studies, an increase from the first to the last deprivation night in the number of awakenings needed to accomplish RD.

Individual Differences in Response to REM Deprivation

Pivik and Foulkes (1966) performed one of the first experiments looking at the relationship between personality variables and an individual's response to RD. Twenty subjects were selected so that half of them scored at the represser end of the Byrne Repression-Sensitization scale of the MMPI, and the other half scored at the sensitization end. In exploring the within night effect of RD on dream content, Pivik and Foulkes found that REM mentation was rated as significantly more dreamlike (Foulkes DF scale) following RD for the first half of the night as compared to REM mentation collected following NRD control awakenings. This finding was true for represser subjects only. Furthermore, the percent of REM epochs (2½ seconds) with at least one rapid eye movement during the first five minutes preceeding mentation collection increased significantly following RD as opposed to control nights. This result was significant for represser subjects but not for sensitizers. Thus, the repressers showed signs of a REM rebound in that there was an increase in REM activity within the REM period and an increase in fantasy activity within the REM period after deprivation.

Looking at the personality data, Byrne (1964) describes the Repression-Sensitization scale as an index of an individual's style of defense in response to anxiety producing stimuli. Repressers defend by attempting to keep anxiety and anxiety producing percepts out of awareness. Sensitizers react to fear inducing percepts by focusing on them. Thus, the sensitizer might be seen as someone who is more involved in internal experience. These subjects, who were normally more focused on their internal life, did not show a response to RD.

There remain, however, certain questions abut this study. Although Pivik and Foulkes claim their results were significant for repressers only, this may be misleading, as they obtained statistically significant results wit both groups combined. Secondly, as many sensitizers as repressers showed a change in the predicted direction. Also, the DF scale was originally designed to rate NREM content and might not be sensitive to more detailed REM reports. Thus, give the fact that the sensitizers had initially higher REM reports, it may be that the DF was not sensitive to the more intense REM reports from sensitizers on R nights. However, this remains a suggestive study and deserves replication.

Foulkes, Pivik, Ahrens and Swanson (1968) attempted to replicate and extend the findings of the Pivik and Foulkes (1966) study using a cross night design. Although this is not strictly an individual difference study, it will be discussed here as it constitutes an inadequate refutation of the earlier study. In a 4 night paradigm, 16 subjects underwent either RD or pseudodeprived by NREM control awakenings during the course of an entire night in order to see the effects of RD on the mentation of the subsequent night. Subjects were randomly assigned to experimental conditions which were counter-balanced. The authors found that mean REM times on pseudodeprivation, post deprivation and post pseudodeprivation nights were quite similar. There was an order effect such that REM times were greater on night four than on night two regardless of condition. With order effects held constant, there was no significant tendency for REM compensation following RD. There was no shortened latency to REM on R nights. There were also no effects of RD on mentation.

There are a number of methodological problems with this study that make its conclusions practically uninterpretable. The authors did not run any adaptation or BL nights. The first night effect (where subjects show lower REM sleep values in both absolute and percent terms than on subsequent BL nights) has been discussed by numerous authors (Agnew et al., 1966; Dement et al., 1965). Thus, in the Foulkes et al. study, we are seeing additive effects of the first night effect, RD, and NREM control effects. These could not be controlled by counterbalancing, as the fact remains that regardless of condition, REM time on night four is always greater than on night two. Secondly, there were an inadequate number of R nights. In the Foulkes et al. study, there was only one R night, and subjects were allowed only 6 hours of TST. It is possible that a REM rebound could have occurred after this time. Similarly, we see that there were no effects of RD in terms of physiological compensation on R nights. We are left to wonder about the effectiveness of their criteria for RD. Low EMG can be an early sign of REM sleep and studies which do not utilize this criterion are often allowing a subject several minutes of REM sleep before an awakening. Foulkes et al. used the first eye movement occurring in conjunction with EMG criterion. While the authors note that their subjects were never deprived less than 50% and averaged 86% reduction in REM sleep, this still allows certain of them a considerable amount of REM. Given these criticisms, this study cannot stand up as a meaningful replication of the Pivik and Foulkes (1966) study.

Cartwright and her coworkers (1967, 1972) conducted two studies of the relationship between the response to RD and personality. Cartwright, Monroe and Palmer (1967) reported that the scoring of sleep records following RD was complicated by the presence of a pattern of low voltage, mixed frequency EEG, accompanied by sleep spindles and without rapid eye movements, which they labelled "ambiguous time." When portions of the sleep record occupied by this pattern were segregated from the tallying of REM sleep, the number of subjects who showed a REM rebound was reduced to half. There were wide variations between subjects in the amount of ambiguous time. The authors divided the response to RD into three categories. The first, compensation, consisted of an increase of REM sleep compared to baseline, and a shortened latency to the first REM period. Compensators were seen to be more field independent (and thus more clearly able to articulate an external stimulus with the help of internal cues) and as having good impulse control in general. The second category, substitution, was marked by the absence of increased REM sleep during R nights and little other change in the sleep cycle. The higher subject's scores on the DF scale during RD awakenings, the lower was their REM rebound, according to the authors. Substitutors were seen to have more access to fantasy under all conditions than compensators. The third pattern, disruption, also showed no increase in REM sleep, but did show an increase in ambiguous time. Disrupters required a larger number of awakenings to achieve RD. These subjects were also the most disturbed in response to a hallucinogenic drug and scored highest on an independent test of their anxiety. However, the authors used 10 subjects to obtain 55 correlation coefficients, rendering the actual significance of each statistic dubious.

In a later study (Cartwright & Ratzel, 1972) the authors state that "the variable which seems likely to be crucial in determining subjects response to RD is the degree to which their dream like activity is restricted to REMPs." In this study subjects were divided into those with relatively higher Foulkes DF scores for mentation collected shortly after REM onset (High Onset Fantasizers or HOFs), and those with relatively lower DF scores, LOF subjects. LOFs were seen to display a significantly higher REM rebound than HOFs, and show more changes in waking behavior. LOFs showed a significant change in the WAIS (largely accounted for by a change in the PAT subtest) and a rise on two Rorschach measures (M+ and M:Sum C scores). Both changes were interpreted to mean that the LOFs had become more sensitive to inner stimulation. LOFs were initially extratensive and more responsive to external stimulation and became more intratensive following RD. HOFs who seemed to normally have more recourse to internal fantasy, showed no change on either of the above measures following RD. Nor did they show a REM rebound. However, Cartwright and Ratzel used only one BL and one R night, which Dement (1965) has stated was an inadequate procedure for assessing the effects of RD. Ellman (1972) has noted other problems with this study as well, including the confounding of two independent variables, which make its suggestive findings difficult to interpret.

Nakasawa, Kotorii, Tachibana and Nako (1975) have reported data which they feel confirmed Cartwright et al. (1967). For a sample of 14 male subjects they reported a highly significant relationship between the scores on the Maudsley Personality Inventory and the increase in REM sleep following RD. Subjects who were extraverted and nonneurotic showed an increase in REM sleep during recovery. Introverted neurotic subjects showed almost no increase. Eysenck has stated that the introverted individual (as defined by scores on the MPI) is one whose behavior is more the product of internally generated stimuli, as opposed to the extravert whose responses are more determined by stimuli from the external environment. However, this study has a number of methodological problems. The one R night was terminated by the subject whenever he woke spontaneously. Monroe (1967) and Jovanovic (1978) have shown that poorer sleepers tend to be more neurotic and anxious. The introverts, who were reported to be "neurotic and nervous" might simply be poorer sleepers who are getting up earlier. Thus, their lower TST may account for their lower REM rebound. There was no data on REM density or REM latency, leaving open the possibility that subjects could have shown a form of rebound by increasing density or shortening REM latency.

Despite the problems exhibited in all of the above studies , individual differences in response to RD remains an important area for study, as it attempts t establish a relationship between physiological variables and personality. In addition, although these studies are flawed, there seems to be some underlying factors in all the personality measures of the subjects who did not show a REM rebound.

These subjects are more sensitive to their internal environment, and seem to be relatively more influenced by internal percepts than by the external world. This sensitivity would elevate Rorschach M responses, MPI introversion, measures of field dependence and sensitization scores on the Byrne R-S scale. In addition, it seems that an individual who is more responsive to internal fantasy and tends to give more attention to inner states, would be more likely to give a richer and more imaginative report under the influence of a hallucinogen. Similarly, when one attends more to inner states, disruption on an externally directed cognitive task is more likely, especially under the influence of a hallocinogen. Both of these characteristics discriminated those who responded to RD with the increased necessity of awakenings and ambiguous time in Cartwright et al. (1967).

Fantasy and Waking Behavior in Response to REM Deprivation

As Ellman et al. (1978) points out, two different questions have been confused when considering the effect of RD on waking functioning. The first question is whether RD has any harmful psychological effects. Early studies (e.g. Dement, 1960; Dement & Fisher, 1963) claimed to find an increase in bizarre behavior and suspiciousness. These studies have been reviewed extensively elsewhere (Albert, 1975; Dement, 1969; Vogel, 1975) and were found inconclusive for the following reasons: First, no NREM control awakenings were made. There was no systematic data reporting. RD awakenings were done with amphetamine, thus confusing RD effects and nonspecific drug effects.

Finally, neither experimenters nor subjects were blind to the purpose of the experiment or the condition in which they were run. The second question, can RD lead to a change in waking behavior and fantasy seems to depend, in part, on what kind of waking measure is used.

Kales, et al. (1964) studied two males subjects for six nights and awakened them at REM onset. Subjects were tested daily on the MMPI, Nowlis Adjective Checklist, Clyde Mood Scale, Stroop word color test and digit span. Psychological testing revealed "few significant changes and although the testing and observation indicate that subjects were somewhat more affected by the longer experiment (a 10 night paradigm was also administered using the same 2 subjects), there is little evidence that these changes are anything more than the result of sleep deprivation and the irritating accompaniment of the experimental situation."

Clemes and Dement (1967) questioned Kales et al. conclusion, claiming that order effects were not taken into account with the psychological test data. Clemes and Dement (1967) either REM or NREM control deprived six male college subjects who were blind to the purpose of the experiment. After the sixth night subjects were administered the following psychological tests: Welsh FIgure Preference, Holtzman Inkblot Test, TAT type cards and the Nowli Mood Checklist. Subjects returned t the lab seven days later, underwent the opposite condition and repeated the tests on the morning after the last deprivation day. Subjects showed higher intensity of need ($p \leq .001$) and feelings ($p \leq .05$), increased pathognomonic verbalization ($p \leq .001$) and decreased movement ($p \leq .06$, ns) following RD.

This increase, primarily in fabulation, was interpreted by the authors to be evidence of an increased sensitivity to internal feelings and a greater freedom to allow these feelings into consciousness. They conclude that their findings showed an increase in drive after RD. The drop in movement scores was seen as evidence that subjects had less ego control and could not delay responding long enough to perceive movement in the Holtzmann blots. Problems with their design include, too small a sample size, inadequate R nights, TST not kept constant, and an absence of BL sleep recording. Nevertheless, their results suggest that fantasy producing tests are more valuable in showing the effects of RD.

Sampson (1966) used two methods to RD six subjects. The first was the standard awakening of the subject at REM onset, the second was partial sleep deprivation. Dream reports were elicited every morning following a lab night, for each RD awakening, and at home before the experiment and during breaks. A test battery was given following BL nights and following the third deprivation night in each series. It consisted of digits forward and backward, a word association task, a serial abstraction task, the D scale of the MMPI and a mood scale. Overall, test battery results showed few consistent changes across subjects. Anecdotally, Sampson reported increases in waking instances of orality, irritability, and the loss of the sense of reality following RD. Dream contents, in contrast, did not show an increase in the proportion of reports containing oral elements when the first and third RD nights were compared. Nor was there an increase in the frequency of oral associations on the word association task, when RD nights were compared to BL nights. Aggressive elements/dream increased from the first to the third night ($p \leq .04$, two tailed test). The proportion of manifest distortion increased significantly ($p \leq .04$, two tailed test). Problems with this study include the lack of a NRD condition, too few subjects and a confounding of partial sleep deprivation effects as a measure of RD with the effects of total sleep loss.

Lerner (1961) believed that RD would produce an increase in the amount of projected movement and a change in the quality of movement reflecting more disintegrated body percepts. Twenty subjects were tested with Holtzman inkblots before and after 2 nights of drug induced RD and compared with 30 controls who did not undergo RD. Before discussing Lerner's results, let us note that her experiment lacks crucial controls for an RD study. There was no NRD control. Amphetamine was used to REM deprive subjects and a barbituate was used to help them sleep, thus confounding RD effects with the results of drug intake. Her drug control was inadequate because she did not administer the barbituate during the day and the amphetamine may not have been metabolized, hence drug control subjects may also have been REM deprived. Control groups were not matched for important details, i.e. an equivalence of baseline movement or body dissolution scores. It is not clear how successful her RD procedures were. Finally, data was not scored blind.

Lerner found that experimental subjects as compared to placebo control and drug control had a greater increase in weighted total movement scores following RD ($p < .001$) and an increase in body dissolution imagery from BL to RD ($p \leq .005$). Lerner's study is of interest because Cartwright and Ratzel (1972) also found an increase in movement after RD, but only for a subgroup of subjects--those who show a REM rebound (LOFs). Clemes and Dement (1967) found a slight nonsignificant decrease in movement on the Holtzman Inkblot test. Both Cartwright and Ratzel (1972) and Clemes and Dement (1967) explain their results as evidence of a slight tendency to become more involved in internal processes following RD. One possibility is that Clemes & Dement's subjects were HOFs. This would explain the disparate results (i.e. these subjects would not show an increase in movement according to Cartwright. Another important variable is the amount of RD. There were three deprivation days for Cartwright's subjects vs. six for Clemes and Dement's subjects. Thus subject variables as well as the amount of RD may be important to consider when assessing the effects of RD. Short and long periods may yield different results, especially in conjunction with individual differences.

Feldstein (1972) found an increase in M, using Holtzmann's scoring system in response to Holtzman plates, which were presented to his 19 subjects on the morning after the 3rd RD night. He also found an almost statistically significant increase in pathognomonic verbalization. This increase in pathognomonic verbalization was significantly greater for the field independent group (a group that would also correspond to Cartwright's LOFs).

Agnew, Wilse, Webb and Williams (1967) compared Stage 4 and Stage REM deprivation. Twelve subjects slept for 4 undisturbed nights followed either by 7 nights of Stage 4 or 7 nights of Stage REM deprivation, followed by 3 R nights. The method of arousal was a 200 msec shock of 5 to 15 ma. Subjects were measured on the pursuit rotor, grip strength, discrimination reaction time and an addition test, during deprivation and R nights. In addition, the MMPI, Pensacola A scale, Taylor Manifest Anxiety and Cattels 16 PF test were given prior to the beginning of the experiment and after the seventh night of deprivation. Psychologically,

> important differences were noted between the two types of deprivation when the personality tests were assessed. During Stage 4 deprivation . . . overall the impression suggested a depressive and hypochondriacal reaction. During 1-REM deprivation the testing revealed the subjects became less well integrated and less interpersonally effective. They tended to show signs of confusion, suspicion and withdrawal. These subjects seemed anxious, insecure, introspective and unable to derive support from other people.

No statistical treatment of the psychological data is reported. FInally, no significant deprivation effects could be established with the paced addition, the strength of grip or the pursuit rotor tasks for either Stage 4 or Stage 1 deprivation.

Again, there seems to be little effect on motor behavior of RD. Although some personality changes were noted, the data is anecdotal. There is no report of how well the two groups were originally matched on psychological variables except to say that subjects were preselected by the MMPI in order to obtain persons with "good psychological ability." Finally, an unorthodox arousal method was used, one we could assume to be more stressful than hand awakenings. It is difficult to separate what might be stress and fatigue effects from those of either Stage 4 deprivation or RD.

Lewin and Glaubman (1975) hypothesized that REM sleep (which they equated with dreaming) was necessary for tasks that demand divergent thinking, but not for tasks which call for adherence to the information given (i.e. rote learning). RD would be associated with lower performance on divergent thinking tasks, and increased performance on rote learning tasks. Twelve males were given 4 tasks in the evening of the RD night (serial memory, free recall, Guilford's word fluency and Guilford's utility test) and told they would have to perform them in the morning. Before discussing their results, let us point out that there were insufficient BL and R nights and that control and experimental conditions were not counterbalanced. Therefore, positive results could be due to order effects. The measures of the utility test showed that RD was associated with impairment in number of words, spontaneous flexibility, originality and uses fluency. On the serial memory task, RD resulted in better performance, as predicted.

Glaubman, Orbach, Aviram, Freider, Freeman Pelled and Glaubman (1978) sought to correct the major methodological flaws of the previous study by counterbalancing experimental and control conditions. However, in their four night paradigm, there were insufficient adaptation nights. Subjects were given a divergent thinking problem (Guilford's consequences test) and a performance task. The consequences test was scored on four scales--number of words, fluency, flexibility, and originality. Fluency and flexibility were impaired following RD ($p < .05$, two tailed test). Originality was not significantly reduced. When Guilford's consequences test was scored for the degree of positive or negative adjustment responses, RD resulted in significantly fewer positive adjustment and total positive remarks. This was interpreted to mean that REM sleep plays a role in the adjustment to new situations. Glaubman et al. (1978) results are interesting in that they suggest a slightly different model of the effects of RD than previous studies. Glaubman et al. (1978) assume that REM sleep is that state in which one has access to divergent thinking, which they loosely define as comparable to Freud's primary process thinking, or creative thinking and oppose to "integrative or consolidating" thought. If one is deprived of an opportunity to work on a task during sleep in this manner, one will later be unable to use this form of thinking during waking. Underlying this is an assumption of the impermeability of sleep stages, and a belief that certain forms of cognition are tied to a physiological process. REM is seen as a time to problem solve and integrate learning, following models for sleep proposed by Greenberg (1974) and Breger, Hunter and Lane (1967). In contrast, the model implied by Clemes and Dement (1967) and Sampson (1966) is a discharge model, where REM sleep is associated with more primary process or dreamlike thought, and can serve as a vehicle for the discharge of drives. When this outlet is blocked there may be an intrusion of such modes of thinking into waking fantasy. Neither model examines the possibility that modes of cognition may be tied to a physiological parameter to a varying degree for different individuals. Nor do they examine that there may be baseline differences in the amount of access one normally has to primary process thinking. Contradictory results in (Glaubman et al., 1978, the effects of loose or primary process thought are reduced following RD, in Clemes and Dement, 1967, Sampson, 1966, there is more evidence of primary process following RD) can be explained largely in terms of their differing definitions of primary process and in the inadequacy of Guilford's Consequences test as a measure of primary process thought.

An interesting study which provides evidence that the effect of RD on waking functioning may be related to the personality characteristics of a subject was done by Zarcone, Zukowsky, Gulevich, Dement and Hodes (1975). Zarcone et al. administered half of the Rorschach before and half of the Rorschach after 2 consecutive nights of RD to 4 schizophrenics and 5 nonpsychotic controls after they had undergone 3 to 11 BL nights. Rorschach responses were scored by Holt's primary process scoring system and included the following variables: degree of blatency in the expression of primary process, adaptive or maladaptive process, adaptive or maladaptive regression, form level and formal deviations in thinking. When responses were analyzed regardless of diagnosis (BL scores were compared with corresponding post RD Rorschach scores) no significant differences were found. A second analysis compared schizophrenics with controls in BL and post RD conditions. While BL scores were not significantly different for the two groups, their post RD scores different significantly. The schizophrenic group showed more blatency in the expression of primary process and more maladaptive ways of handling primary process material. Methodological problems with this study include the lack of a NRD condition, the fact that Rorschachs were not scored independently by two judges, and the lack of split half reliability data on the Rorschach.

Summing up the studies, we see no effects of RD on motor performance, i.e. digits forward or backward (Kales et al., 1964, Sampson, 1966, Agnew et al., 1967). Lewin and Glaubman did see better performance on serial memory following RD, but this could be due to order effects in their study. Sampson (1966) did see some increases in oral phenomenon and loss of sense of reality, in agreement with Dement (1960) but neither he or Dement specified on what criteria his observations were made. Clemes and Dement (1967) found a number of results following RD on the Holtzman, as did Lerner (1966) and Feldstein (1972). Their different findings in the amount of projected movement following RD could be explained by taking into account individual differences.

Overall, this particular area of the RD literature is riddled with contradictory results. It is difficult to summarize because: (a) too few subjects were used in any one experiment, (b) few studies took into account the effect of individual differences when looking at RD effects on waking psychological functioning, (c) differing methodologies and measures were used to assess the effects of RD. However, it is interesting that individual differences seem to be related to the response to RD, both in terms of physiological response as well as psychological response. Finally, we can say that the most promising direction in which to look for results are in terms of tests that measure fantasy and imaginal processes, rather than motor behavior or paper and pencil type inventories. A useful direction for further research would be an attempt to specify what constructs might underlie the fantasy material which does change following RD.

RD and Sleep Mentation

Since there seems to be a need, in most individuals for compensation of the physiological aspects of REM sleep after deprivation the question arises whether there is also a need for compensation of the dream experience. Predictions from classical psychoanalysis (Freud, 1905) would lead us to believe that this would be the case. In addition, the physiological components of the REMP become less cohesive during REM deprivation. During deprivation penile erections (usually associated with REM sleep) are seen in NREM sleep as well. Sampson (1966) noted brief REM bursts with segments of EEG Stage 1 "intruding into NREM sleep." Similarly, de Barros, Goldsteinas and Lairy (1973) noted an increase of intermediate stage sleep (a stage of sleep with features of both REM and Stage 2 sleep) following RD. Thus, is the physiology of REM sleep becomes less cohesive during RD, it is possible that the psychological experience of vivid dreaming normally associated with REM sleep may also occur in other psychological states. Even under normal conditions a significant amount of dreaming goes on during Stage 2 sleep and Stage 1 NREM (Foulkes, 1967; Schwartz, Weinstein, & Arkin, 1978). In addition, Foulkes and Fleisher (1975) reported that subjects who were awake according to both EEG-EOG and subjective criteria reported mentation that was hallucinatory 19% of the time and regressive 25% of the time when mentation was scored by criteria usually applied to sleep mentation. In short, waking thought is subject to momentary intrustions of bizarre and vivid content, even without the use of specific induction techniques.

There has been little direct examination of this question. The first was Pivik and Foulkes (1966) finding that within one night dream content elicited following RD was intensified compared to that elicited under control conditions. This finding was true for a certain subgroup of subjects only, those who scored on the repression end of the Byrne Repression-Sensitization scale. A subsequent attempt to extend these findings to a cross night design (Foulkes, Ahrens, Pivik, & Swanson, 1968) used only represser subjects and showed no evidence of dream enhancement following RD. A third study by Dement (1967) is cited by Arkin, Antrobus, Ellman, & Farber (1978). Dement found that in six adult subjects dreams on the first R night following six nights of RD were more active than those on the first R night following six nights of NRD.

Arkin, et al. (1978) attempted to assess the effect of RD on NREM mentation in a well controlled study of 20 male subjects who were light sleepers and good dream recallers. The methodology of this study will be described in detail in the Methodology section. The effects of RD on mentation were as follows: Comparisons of mean ratings of dream like mentation on stage REM vs Stage 2 deprivation nights revealed no significant differences between these two conditions (*t* for Stages REM and 2 together = -.04, Stage REM alone = .57, for Stage 2 alone = -.1). In addition RD had no effect on mentation associated with sleep onset Stage 1 NREM.

Although the results of Arkin et al. (1978) speak against the hypothesis that RD affects sleep mentation, we must note that individual differences were not taken into account. Secondly, we have seen, in our review of the effects of RD, that the choice of task is crucial. It is possible that the Foulkes DF scale, which has been used in a number of these studies is not the most appropriate measure with which to test the effects of RD. It combines at least three components (hallucinatory, or how real the dream felt, bizarreness, and conceptual vs. perceptual) of a dream report into a single global score. Schwartz (1979) has shown that at least one of these components is a variable which differs between individuals as well as between sleep stages. In addition, Vogel, Foulkes and Trosman (1966) in their study on sleep onset mentation suggest that these functions may not always correlate. When sleep onset reports were most dreamlike in one way (regressed and bizarre) another ego function showed the least inhibition--subjects retained reality contact, and did not believe their experience was really happening. Mentation scales which are able to differentiate phasic and tonic arousals might be useful, since some studies (e.g. Rechschaffen & Chernick, 1972; Roffwarg, 1975) show an increase of phasic activity outside the REM following RD.

REM Sleep and RD in Schizophrenia

As far back as Bleuler (1890) people compared schizophrenia to the dream process. After the discovery of REM sleep the initial thought was that there would be some REM sleep abnormality in schizophrenia. Early studies failed to bear this out. No manifestations of REM sleep were found in waking schizophrenics (Rechtschaffen et al., 1964) and no marked deviation was found in REM percent during sleep between chronic schizophrenic patients and normals (Dement, 1955; Feinberg, Koresko, Gottleib, & Wender, 1964; Feinberg, Koresko, Heller, & Steinberg, 1965; Hartmann et al., 1966; Jus et al., 1968). No difference was found in REM percent between hallucinating and nonhallucinating schizophrenics (Koresco, Snyder, & Feinberg, 1963).

Two studies of chronic schizophrenics did find sleep abnormalities. Gulevich et al. (1967) reported an increased amount of REM in a group of 13 chronic unmedicated patients, compared to 7 non-psychotic controls, in contrast to Azumi (1966) who found less REM sleep in a group of 35 chronic schizophrencis than in 33 normals. Gulevich's study seems compatible with Feinberg et al., (1964) finding that short term (< 1 year) schizophrenics have significantly lower REM time than long term (> 1 year) schizophrenics. Gulevich's patients seem to be in more stable remission than Azumi's chronic patients, as Azumi defines chronic as irreversibility or process schizophrenia and not active symptomatology. Lairy (1965) confirmed the presence of low amount of REM in disturbed patients as did Vincent et al. (1968) Rogina et al. (1968) and Kupfer, Wyatt, Scott, & Snyder (1970). However, as Gillin and Wyatt (1974) point out not all so called acutes have low amounts of REM. These discrepant results could reflect differences in symptomatology, severity, length of illness or past use of drugs--all factors which must be taken into account when evaluating studies in populations with psychopathology.

The longitudinal studies of schizophrenia suggest that those schizophrenics who suffer loss of REM during an acute psychosis do not show REM compensation. Kupfer et al. (1970) in a study of six acute schizophrenic patients showed marked reductions in REM percent, REM activity and NREM sleep were present during the waxing phase of illness. In the waning phase there was a gradual restoration of normal sleep patterns with REM returning to normal slower than NREM. So, while there is a marked REM deficit during the waxing phase, there is little increase in REM time over that shown by normal controls during remission. The authors conclude that the loss of sleep in the acutely disturbed patient is a nonspecific concomitant of the inner distress of psychological decompensation. As Wyatt & Gillin (1975) point out, conclusions regarding the REM compensation hypothesis are difficult to make since no detailed data were presented from the two week period between the end of the waning phase of the acute psychosis and the beginning of the postpsychotic phase. In addition, the idea of REM compensation depends on knowledge of what is the "normal" or baseline pattern. This is difficult to ascertain with schizophrenic patients, as anxiety and distress are present before an acute psychotic break and continue well into the remission or recovery period.

Our theoretical interest in the literature on the effects of RD in schizophrenia grows from a belief that schizophrenics represent a population who exhibit an extreme absorption in internal fantasy and perceptions, to the extent that these preceptions cannot be clearly separated from external reality. This can be viewed as an exaggerated form of the same characteristic that seemed to pull together the findings on normals who responded to RD without showing a REM rebound. In addition, increased absorption in or influence by internally generated stimuli was characteristic of the post RD behavior of certain subjects as measured by projective test material.

Zarcone et al. (1968, 1969, 1975) have suggested that actively ill schizophrenics do not show a REM rebound, while inactive or schizophrenics in remission show a larger than normal (i.e. control group) rebound. Zarcone, Gulevitch, Pivik, & Dement (1968) studied 12 male patients divided into 3 groups--6 schizophrenics in remission, 3 actively ill patients and 4 control personality disorders. Medication was continued unchanged throughout the course of the experiment. The paradigm was 3 to 11 BL nights, 2 RD nights and 5 R nights. On RD nights REM was reduced to 25% BL level and TST was reduced to 75% baseline TST. The inactive schizophrenics showed "dramatically high" nightly REM sleep times following two nights of partial REM deprivation (215% of BL REM time). The mean percentage elevation above baseline for the group on each of 5 R nights was significantly different from control ($.005 > p > .001$). Latency was significantly reduced below baseline average latency ($.05 > p > .025$). The three patients who were deprived while actively ill failed to rebound comparable to the control subjects. There was "no significant excess REM sleep time above the baseline mean" on each of the five R nights.

Zarcone, Azumi, Dement, Gulevich, Kraemer & Pivik (1975) published statistical data for the seven nonschizophrenic controls and the nine active schizophrenic patients they had studied. During baseline sleep the only significant difference between the two groups was that schizophrenics had more Stage 3 and 4 sleep. During recovery the actively ill group showed no change from baseline in any sleep measurement. The control and schizophrenic groups different significantly on total REM time and on percent REM time on R nights ($p < .05$). However, change in total sleep time is correlated with both change in total REM time ($r = .57$) and with change in percent REM time ($r = .43$) in control group. So, within the control group some amount of REM rebound is attributable to an increase in TST. Sleep loss may also have been a factor in Zarcone et al's results, since the overall sleep time on RD nights was reduced by as much as 40% in some patients.

The Zarcone et al. studies contain numerous methodological flaws. First, the use of phenothizines could confuse nonspecific drug effects with the effects of RD, as Cohen (1968) and Kupfer (1970) have demonstrated. Zarcone's published data shows considerable variability in the amount of REM compensation within the actively ill group and the control group. Feinberg (9169) has criticized Zarcone's studies because patients and controls were not well matched for baseline sleep characteristics, age and anxiety. Vogel (1974) claimed that by a Mann-Whitney U test there were no significant differences between the schizophrenic and control patients for total REM time on the first R night ($p > .3$) and for the average nightly REM percent of the five R nights ($p = .2$). Vogel concludes that Zarcone's data actually refutes his hypothesis, although as Ellman et al. (1978) point out in an excellent review of this literature, the Mann-Whitney U test that

Vogel uses in his analysis is as a low power nonparametric statistic. Finally, Zarcone's use of multiple t tests in the data analysis can yield spuriously high rates of significance.

Azumi, Takahashi, Takahashi, Maruyama and Kikuti (1967) studied 4 normal controls and 3 drug free chronic schizophrenics over 4 to 5 BL nights, 5 RD nights and 3 to 4 R nights. In two of the three schizophrenic subjects there was only a slight increase in REM sleep over Bl on recovery nights. Similar criticisms to those raised of the Zarcone studies can be raised about Azumi et al. (1967). There were too few subjects for any statistical treatment, and there was a lack of an appropriate control group since the schizophrenics were older than the controls, and were not matched for anxiety for length of hospitalization. Vogel (1975) in a reanalysis of Azumi's data found no significant differences between schizophrenic and control groups in various measures of REM rebound, but his use of the Mann-Whitney U test remains questionable.

Vogel and Traub (1968) REM deprived five chronic schizophrenic patients, four of whom were on daily maintenance doses of phenothiazines which were continued unchanged during the course of the experiment. The following schedule was used: 2 to 3 BL nights, 7 RD nights and 5 R nights. Awakenings were made by hand and the administration f dextroamphetamine. Nembutal was used to insure that subjects would fall asleep. Their results show schizophrenic patients responded to RD both qualitatively and quantitatively similarly to normals. Mean baseline REM percent was in the normal range of 23.1%. During RD subjects showed a progressive increase in the number of awakenings needed to successfully accomplish deprivation. REM latency during baseline was 85 minutes. During deprivation REM time was reduced to 7% TST, and rose to 35.5% TST by the fifth post deprivation night. For the group as a whole the mean REM percent on the first R night was 153% BL REM ($p < .025$, one tailed test).

Problems with this study include the fact that the clinical status of these patients was not spelled out, although Gillin et al. (1974) states that Vogel's patients were "active to an unquantified degree." RD awakenings were accomplished without the routine use f EMG criteria. No control group was used for comparison, TST was allowed to vary and increased during the recovery period. The confounding variable of amphetamine administration during the deprivation period confuses the effects of RD with nonspecific drug effects, and makes the study virtually uninterpretable.

De Barros-Ferreira, Goldsteinas & Lairy (1973) REM deprived 11 chronic female schizophrenics and 5 control subjects. Eight of the 11 patients were on phenothiazines, although drug doses were reduced to minimal doses. The paradigm was: 3 BL nights, 3 RD nights and 3 R nights. Awakening criteria was based on the appearance of REMs in the EOG. The authors state that all patients exhibited a REM rebound similar to that of control subjects. Records were not scored according to standard criteria. Intermediate Stage (IS) sleep (either the same EEG pattern as that of REM sleep but without REMs or a pattern common to fast sleep and stage 11 low voltage fast EEG alternating with spindles or K complexes, also without REMs) was tabulated along with REM (defined as the time of fast sleep occurring between the first and the last eye movements of each cycle). IS sleep was higher in schizophrenics than controls, during all three periods (BL, RD, and R nights). In both patients and controls, the amount of IS increased during the deprivation period.

No statistical comparison was presented between controls and patients, and the medication and clinical status of the patients as stated is vague. Control groups were inadequate, being younger than the patients, drug free, and having a lower TST. The authors allowed TST to vary from BL to recovery nights. Although the authors feel that their data confirms Vogel and Traub's (1968) finding of normal REM rebound in chronic schizophrenics, their use of nonstandard scoring criteria belies any comparison of the two studies. In addition, Zarcone (1975) has noted some difficulty in replicating the de Barros et al. finding of an increased IS in schizophrenic patients during deprivation.

Gillin, Buchsbaum, Jacobs, Fram Williams, Vaughan, Melton, Synder, & Wyall (1974) REM deprived eight actively ill schizophrencis and eight age and sex matched nonpsychotic psychiatric controls. Except fr one patient who received a low dose of chlorpromazine, the patients were drug free. During BL no significant differences in sleep were observed between schizophrenics and controls. Subjects were studied from 2 to 4 BL nights, 2 partial RD nights and 5 R nights. RD was accomplished by awakening the patient as soon as REM sleep was identified by polygraphic recording, usually with the first eye movements.

During BL, the actively ill schizophrenics and controls had similar sleep patterns. During the two deprivation nights, the two groups achieved a comparable level of RD. They were also similar with respect to changes relative to baseline REM percent TST, RD, and stages 3 and 4. The actively ill group needed less awakenings/night to achieve the same level of RD as controls ($\underline{p} < .05$, one tailed test). During recovery controls showed a normal REM rebound pattern. The actively ill schizophrenics showed almost the same amount of REM and percent REM as during the baseline period and remained at or near baseline level for the five recovery nights. On the first recovery night controls showed a significant ($\underline{p} < .0025$ one tailed test) rise over BL REM values while controls showed a slight insignificant decrease from BL to the first R night.

The major confounding variable is that the nonpsychotic controls average 53 minutes more total sleep time on the 1st R night compared to BL nights and 71 minutes more total sleep time on the 1st R night than did the actively ill group. Ellman (1978) suggests that the actively ill group might be showing something similar to a first night effect on the first R night, and are having suppressed REM due to their increased vulnerability to disruption. As evidence, he cites that the actively ill patients do seem to show some signs of rebound on R night 3. On the third recovery night, the actively ill patients showed a small nonsignificant elevation of REM time, REM percent and TST. In addition REM latency was low for the active group on that night. Also, on the 1st and 2nd R nights the activity ill group did show some signs previously associated with increased REM pressure (nonsignificant increases in REM density and shortened latency). THus, the actively ill group may be showing a rebound in a fragmented form. This suggested that phasic events (i.e. REM density) and amount of REM time might be alternative ways of showing REM rebound. If we consider Dement's (1968) notion that the trigger for REM rebound may not be REM time per se, but phasic activity (the evidence for this prediction will be reviewed in the next chapter), than these fragmented forms of sleep may be evidence that the schizophrenic patient is discharging phasic activity outside of REM sleep, and hence not showing the classical REM rebound pattern. At any rate, it is a good idea to combine REM density measures, REM time measures and IS sleep measures to obtain the best picture of REM rebound in the actively ill patient. One of the methodological problems with Gillin et al.'s study was the use of multiple _t_ tests, which raises the _p_ level of the overall experiment. If one were to calculate the experiment wise _p_ level, a number of results would no longer reach significance. However, Gillin et al.'s study does remain the best controlled and statistically sophisticated one in this area to date.

In attempting to make sense of the conflicting results so far presented, we agree with Wyatt (1975), Vogel (1975), and Ellman (1978) when they state the studies are not definitive due to the methodological flaws we have spelled out in the individual reviews. There are numerous methodological issues in studying a psychopathological group. A clear statement of the clinical status of the patient is essential, since results suggest that chronic and acute schizophrenics may have a different response to RD. However, the difficulty of insuring homogenous groups is well known, since there are few reliable differential criteria for schizophrenia. To the extent possible patients should be drug free prior to the onset of the experiment, as Kaplan, Dawson, Vaughan, Green, and Wyatt (1974) and others have shown that antipsychotic medication does affect BL sleep measurements. Total sleep time should be kept constant. In order to do a meaningful statistical comparison with a control group, controls should be matched (as far as possible) for age, sex, medication, anxiety levels, and length of psychiatric hospitalization. All the previous experiments used too small a sample size. Finally, studies are only comparable when the same criterion (e.g. Rechschaffen-Kales criteria vs. de Barros-Ferreira et al.'s criteria) are used to score the data.

Overall, Gillin et al.'s (1974) data that actively ill schizophrenics do not show a REM rebound are to be taken seriously, especially in conjunction with the three supporting studies of Zarcone (1968, 1969, 1975). Vogel and Traub's (1968) study did not show these results, but this could be attributable to the use of amphetamine, nembutal and phenothizines and the failure to equate TST from BL nights to R nights. Zarcone (1974) has explained his different results from Vogel and Traub by saying there is a continuum of response to RD and some patients might respond at the level of normal subjects. Thus Vogel's patients are seen as being in between Zarcone's active and chronic patients. De Barros et al.'s (1973) is the only study besides Vogel and Traub which shows a normal REM rebound in schizophrenics but this study does not add any information to the active vs. remitted controversy because all the patients studied were chronic and the authors did not score sleep according to conventional criteria. The balance of evidence lies on the side of the studies showing that actively ill patients do not evidence a normal REM rebound following RD. However, Vogel (1975) makes the important point that lack of REM rebound may not be a distinguishing factor of active schizophrenia, as there are normals who don't show REM rebound (e.g. Cartwright, 1967, 1972; Pivik & Foulkes, 1966). Schizophrenic subjects could constitute a biologically heterogenous group in which some have low REM rebound and some show a normal REM rebound. Similarly, schizophrenia as an entity may be imperfectly correlated with more fundamental variables that really determine REM rebound and are not limited to schizophrenia. For example, in Gillin's (1974) study and in Cartwright's (1976) field independence is one factor correlated with REM rebound. This research for underlying personality factors (which would be present in normal and pathological populations) is, in part, the focus of the present research.

Summary of the RD Literature

While the response of compensation following RD is a well documented phenomenon, there seems to be a group of subjects who do not show the classic REM rebound noted by Dement (1960) and others. Although the few studies examining individual differences (Cartwright & Ratzel, 1972; Foulkes, Pivik, Ahrens, & Swanson, 1968; Pivik & Foulkes, 1966; Nakasawa et al., 1974) are riddled with methodological flaws, it seems that an examination of the apparently diverse correlations between personality measures and patterns of sleep and dreaming suggests a personality factor which might be related to the response to RD. Subjects who did not show a REM rebound tended to be more sensitive to their internal fantasy, and to be relatively more influenced by internal percepts than rebounders. Included in this subgroup of subjects are actively ill schizophrenics--a group who shows extreme confusion in their perception of internal vs. external events (Freeman, Cameron & McGhie, 1958).

If we conceptualize the tendency to be absorbed by internally generated stimuli as a psychological trait which interacts with the underlying arousal state (REM, NREM and waking), we recome curious as to whether the nonrebounding subjects will experience greater involvement in their mental experiences during NREM sleep or if there is less difference between their REM mentation and NREM mentation on a number of dimensions. What evidence is available suggests that this is the case. Cartwright's (1972) HOFs showed more dreamlike fantasy when awakened at REMP onset, and tended not to show a REM rebound. Thus, the ability to confine the most intensely dreamlike activity to the REMP seems to be correlated with the ability to exhibit a classic REM rebound. Cartwright (1972) present a model of baseline mentation which utilizes three groups which would roughly correspond to three points on the continuum of involvement in internally generated stimuli. The first group, schizophrenics are extremely absorbed in their inner life. They tend to show an equal level of fantasy behavior in all three arousal states. A second group (she refers to them as normals with high MMPI SCk scores) remain reality oriented during waking, but have more "dreamlike NREM" mentation as well as REMP mentation. Finally, normals with low ScK scores, or in our model those who could clearly separate internal and external percepts, confine their dreamlike fantasy to the REMP. One possibility is that subjects who do not normally confine their most intense dreamlike fantasy to the REMP are more able to displace this fantasy to NREM or waking during RD.

The studies examining if there is an increase in dream intensity following RD have been equivocal. Pivik and Foulkes (1966) found that dream content elicited following RD was intensified compared to that elicited under nondeprivation conditions for their represser subjects, but this increase took place in subsequent REM periods. Arkin et al. (1978) found no increase in NREM dreaming following RD. The literature on waking effects of RD shows that some measures change following RD. These measures (M+, M:C ratio on the Rorschach, fabulation on the Rorschach, and Holtzman), can be to some extent understood as tests which tap into a subject's sensitivity and ability to make use of internal imagery. However, in these studies, individual differences were not taken into account, which may explain the many contradictory results. We would suspect that changes in waking fantasy measures could be predicted only for a certain subgroup of subjects. Interestingly, one measures that does increase following RD (fabulation) has been found to be useful in discriminating the Rorschach records of schizophrenics (Blatt, 1977 unpublished). As we have spelled out, there is some evidence that actively ill schizophrenics do not show REM rebound.

The question remains as to why there should be a link between a psychological parameter (one's sensitivity to internal experiences) and a physiological measure such as the response to RD. This led to a search for an underlying physiological parameter which could be the mediator for REM rebound, and also be related in some manner to the aforementioned trait. In the next chapter, the data on phasic activity, it's contribution to mentation qualities, and the evidence for its being the crucial physiological variable in the response to RD will be reviewed.

Chapter III

PHASIC ACTIVITY: ITS RELATIONSHIP TO REM REBOUND AND QUALITIES OF SLEEP MENTATION

Our interest in individual differences and the response to RD as well as changes in sleep mentation following REM deprivation had come largely from previously unclarified results in human sleep research. There is, however, a supportive line of animal sleep research which has grown out of the distinction first made by Moruzzi (1963) between phasic and tonic events in REM sleep. Tonic events are long lasting changes which are continuously maintained throughout the REM period and consist of a fast low voltage cortical activity similar to that of waking, an absence of electromyographic evidence of muscular activity and brain temperature elevation. Phasic events are short lasting and discontinuous and include eye movements (EMs), middle ear muscle contractions (MEMAs) EMG hypersuppressions, cardiovascular irregularities and bursts of monophasic sharp waves that characterize the electrical activity of the pons, oculomotor nuclei, lateral geniculate nuclei and visual cortices during REM sleep (PGO spikes). Although the initial phasic and tonic distinction was made with respect to REM sleep, subsequent research has shown that all phasic activity is not confined to REM sleep, but occurs in NREM sleep as well.

PGO spikes are thought to be the primary triggering event for phasic events in general (Dement, 1968). They occur at a fairly constant daily rate, and are most concentrated in REM sleep, although they also occur occasionally during NREM sleep and wakefulness (Brooks, 1968; Dement, 1968; Thomas & Benoit, 1967). It has been shown that phasic and tonic events can be dissociated (Delorme, Jennerod, & Jouvet, 1965; Jouvet & Delorme, 1965; Morrison & Pompeiano, 1970). Dement and his colleagues (Cohen, Mitchell, & Dement, 1968; Ferguson & Dement, 1968; Ferguson et al., 1968) performed a series of experiments designed to tease out the trigger for REM rebound and to explore the tenacity of the association of the phasic and tonic events of REM sleep.

One experiment involved the chronic administration of PCPA. Cats, maintained on 150 to 300 mg/kg of PCPA per day underwent sleep changes and major behavioral alterations. The initial effect of PCPA administration is a slight increase in the number of PGO spikes in REM sleep. This is followed after one to two days by the breakthrough of PGO spikes into the waking state, and a number of other concomitant behavioral changes. As Dement (1968) describes, an almost total insomnia develops, "hallucinatory" behavior begins to accompany bursts of spikes and hyperphagia, hypersexual and hyperaggressive behavior is seen. After three to four days of PCPA administration, animals begin to sleep, and by the fourth or fifth day, they show both REM and NREM sleep. However, PGO spikes are occurring not only in REM sleep, but in NREM and waking as well. Overall, other investigators have reported data confirming the behavioral effects of PCPA (Sheard, 1969; Tagliamonte, Tagliamone, Gessa, & Brodie, 1969) although Zitron, Beach, Barchas and Dement (1970) did not find hypersexual behavior in their animals.

Delorme, Jeannerod and Jouvet (1965) had showed that REM periods were abolished by high doses of reserpine (.5 mg/kg) in the cat, but that a continuous spike discharge was evident throughout the period of suppression. This prolonged suppression of REM was not followed by REM compensation. Dement and his colleagues reasoned that if PGO spikes are the trigger for REM rebound, than cats maintained on PCPA should fail to show a compensatory increase in REM time following RD. In fact, this was the case.

Feguson and Dement (1968) showed that following prolonged REM suppression, phasic events increased in frequency as a function of prior RD. This suggested another mode of compensating for REM sleep--changes in the frequency of phasic activity, as opposed to simply making up lost REM time. Furthermore, when Ferguson et al. (1968) REM deprived animals by awakening them at the first noticeable PGO spike in NREM sleep prior to the REM period, this "spike deprivation" resulted in a larger REM rebound than a control experiment where the same animals were awakened by standard RD procedures. However, this result might simply be the consequence of a more efficient RD procedure. There was no proof that it was the deprivation of PGO spikes that led to the enhanced rebound. Finally, Dement and his colleagues attempted to "gently awaken" the animals in order to prevent REM sleep, but still allow the buildup of NREM PGO spikes. After two days of this procedure, there was a very small or nonexistent REM rebound. Dement felt that this constituted proof that PGO spikes were the trigger for REM rebound, but this experiment and the gentle awakenings technique have not been replicated.

Despite methodological difficulties and an absence of replication, Dement's studies do suggest some interesting possibilities. First, that REM sleep is not a unitary entity, but rather a convergence of a number of processes which usually occur together, but can be dissociated under certain conditions. Secondly, that the crucial variable in the occurrence of REM rebound may not be REM time per se, but rather phasic activity. IF phasic events are somehow displaced or dissociated from tonic REM events, REM rebound will not occur. Finally, hallucinatory behavior may be associated with PGO spikes in the waking state.

Dement's anecdotal evidence that animals seem to show "drive" behavior following the displacement of PGO spikes to waking suggests a metaphorical comparison to the behavior of schizophrenics. More specifically, these hypotheses led Zarcone (1968, 1969, 1975) and Gillin et al. (1974) to perform RD studies with schizophrenics. They postulated that in schizophrenic patients, REM phasic events are dissociated from REM tonic events and can occur during NREM sleep or in waking. Phasic activity occurring in the waking state is seen as contributing to the hallucinations that frequently occur in acute schizophrenic patients. The prediction derived from this line of reasoning is that hallucinating or "actively ill" schizophrenics should not display a REM rebound in response to RD. Dement seems to be postulating that the capacity for the dissociation of phasic and tonic REM events is a temporary capacity, one that is not present in schizophrenics in remission or chronic schizophrenics. It seems that looking at the literature on RD and schizophrenia, serious questions can be raised about the exclusiveness of the relationship between acute schizophrenia and the lack of REM rebound. These questions are compounded when the data on normal subjects who do not exhibit REM rebound following RD are considered (e.g. Cartwright, Monroe, & Palmer, 1967; Cartwright & Ratzel, 1972; Nakasawa et al., 1975).

It seems that Dement's argument hinges, in part, on the belief that PGO activity occurring during waking contributes in an unmediated way to hallucinatory like behavior. Since there has been no demonstration of PGO activity in the human, a direct application of his data has been impossible. However, there are probable correlates of PGO activity in man. We will briefly review the literature on phasic activity in humans, and attempt to conceptualize what phasic activity might contribute to ongoing mentation.

The most likely candidate for a PGO spike analogue is eye movement activity, since PGO spikes and eye movements are highly correlated in the act. Although REMs have been seen in NREM sleep in humans (Jacobs, Feldman, & Bender, 1965) these authors used DC recording which precludes accurate assessment of the number of eye movements. As Messin and Kripke (1974) note, while the EOG is an excellent indicator of REMs during REM sleep, EEG slow waves are often also recorded by the same electrodes and rapid eye movements are obscured during NREM sleep. Thus, little research has been done examining the relationship between the amount of NREM eye movement activity and REM rebound.

Rechtschaffen, Molinari, Watson and Wincor (1970) found that periorbital integrated potentials (PIPs) accompanied all unambiguous eye movements in REM sleep and also occurred independently of eye movements. Like PGO spikes, they could be recorded from NREM sleep, and like PGO spikes during NREM they occur with the greatest frequency shortly in advance of the REM period. Rechtschaffen and Chernik (1972) found that PIPs increase in NREM sleep following RD. Wyatt, Gillin, Green, Horowitz, and Snyder (1972) reported briefly on the administration of PCPA to four human subjects. Drug administration was followed by a fourfold increase in the ratio of NREM PIPs/minute to REM PIPs, as compared to baseline. This occurred at a time when REM sleep was 30% below baseline. No data was given on the total amount of PIPs. Watson, Liebman and Watson (1973) recorded the sleep of two acute schizophrenic subjects during every fourth and fifth night of the patient's hospitalization. They found the percentage of 30 second NREM epochs containing PIPs ranged from 50 to 60% in both patients during the initial phase of their illness while the percent of REM sleep was "below normal." When the patients improved clinically, they showed normal REM values and the NREM PIP percentage returned to 5 to 15%. While the conclusiveness of this study is limited by the fact that there were only two subjects, it does provide a striking parallel to Dement's cat data in that phasic activity was accompanied by bizarre behavior at a time when it occurred outside of REM sleep. However, Metz, Pivik and Rechtschaffen (1975) suggest PIPs may not really be a good indicator of PGO spikes in NREM sleep.

MEMAs (spontaneous contractions of the middle ear muscles) were first studied in the human by Roffwarg (1972). MEMAs appeared during every REM period, generally beginning at the onset of the REM period just before the first rapid eye movement. MEMAs build to an early peak in the REM period, then decrease in frequency before the end of the REM period. Lamstein, Roffwarg, & Herman (1975) suggest that the MEMA is a lower threshold indicator of REM activation than eye movements. The effect of RD on MEMA activity had been reported in one subject. On the first two deprivation nights, MEMAs in the absence of rapid eye movements appeared before EEG desynchronization. The proportion of NREM MEMA increased during RD (no statistics are reported) and MEMAs were seen during NREM sleep onset when a subject returned to sleep after an awakening. Pessah and Roffwarg (1972) studied five subjects and showed that MEMAs reflect considerable intersubject variability in terms of the total amount of MEMA/subject and the percent of MEMAs in REM sleep. However, within subject measurements were stable (no statistics reported). Comparable data on the stability of eye movement activity between nights was found by Feinberg (1974) and Clausen, Sersen and Lidsky (1974). This suggests that like PGO spike activity, the total amount of phasic activity in humans remains fairly constant from night to night.

Pivik and Dement (1968), Pivik, Halper and Dement (1969) and Pivik (1971) suggested that the transient suppression of submental EMG activity could be an analogue to PGO spike activity. EMG suppressions were similar in distribution to PGO activity. EMG suppressions were similar in distribution to PGO activity, occurred in both REM and NREM sleep, and were seen to increase in NREM sleep following RD. Furthermore, changes in EMG activity correlated with variations in amplitude of the monosynaptic H reflex, a reflex which is tonically inhibited during REM sleep and undergoes a more complete phasic inhibition during eye movement bursts. This observation further confirmed the EMG suppression--PGO spike hypothesis.

Studies of the mentation correlates of phasic activity have generally lent support to one implication of Moruzzi's (1963) model, namely that the phasic event is qualitatively different than the tonic activity which surrounds it. Within REM sleep all studies report a significant difference between reports associated with phasic activity, and those from tonic intervals. Bursts of rapid eye movements were associated with increased activity in the dream (Berger & Oswald, 1962; Dement & Wolpert, 1958; Pivik & Foulkes, 1969), and with increased vividness and emotionality (Hobson, Goldfrank, & Snyder, 1965; Verdone, 1963). Ellman et al. (1974), in a well controlled study showed that within REM sleep dream reports associated with rapid eye movements were more "dreamlike" as measured by the Foulkes DF scale. Phasic activity in the form of PIPs was associated with more bizarreness and discontinuity in the dream report (Watson, 1972). Bosinelli, Molinari, Bagnaresi and Salzarulo (1974) found phasic activity was associated with reports that were less conceptual and thoughtlike, and had a greater feeling of self participation on the part of the dreamer. Pivik (1971) found greater aggression and more auditory sensations in phasic awakening reports. By and large these studies are difficult to compare because of the many different psychological constructs involved, the varying quality of the methodology, and small number of subjects in most of the studies.

Molinari and Foulkes (1969) and Foulkes and Pope (1973) sought to develop a construct which would distinguish phasic from tonic awakenings. Ten subjects who were judged on the basis of Fitzgerald's (1966) Experience Inquiry to be "relatively acceptant of their inner experience" slept in the lab for four nonconsecutive nights. Four awakenings per night were made from the following sleep stages: sleep onset stage 1, sleep onset stage 2, NREM ascending stage 2, REM-M with eye movements and REM-Q (after a burst of eye movements and at least 30 seconds of quiescent activity). Although the authors found no significant difference between REM-M and REM-Q on normal dimensions (hallucinatory quality, control over the course of mentation, felt participation in dream activity, felt body presence in dream activity, subjectively defined depth of sleep) they found that they could distinguish between REM tonic and REM phasic arousals by classifying the reports as Primary Visual Experience (PVE) or as Secondary Cognitive Elaboration (SCE). PVE was defined as watching an event in an intellectually passive way, without apparent reflection or cognitive elaboration upon the visual imagery. SCE was scored when the visual experience also included evidence of conceptual activity, or when there was pure conceptual activity alone. REM phasic awakenings were associated with PVE significantly more often than REM tonic awakenings ($p \leq .0005$). Similarly, NREM awakenings were characterized more often by SCE ($p \leq .05$).

While the Molinari and Foulkes (1969) study has been cited as proof that there is a direct correlation between physiological events and the quality of the dream report (e.g. Grosser & Siegal, 1971) a number of methodological problems make these conclusions tentative. First, the two raters were not blind to the awakening condition. As Herman, Ellman and Roffwarg (1978) have shown experimenter bias can be a factor in rating dream content. Secondly, the categories of SCE and PVE were not a priori categories, but were formulated after the authors looked at their data. Their statistical procedures were also questionable. As Ellman (unpublished) has noted, the use of the Sheffe test would be the most applicable to a post hoc analysis. At any rate, the authors "doubled" their probability of finding significant results by the use of a one tailed test. Finally, the authors confounded two variables--time into REM sleep and phasic vs. tonic awakenings. Since the REM period is a time of building phasic activation, it is most likely that REM-M awakenings were made later in REM sleep than REM-Q awakenings, which are most likely to occur earlier in the REM period. In addition, dream content has been seen to undergo changes with time into the REM period (Kramer, Czaya, Arand & Roth, 1974).

Foulkes and Pope (1973) attempted to replicate Molinari and Foulkes (1969) finding. They scaled dreams in three ways: using the SCE/PVE dichotomy on the first two open ended questions of the mentation interview, using subject's answers to questions directed to the presence or absence of SCE material on a sensory conceptual scale which used the whole interview and elaborating the SCE/PVE dichotomy into a five point rating scale of greater to lesser sensory vs. conceptual material, and on a scale of dream bizarreness. ALl three categories yielded equivalent recall of mentation. Visual imagery predominated in reports from all categories, irrespective of whether there were preawakening eye movements. Auditory imagery was seen equalling all categories and no differences were found in subject's degree of active participation in the dream. Foulkes and Pope (1973) were able to confirm the finding that the spontaneous report of PVE would discriminate between REM phasic and REM tonic awakenings. However, there was considerable shrinkage from Molinari and Foulkes (1969) findings of 88% PVE on REM phasic awakenings vs. only 20% on REM tonic arousals. The PVE/SCE distinction did not hold when no eye movement arousals were associated with sawtooth bursts, or when SCE material was scored in the protocol as well. In addition, when SCE/PVE distinctions were scaled rather than dichotomized, no significant differences were found between awakening categories. Although Foulkes and Pope represented a methodological improvement over the Molinari and Foulkes (1969) study, time into the REM period was not controlled in this study either.

In conclusion, the studies of mentation correlates of phasic activity in REM sleep support a phasic/tonic model of sleep mentation. But, they do not provide a unified conception of what the phasic event adds to mentation.

Because rapid eye movements are difficult to record outside of REM sleep, studies of phasic activity in NREM sleep focus on other phasic events--PIPs, MEMAs and K complexes, (which do not ordinarily occur during REM sleep). Rechtschaffen, Watson, Wincor and Molinari (1972) assessed NREM PIP activity, making awakenings under four conditions: (1) no phasic PIPs and no tonic priorbital activity

(2) PIPs with tonic eye movement activity, (3) bursts of tonic activity and no PIPs, (4) PIPs alone. PIP alone and PIP with tonic activity reports were longer and more highly distorted. Pivik (1971) found that the awakenings associated with the transient inhibition of the spinal monosynaptic H reflex which was coincident with EMG supressions yielded reports with more auditory imagery and hostility than nonphasic awakenings. Roffwarg (1975) has reported ancetodal data linking MEMAs with auditory imagery.

The K complex, although not ordinarily seen in REM sleep shows some similarity to PGO spike activity in terms of its distribution prior to the REM period, and in its reaction to experimental manipulation. Pivik, Halper and Dement (1969) found that high K complex frequencies were associated either with the most dreamlike mentation, or a complete absence of recall. Low rates of K complexes were associated with perceptual nonhallucinatory mentation, or conceptual mentation which could be either everyday or bizarre. Rados and Cartwright (1976) found that the density of K complexes was significantly related to bizarreness. Weisz (1972) making awakenings following a single K complex or sleep spindle did not find any difference between phasic and nonphasic reports. Nor did Ellman et al. (1974) who awoke subjects following either phasic EMG suppression with K complexes or without K complexes, or K complexes alone, and grouped all three awakening categories together in order to analyze NREM phasic awakenings.

In general, the data on NREM phasic activity is less definitive than on REM phasic activity and suggests that NREM phasic activity may interact with other variables (e.g. underlying tonic activity, arousal, frequency of phasic activity) in order to produce an effect. Summing up the studies of attempts to understand the effect of phasic activity on the quality of sleep mentation, Schwartz (1979) suggests that one concept which pulls together the many diverse measures is that the occurrence of phasic activity contributes to the suspension of reflective self representation. Reflective self representation is a clinical concept, an ego function first described by Schaefer (1968) which refers to an ability to perceive oneself as the person who is having a particular thought or fantasy. Its loss would lead to the belief that the thought or fantasy is real, and would be reacted to with real consequences, i.e. pleasure, anxiety, guilt, etc. It seems that a dream that is more active (Berger & Oswald, 1962), more "dreamlike" (Ellman et al., 1974), more emotional and vivid (Verdone, 1963) involves more self participation (Bosinelli, Cicogna, & Molinari, 1974) is more bizarre (Watson, 1972) and has decreased thought like properties (Bosinelli, et al., 1974; Foulkes & Pope, 1973; Molinari & Foulkes, 1969) would be more likely to be reacted to as if it were external and really happening because it is more compelling on a number of dimensions.

Schwartz (1979), studied 715 dream reports from 4 baseline nights of 20 male subjects in order to test whether the suspension of reflective self representation was associated with phasic awakenings. Dreams were rated on seven scales which were thought to be indicators of the suspension of reflective self representation. Dreams were collected during either phasic or tonic intervals of REM and NREM sleep. In addition social desirability response bias and daydreaming patterns of subjects were assessed via the MMPI and the Imaginal Processes Inventory. His results were that the suspension of reflective self representation was significantly associated with REM as opposed to NREM sleep, and within REM sleep with phasic as opposed to tonic intervals. However this latter effect was not significant for some indicators of the suspension of reflective self representation for subjects who were high on social desirability response bias. High school desirability response bias was associated with inhibition of phasic REM reports.

In our review of individual differences in response to RD, it was shown that subjects who did not show a classic pattern of compensation following RD tended to be more influenced by internal percepts, and to react to these percepts as if they were real. One hypothesis is that these nonrebounders are having phasic activation outside of REM sleep, and are reacting with a suspension of reflective self representation to their mental productions in NREM and waking. The fact that they are unable to confine phasic activation to REM sleep could also account for their lack of REM rebound.

A reexamination of the sleep data on those subjects who do not show a rebound shows suggestive evidence that they do not confine phasic activation to REM sleep. In Cartwright et al. (1967) the sleep parameters which seemed to explain the most variance in predicting personality characteristics were the number of awakenings necessary during RD, the amount of ambiguous time on the first R night and the amount of increase in REM sleep over BL nights during R nights. The number of awakenings necessary to accomplish RD is usually taken as an index of REM pressure. However, in Cartwright, Monroe, and Palmer's (1967) study, it did not significantly correlate with the increase in REM sleep on R nights, but did correlate positively and significantly with the amount of ambiguous time on the first R night. This suggested that it might be related to what Cartwright called unclarity, and what we would see as dissociation of phasic activity from REM sleep. To assume the number of awakenings is evidence of dissociation makes sense if it is kept in mind that the EMG criteria for carrying out RD awakenings if often, of necessity, more inclusive than the criteria for scoring REM sleep because awakenings are made at the first sign of REMs or at the appearance of low voltage mixed frequency EEG without REMs, and (as in Cartwright et al., 1967) without EMG criterion. Therefore, the number of awakenings necessary to accomplish RD might be the result of the appearance in the EEG of dissociated electrophysiological phenomenon usually seen within REM sleep. Thus, subjects who showed dissociation in their sleep cycle, also failed to produce a REM rebound, and were the same ones who were seen as having more access to fantasy in all levels of arousal. Similarly, in Cartwright and Ratzel (1972) the two groups being compared correspond to our model of subjects who do not confine phasic activity to the REMP. THe HOFs showed an increase from night to night in the number of awakenings necessary for RD, while LOFs did not. In Pivik and Foulkes (1966) it could be said that the increase in the proportion of REM sleep containing REM activity following RD represents a REM rebound in that the various components of REM sleep are occurring together, rather than being dissociated. Thus sensitizers, who did not show a REM rebound as so defined, may have been showing dissociation of REM components in response to deprivation, while repressers did not.

In sum, the data on the mentation correlates of phasic activity may provide the link between measures of REM rebound and personality data. We have seen from Dement et al. (1969) that the ability to confine phasic activity to the REM sleep is related to the amount of REM rebound shown in animals. In humans, we have also seen that phasic activity correlates with a quality of sleep mentation, namely the suspension of reflective self representation. This correlation seems most clear within REM sleep. The view that the nonrebounder is having phasic activity outside of REM sleep with a consequent loss of reflective self representation implies that there must be a direct unmediated psychophysiological correlate of each occurrence of phasic activity. This seems to be a somewhat simplistic view. Rather it appears that a more reasonable way of conceptualizing this connection is that the chronic recurrence of a particular psychological state (the suspension of reflective self representation accompanying the occurrence of phasic activity, for example) will eventually give rise to the development of some adaptation. One such adaptation might be the development of a cognitive style, which incorporates some similarities and features of the suspension of self representation, but which may later become independent of or only roughly correlate with a particular physiological substructure. This cognitive style would then have an effect on all states of consciousness, and could be measurable by psychological tests or self report inventories.

The following study will explore two personality variables, measurable during waking in self report inventories which we believe show a relationship to a subject's response to RD. One is a measure of the subject's immersion in fantasy during waking, the other measures a subject's mode of handling with anxiety producing thoughts. These measures will be discussed more thoroughly in the next section.

Chapter IV

RATIONALE AND PREDICTIONS

The aim of the present study was to examine individual differences in response to RD, both in terms of any changes in REM and NREM mentation following RD, as well as differential amounts of REM compensation among subgroups of subjects.

I felt that phasic activity was the trigger to REM rebound, following Dement (1969) and that subjects who were able to confine phasic activity to REM sleep would show a compensatory REM rebound following RD. Those subjects who did not confine phasic activity to REM sleep would not show a rebound. I also believed that phasic activity contributed to qualities of sleep mentation, specifically that it was correlated with the sense that the dream was "real" and taking place in the external world. Since during RD, phasic activity is displaced into NREM sleep, increases in NREM mentation on scales which measured how involved a subject was in his dream experience would be expected following RD.

From an analysis of baseline mentation, Schwartz (1979) developed two dream mentation scales which were able to distinguish phasic from tonic awakenings. These scales, the Global scale and the Self Representation scale were used in the present study. A third scale, the Reality scale was included because it was able to distinguish phasic from tonic awakenings for a subgroup of subjects. Two additional scales from his study were included (Affect and

Temporal), although they were not good phasic/tonic discriminators for validation purposes. An additional three scales were taken from previous sleep literature--Molinari and Foulkes (1969) SCE/PVE scale, Foulkes (1965) DF scale and Foulkes and Pope (1973) Sensory scale. These scales were included because they had been cited as discriminating phasic from tonic awakenings in the past (SCE/PVE and Sensory) or because they had been used in other studies of individual differences in response to RD (Foulkes DF scale).

Schwartz had determined which of these scales was a good discriminator of phasic vs. tonic awakenings by a three way ANOVA with the three independent conditions being REM vs NREM, phasic vs. tonic, and early vs. late. Planned comparisons were made on phasic vs tonic REM mentation both for all subjects, and for certain subgroups of subjects. A similar analysis was conducted on the DF, SCE/PVE scale and the Sensory scale so that it could be determined if they were good phasic tonic discriminators. The tables showing a summary of the three way ANOVAs on all eight scales, and the planned comparisons is included in the appendix, as well as the cell means for the ANOVAs.

In short, of the eight scales three were designated as good discriminators of phasic vs. tonic awakenings--the Global scale, the Self Representation scale, and the Sensory scale. The Reality scale was a good phasic tonic discriminator for the high guilt daydreaming subjects only. We expected changes following RD on the Global, Self Representation, and Sensory scale among all subjects. We expected changes following RD on the Reality scale for the high guilt daydreamers only.

The four additional scales (DF, SCE/PVE, Affect and Temporal) were included because they were not expected to show changes following RD, since they were not good discriminators of phasic vs. tonic awakenings on BL. The eight scales different on a number of other dimensions as well (i.e. how many questions of the mentation interview were required for their scaling, if they were self report scales or ratings made by independent judges based on the report, etc). These dimensions are described in the Methodology. By including scales which discriminated phasic from tonic awakenings on BL as well as those which didn't, we could powerfully validate Schwartz's (1979) findings--by showing that his scales would work in the manner predicted during RD, while other scales which differed in their ability to discriminate phasic from tonic awakenings would not change following RD.

In addition, it was felt that two dimensions of waking personality might interact with a subject's response to RD. These dimensions were chosen because Schwartz (1979) found them to be useful in his analysis of BL mentation, and because we though they bore some relationship to the concept of the suspension of reflective self representation. The scales are taken from the Imaginal Processes INventory (Antrobus & Singer, 1972). The first scale, acceptance of daydreaming, was chosen as an indicator of what Schwartz (1979) called flexible frequent daydreaming. It was a measure of how immersed a subject was during waking in relatively positively toned daydreaming. During BL there were significant correlations between a subject's acceptance of daydreaming score and the augmentation of certain qualities of NREM mentation. Subjects high in acceptance of daydreaming had less difference between their REM and NREM mentation on BL. We thought that acceptance of daydreaming measured a subject's waking tendency to suspend reflective self representation. We predicted subjects high on acceptance of daydreaming would show more changes in NREM mentation following RD than subjects low in acceptance of daydreaming. We also believed that high acceptance of daydreaming subjects would not show a compensatory increase in REM time following RD.

The second scale, guilt daydreaming, was chosen as a measure of a subject's characteristic style of reporting anxiety producing thoughts. High guilt daydreamers were more likely to endorse bizarre self descriptions and to report anxiety producing experiences. The guilt daydreaming scale was also interpreted to be an indicator of social desirability response bias, since it showed a high (.57) correlation with the Social Introversion scale of the MMPI. In addition, the guilt daydreaming scale was chosen because during BL there was an interaction between guilt daydreaming and a subject's ability to answer the question "How real did the dream feel?" in a way that raters could later use to distinguish phasic from tonic awakenings in REM sleep. High guilt subjects were viewed as more accurate reporters since their own judgment of the reality of their experience was better correlated with the independent physiological criterion of phasic activity. Guilt daydreaming showed no significant correlation with acceptance of daydreaming ($\underline{r} = -.23$). These two scales were felt to measure orthogonal dimensions. Our predictions for the reaction of the high vs. low guilt daydreamers to RD was not spelled out. However, to reiterate, these scales were chosen as the dimensions on which to split subjects because of previous findings (Schwartz, 1979) on their relationship to patterns of sleep stage specific mentation during BL nights.

It was felt that this study could contribute both to sleep research and the study of psychophysiology by differentiating subject groups in their response to RD. In finding traits in normals that may bear some similarity to those of psychopathological groups who also don't show REM rebound, we hoped to contribute to the study of psychopathology as well.

Chapter V

METHODOLOGY

The data that Arkin et al. (1978) used was made available for purposes of this study. This data presents a number of methodological advantages over previous RD and mentation correlate studies. These advantages will be spelled out after a brief description of the experimental paradigm, and the process of mentation collection. A more complete description of the experimental paradigm can be found in the appendix.

As noted, Arkin et al. (1978) attempted to assess the effect of RD on NREM mentation, using 20 male subjects who were light sleepers and good dream recallers. Each subject was used as his own control and the order of the two deprivation conditions (NRD and RD) were counterbalanced. There were three BL conditions, at the beginning, middle and end of each experimental series. All variables were measured on R as well as deprivation nights. The experimental design was as follows:

2 unrecorded adaptation nights
1 recorded adaptation night
2 initial baseline nights
3 nights either RD or NREM control deprivation
1 recovery night
3 to 8 day break
2 middle baseline nights
3 nights NREM control deprivation or RD
1 recovery night
2 terminal baseline nights

Mentation reports were collected as follows: 1 sleep onset NREM report, followed by 70 to 90 minutes of uninterrupted sleep. The remainder of the night was divided into two equal intervals. During each of the intervals 1 REM and 3 stage 2 mentation reports were collected. REM reports were elicited 2 to 4 minutes after REM onset and equal numbers were taken from REM phasic and REM tonic states. Stage 2 mentations were collected 15 minutes after the termination of the REM period, with equal numbers being taken from tonic episodes and phasic periods (consisting of phasic EMG suppressions and K complexes either together or separate).

The advantages of this data over Foulkes, Pivik, Ahrens, and Swanson (1968) is that there is evidence that the RD procedures were successful. From a normal range of 20 to 28% REM sleep, the range of deprivation nights was reduced 3 to 4%. In addition, there are adequate BL measures. The data also represents an improvement over Molinari and Foulkes (1969) and Foulkes and Pope (1973) in that the confounding variable of time into the REM period was controlled.

Mentation Report Selection and Assessment

Mentation reports from 4 BL nights (2 consecutive baseline and 2 consecutive midbaseline) 2 R nights, the first deprivation night in each serious, and the first half of the second deprivation night in each series were scored on eight dream scales. These were the five scales which were taken from Schwartz (1979), the Reality scale, the Affect scale, the Self Representation scale, the Temporal scale and the Global scale. In addition the Foulkes DF scale, Molinari and

Foulkes SCE/PVE scale, and Foulkes and Pope (1973) five point scale of Sensory prominence were used.

The four BL nights were scored so that we could discriminate which scales would differentiate phasic from tonic awakenings on baseline. The five scales taken from Schwartz (1979) had already been analyzed for their properties on baseline nights, and a similar analysis to the one he performed was done on the DF scale, the SCE/PVE scale and the Sensory scale. The analysis of the baseline data is presented in summary form in the appendix.

The first RD and NRD nights were scaled in an attempt to replicate Pivik and Foulkes (1968) finding of an increase in the "dreamlikeness" of REM mentation during one night of RD for a subgroup of subjects. We also wished to assess any changes within the night in NREM mentation following RD. The effect of RD on mentation across nights was examined by comparing the first half of the second deprivation night in both series. This was a replication of Foulkes et al. (1968) which attempted to correct the major methodological flaws of that study. Finally, R mentation following RD was compared to R mentation following NRD.

Scoring Procedures for Mentation

Each of the 20 male subjects produced approximately 9 dream reports per night, making a total of 1,600 reports. All reports were scored on the eight aforementioned dream scales. Each of the eight scales will be described separately. Copies of all scales and scoring procedures are included in the appendix.

Each of the 1,600 reports on the 5 scales adapted from Schwartz (1979) were rated by two independent judges who were blind to sleep conditions and subject characteristics. Reports were rated for one subject at a time, and were shuffled into an approximation of a random order. Reports for which the subject did not produce a single idea unit were designated as no report and were discarded from the data analysis. Interrater reliability for each of these five scales was assessed via product moment correlation for the continuous scales (Reality and Affect) and via tetrachoric correlations for the dichotomous scales (Self Representation, Temporal, Global). This was done for 100 randomly selected subjects who had been scored amongst the first 10 subjects were rerated following the completion of all scoring (approximately 15 months later) in order to assess unreliability due to temporal drift. These reliability data are contained in Table 1. A description of the scales taken from Schwartz follows:

1. Reality: 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 his mind.

2. Affect: This 7-point scale was designed to rate the subject's evaluation of the intensity of his emotional experience during the preceeding dream. It was based on the subject's answer to the fourth question "What feelings or emotions did you have?" Since this was the fourth question, the subject was more likely to be awake

Table 1

Reality of Dream Scale Scoring

Dream Scale	Inter-Rater Reliability	Temporal Reliability
Reality	.82	.87
Affect	.86	.92
Self Representation	.94	.93
Temporal	.85	.85
Global	.82	.90
DF	.89	.89
SCE/PVE	.85	.85
Sensory	.88	.87

and coherent than during the spontaneous report. Scoring was based largely on his self evaluation unless there were clear indicators (i.e. denial or defensive minimization) in the answer which indicated he was not responding accurately.

3. Suspension of Self Representation: This was 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 his 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.

4. Temporal: This dichotomous scale was designed to assess whether or not any inappropriate fluctuations in the subject's employment of verbal tense was evident from his responses to question 1 and 2 of the mentation interview. It is independent of any evaluation on the part of the subject.

5. Global: 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 preceeding mentation. Unlike either Reality or Affect, Global is relatively independent of the subject's own judgment. Global is based on the first three questions of the mentation interview ("What was going through your mind?," "Any more to this?," "How vivid and clear was it?).

Three additional dream scales were scored:

6. Foulkes DF scale: The Foulkes DF scale (1966) 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 "no recall--feels mind was blank" (1) or "no recall--feels he was experiencing something but forgets what" (2). These reports were included in the data analysis, following Foulkes (1966).

Each of the 1,600 reports were rated on the Foulkes DF scale by one of two independent judges blind to sleep conditions and subject characteristics. Reports were rated for one subject at a time and were shuffled into an approximation of a random order. Interrater reliability was assessed by product moment correlation and was done for 71 sets of paired observations taken from 2 randomly selected subjects. In addition, rerating to check for unreliability due to temporal drift was done on 71 sets of dreams from 4 randomly selected subjects after all rating on the scale was completed (a period of approximately 5 months). These reliability data are found in Table 1.

7. SCE/PVE scale (Molinari & Foulkes, 1969): This dichotomous rating scored each report as containing Secondary Cognitive Elaboration of Primary Visual Experience, which was a residual score. PVE was visual imagery apprehended in a direct unreflective way; SCE was active thinking or reflecting about sensory imagery, or the absence of such imagery. The rating was based on subject's answers to

question 1 and 2 of the mentation interview. It was independent of his evaluation of the sensory vs. conceptual nature of the mentation experience. Scoring criteria are contained in the appendix. Each of the 1,600 reports was scored by 1 of 2 independent judges blind to sleep conditions and subject characteristics. Reports were rated for one subject at a time and shuffled into an approximation of a random order. Interrater reliability was assessed by tetrachoric correlation on 3 randomly selected subjects for a total of 222 dream report pairs. One subject was rerated following completion of all scoring (1½ months) to assess unreliability due to temporal drift. These reliability data are contained in Table 1.

Sensory scale (Foulkes & Pope, 1973). This rating attempted to elaborate the dichotomy of SCE/PVE into a five point scale of greater to lesser sensory vs. conceptual prominence in reported dream experiences. It was based on the subject's answer to the first three questions of the mentation interview and was primarily dependent on the rater's impression of the subject's experience, with the subject's own judgment used for clarification or elaboration. Rating reliability was determined by comparing the two independent blind judges ratings for 222 sets of ratings from 2 randomly selected subjects. Unreliability due to temporal drift was assessed by rerating one subject following completion of all scoring (1½ months). These reliability data are contained in Table 1.

Personality Assessment

Each subject was administered the basic clinical and validity scales of the MMPI, the Imaginal Processes Inventory (Singer & Antrobus, 1972) the Maudsley Personality Inventory, and the Rod and Frame test in the course of the collection of the sleep and dream data.

Subjects were scored on the following standard IPI scales: Acceptance of Daydreaming and Guilty Daydreams. Items which make up these scales are contained in the appendix. These scales were selected because of their relationship to BL mentation qualities, discussed in more detail by Schwartz (1979). Subjects were also scored on the Neuroticism and Extraversion scales of the Maudsley Personality Inventory, the Hysteria, Schizophrenia and Social Introversion scales of the MMPI and on the Byrne Repression--Sensitization index of the MMPI. Finally, the were scored for Field Dependence/Independence using the Witkin Rod and Frame apparatus. The additional personality scores after the two IPI scales were included so that our results could be compared to results previously cited in the literature.

Assessment of REM Rebound

Each subject was scored for REM rebound which was defined as the increase in REM sleep on recovery night over baseline. Rebound was scored both in minutes of REM sleep and in percent of TST.

Analysis of BL Sleep Mentation

The analysis of BL sleep mentation was adapted from Schwartz (1979) who performed a three way analysis of variance on the BL mentation. The three independent conditions were REM vs. NREM, phasic vs. tonic, and early vs. late. Each of the five dream scales (Reality, Affect, Self Representation, Temporal and Global) were the dependent variables. Following this planned comparisons of REM phasic vs. REM tonic mentation was carried out. Subjects were also split on the median of their guilt daydreaming scales, and the phasic vs. tonic comparisons were carried out for the high guilt daydreamers only. This analysis was repeated using the three dream scales adapted from the literature (DF, SCE/PVE, Sensory). Following this scales which were good phasic/tonic discriminators were selected. Since the analysis of BL mentation was preliminary to our major interest in the response to RD, and since much of this work was taken from Schwartz (1979), the reader is referred to the appendix for a summary of the analysis, and the cell means for the three way ANOVA.

Analysis of the Effects of RD--The Correlation Between Personality Measures and REM Rebound

Each subject's scores on the nine personality measures were correlated with REM rebound in order to assess the relationship between waking personality styles and the physiological response to RD.

Analysis of the Response to RD and Mentation Report Qualities Among Different Subject Groups within Different Awakening Conditions

For each subject a mean rating for each of the eight mentation scales was computed for each of the six sleep conditions: REM, NREM REM tonic, NREM tonic REM phasic, NREM phasic. These scores were computed for the first deprivation night in each series, and for the R night in each series. Because of the limitations of the data and the samll number of REM awakenings, only REM and NREM mentation mean scores were computed for the second deprivation night.

A 2 x 2 x 2 repeated measures analysis of variance was conducted with respect to the eight dream scale mean scores as the dependent variable. The three independent variable for each repeated measures analysis of variance were Nightkind, i.e. RD series vs. NRD; REM condition, i.e. REM or NREM; and Phasic condition, i.e. phasic or tonic. The analysis was done with a blocking factor which split subjects on the median of the two selected personality scores (Guilt Daydreams and Acceptance of Daydreaming). The 2 x 2 x 2 analysis was done comparing the R night in each series, and comparing the first deprivation night in each series to each other. For the comparison of the first half of the second deprivation night, the smaller number of awakenings made prescribed a less differentiated analysis, namely, a 2 x 2 analysis with the independent variables being nightkind and REM condition. Following the repeated measures analysis of variance follow up tests, using the Duncan Range test were conducted if the overall F was significant. Comparisons were carried out between all

NREM mentation following RD vs. NRD, all REM mentation, all REM phasic mentation, and all REM tonic mentation. These tests were carried out for all subjects together and for separate groups of subjects after they had been segregated on selected personality scales.

Chapter VI

RESULTS

Each mentation report was scored by one of the two independent judges who were bind to night, subject and awakening condition. The exact procedure for scoring each of the eight dream scales is contained in the Appendix. A total of 1,612 mentation reports were rated with 20 subjects contributing approximately 9 reports for each of 8 nights and an additional 5 reports per night for the early half of the second deprivation night in each series. For the analysis of the Reality, Affect, Self Representation, Temporal and Global scale 149 reports were rated as having no content and were excluded from the data analysis. An additional 195 reports from the sleep onset period were also excluded from the data analysis. Of the remaining 1,263 reports, 340 were REM reports (193 phasic reports and 147 tonic reports) and 930 were NREM reports (634 phasic reports and 296 tonic reports). Each report was designated either early or late depending on whether it was recorded before or after 50% of the subject's total sleep time had elapsed. Five hundred eighty-six reports were designated as early (165 REM reports and 421 NREM reports). Six hundred eighty-four reports were designated as late (175 REM reports and 509 NREM reports).

The DF scale incorporated no content reports into its scoring and includes these reports in the data analysis. Of the original 1,612 reports, only 200 sleep onset reports were eliminated from the analysis. Of the remaining 1,412 reports, 358 were REM reports (202 phasic reports and 156 tonic reports) and 1,054 were NREM reports (703 phasic and 351 tonic reports). Each report was designated as early or late. Six hundred fifty-three reports were designated as early (174 REM and 479 NREM reports) and 759 were designated as late (184 REM and 759 NREM).

For the SCE/PVE scale and the Sensory scale 1,426 of the original 1,612 reports were included in the analysis. Of these 1,426 reports, and additional 192 reports were excluded because they were from the sleep onset period. Of the remaining 1,234 reports, 338 were REM reports (192 phasic REM reports and 146 REM tonic reports). Eight hundred ninety-six reports were from the NREM period. Six hundred four of these were phasic reports and 292 were tonic reports. Five hundred sixty-two reports were designated as early (164 REM and 398 NREM) and 672 were designated late reports (174 REM and 498 NREM reports).

The Effects of REM Deprivation

Analysis of the Correlations Between Personality Measures and REM Rebound

Since previous literature (e.g. Cartwright, Monroe, & Palmer, 1967; Gillin et al., 1975; Nakasawa et al., 1975) had reported a relationship between measures of waking personality functioning and the response to REM deprivation, we correlated the nine personality scales with REM rebound. These correlations are seen in Table 2. Intercorrelations amongst the personality measures are shown in Table 3. Only field dependence correlated significantly with the

Table 2

Correlations Between Personality Measures

and REM Rebound

	REM Rebound (Minutes)	REM Rebound (Percent)
Extraversion	.15	.05
Neuroticism	.37	.34
Sensitization	.39*	.42*
Hysteria	.17	.07
Schizophrenia	.29	.29
Social Introversion	.13	.23
Field Dependence/Independence	.63****	.54**
Acceptance of Daydreaming	.21	.19
Guilt Daydreaming	.35	.26

*$p \leq .05$.
**$p \leq .025$.
***$p \leq .01$.
****$p \leq .005$ one tailed test.

Table 3

Intercorrelations Among Personality Measures

	1	2	3	4	5	6	7	8	9
Extraversion		-.05	-.05	-.33	-.34	-.39	-.31	.06	-.16
Neuroticism			.83[a]	.04	.43*	.42	.53**	.21	.05
Sensitization				.10	.60[a]	.58***	.58***	.17	.28
Hysteria					.57[a]	-.03	.51**	-.11	.33
Schizophrenia						.37	.55**	.06	.45**
Social Interversion							.38	-.07	.57[a]
Field Dependence/ Independence								-.1	.38
Acceptance of Daydreaming									-.23
Guilt Daydreaming									

*$p = \leq .05$.

**$p = \leq .025$.

***$p = \leq .01$.

[a]$p \leq .005$ one tailed test.

the percent of increase in REM time on Recovery night following REM deprivation ($\underline{r}^2$ = .54, $\underline{p}$ = .025, two tailed test). However, this was in the opposite direction from that predicted by previous literature, in that it was the field dependent subjects were showing a REM rebound. In addition, this correlation was based on data from only 16 of the 20 subjects. Four of the other personality scales showed positive, nonzero order correlations with the increase in REM sleep on recovery (Sensitization, Schizophrenia, Guilt daydreaming, and Neuroticism as measured by the MPI). These results are also in the opposite direction to what one would have predicted based on previous findings--subjects who were scoring high n these dimensions were more likely to show a REM rebound in our sample.

The Effects of REM Deprivation on Mentation

The interpretation of the data for all three sets of comparison nights (the first deprivation night, the second deprivation night, and the recovery night) focused only on those effects which showed the influence of REM deprivation vs. NREM deprivation, either as a main effect on in interaction with other factors such as REM condition, phasic condition or subject factors. In addition, since the effect of phasic activity on mentation dependent, in part, on the underlying arousal state first order interactions between phasic condition and deprivation condition were not analyzed. Cell means for all analyses are shown in Tables 4 to 6.

Table 4

Cell Means for Analysis of Variance

First Deprivation Night

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
Global								
			Guilt					
High	.125	.3916	.7166	.8286	.3833	.4583	.7417	.8571
Low	.20	.3399	.74286	1.0	.35	.4249	.80	.40
			Acceptance					
High	.10	.3066	.65946	.8686	.30	.4167	.7417	.90
Low	.225	.4249	.80	.90	.433	.4666	.800	.3571
Reality								
			Guilt					
High	3.4	3.475	2.7827	5.2625	2.95	3.6917	4.2567	4.7125
Low	3.85	3.71	3.637	6.2	4.05	3.292	4.1	3.528
			Acceptance					
High	3.0	3.435	3.523	5.579	3.50	3.875	3.757	5.25
Low	4.25	3.75	2.90	5.883	3.50	3.108	4.60	2.99

Table 4 (Continued)

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
Affect								
			Guilt					
High	2.4	2.9417	4.1	4.129	3.047	3.1083	4.017	4.438
Low	3.35	3.1967	3.813	4.40	3.5	2.933	4.55	3.80
			Acceptance					
High	2.35	2.73	3.4125	4.229	2.8928	2.9083	3.5167	4.30
Low	3.40	3.408	4.50	4.30	3.65	3.133	5.05	3.9375
Self Representation								
			Guilt					
High	.10	.25	.2167	.629	.1333	.275	.3417	.3296
Low	.35	.1867	.4429	.40	.05	.30	.30	.233
			Acceptance					
High	.25	.195	.3595	.6286	0.0	.2417	.4417	.20
Low	.20	.2417	.30	.40	.1833	.333	.20	.3619
Temporal								
			Guilt					
High	.125	.1583	.26667	.14857	.1500	.0833	.2417	.2286
Low	.1333	.18333	.1000	0	.20	.125	.650	.0333
			Acceptance					
High	.1333	.225	.167	.1286	.20	.1167	.3417	.10
Low	.125	.1167	.20	.02	.15	.0917	.55	.1619

Table 4 (Continued)

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
DF								
			Guilt					
High	4.05	4.533	5.7876	6.505	3.8	4.617	5.638	6.2
Low	5.30	5.207	5.8	7.2	4.95	4.67	6.2	5.77
			Acceptance					
High	4.50	4.682	5.4875	6.5334	4.10	4.475	5.8383	6.50
Low	4.85	5.0583	6.10	7.1714	4.65	4.8167	6.0	5.4714
SCE/PVE								
			Guilt					
High	.85	.817	.76	.633	.93	.86	.833	.75
Low	.95	.9417	.6857	.60	.75	.825	.80	.7714
			Acceptance					
High	.95	.94167	.6457	.4667	.83	.8917	.7333	.750
Low	.85	.8167	.80	.7667	.85	.7917	.900	.7714
Sensory								
			Guilt					
High	3.75	3.408	2.50	2.125	3.587	3.183	2.80	2.338
Low	3.45	3.775	2.429	1.6	3.2	3.28	2.65	3.014
			Acceptance					
High	3.95	3.908	2.6288	1.8417	3.837	3.3583	2.50	2.20
Low	3.25	3.275	2.30	1.8833	2.95	3.1083	2.95	3.1518

Table 5

Cell Means for Analysis of Variance

	REM Deprivation		NREM Deprivation		REM Deprivation		NREM Deprivation	
	NREM	REM	NREM	REM	NREM	REM	NREM	REM
<u>Global</u>					<u>Temporal</u>			
			Guilt				Guilt	
High	.51667	.8000	.41667	.8833	.1333	.2000	.2833	.20
Low	.31667	.9000	.51667	.3500	.2833	.4000	.1833	.1000
			Acceptance				Acceptance	
High	.40	.80	.41667	.6	.2833	.20	.1667	.10
Low	.4333	.90	.51667	.6333	.1333	.40	.30	.20
<u>Reality</u>					<u>DF</u>			
			Guilt				Guilt	
High	3.4833	4.7330	3.5333	4.4330	4.1417	6.7	5.3167	5.95
Low	3.6667	4.7000	4.8000	4.5500	4.93	6.7	5.1667	5.20
			Acceptance				Acceptance	
High	3.233	3.533	4.21667	4.95	4.975	5.90	5.333	5.55
Low	3.91667	5.90	4.11667	4.0333	4.10	7.50	5.15	5.6
<u>Affect</u>					<u>SCE/PVE</u>			
			Guilt				Guilt	
High	3.3333	3.7	3.65	3.933	.9	.9	.7	.6667
Low	3.35	4.0	3.6333	3.55	.91667	.8	.9667	1.0
			Acceptance				Acceptance	
High	3.5833	3.9	4.01667	3.95	.81667	1.0	.91667	.90
Low	3.1	3.8	3.2667	3.533	1.0	.70	.75	.76667

Table 5 (Continued)

	REM Deprivation		NREM Deprivation		REM Deprivation		NREM Deprivation	
	NREM	REM	NREM	REM	NREM	REM	NREM	REM
Self Representation					Sensory			
			Guilt				Guilt	
High	.25	.30	.20	.45	3.375	2.7	2.8667	1.9833
Low	.31667	.50	.51667	.25	3.91667	2.5	3.5833	3.6
			Acceptance				Acceptance	
High	.25	.40	.45	.50	3.3583	3.10	3.61667	3.05
Low	.31667	.40	.2667	.20	3.933	2.10	2.833	2.533

Table 6

Cell Means for the Analysis of Variance

Recovery Nights

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
Global								
			Guilt					
High	.45	.55833	.5875	.90	.30	.475	.50	.50
Low	.60	.675	.1571	.45	.4667	.5100	.70714	.70
			Acceptance					
High	.60	.675	.30	.70	.417	.610	.55	.65
Low	.45	.559	.447	.65	.35	.375	.657	.55
Reality								
			Guilt					
High	4.05	3.625	3.9889	3.6214	3.95	3.333	3.5	3.6
Low	4.75	4.735	4.223	5.0	4.1	5.015	4.381	3.75
			Acceptance					
High	4.60	4.71	4.279	4.50	3.45	4.115	4.2556	3.20
Low	4.20	3.65	3.9329	4.1214	4.60	4.233	3.625	4.15

Table 6 (Continued)

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
Affect								
			Guilt					
High	3.55	3.575	3.894	3.657	3.1	2.992	4.30	3.30
Low	3.55	3.80	3.40	4.10	2.567	3.27	3.826	3.10
			Acceptance					
High	3.70	4.40	3.979	4.80	2.817	3.303	3.789	2.90
Low	3.40	2.975	3.315	2.957	2.85	2.958	4.338	3.50
Self Representation								
			Guilt					
High	.40	.35	.3375	.45	.30	.225	.30	.30
Low	.45	.55	.229	.350	.433	.408	.5161	.75
			Acceptance					
High	.40	.40	.30	.30	.483	.333	.3875	.55
Low	.45	.50	.2661	.50	.25	.30	.429	.50
Temporal								
			Guilt					
High	.30	.208	.125	.20	.25	.30	.30	.60
Low	.30	.515	.157	.150	.20	.303	.155	.15
			Acceptance					
High	.30	.415	0.0	.20	.20	.228	.1125	.30
Low	.30	.308	.2821	.15	.25	.375	.3429	.450

Table 6 (Continued)

	REM Deprivation				NREM Deprivation			
	NREM		REM		NREM		REM	
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic
DF								
			Guilt					
High	5.60	5.2167	5.9667	5.95	4.50	5.20	5.90	6.10
Low	6.30	6.82	5.422	7.05	5.667	6.1917	5.11	6.0
			Acceptance					
High	6.30	6.345	5.20	7.20	5.317	5.942	6.389	5.80
Low	5.60	5.692	6.189	5.80	4.85	5.45	6.022	6.30
SCE/PVE								
			Guilt					
High	.70	.75	.375	.6089	.85	.7667	.5875	.80
Low	.75	.765	.9625	.85	.7667	.7467	.5492	.78751
			Acceptance					
High	.65	.715	.6875	.7375	.7167	.7217	.7653	.80
Low	.80	.80	.65	.7214	.90	.7917	.3714	.7875
Sensory								
			Guilt					
High	3.10	3.0167	1.6875	2.1054	3.40	3.284	2.3286	3.10
Low	2.30	2.743	3.4625	2.70	2.65	2.687	2.105	3.02
			Acceptance					
High	2.40	2.568	2.737	2.413	2.70	2.62	2.6619	3.05
Low	3.0	3.1917	2.413	2.393	3.350	3.35	1.7714	3.0714

Analysis of the First Deprivation Night

The Global scale produced no main effects. There was a significant interaction between deprivation condition and REM condition (F = 5.05, p = .0373) with REM scores significantly higher after RD than after NRD ($p \leq .05$, Duncan range test). There was also a significant four way interaction between deprivation condition, REM condition, phasic condition and guilt daydreaming (F = 4.62, p = .0455). This effect, which is presented in Figure 1, is largely accounted for by the significant difference in REM phasic mentation scores during REM deprivation vs. REM phasic mentation scores during NREM deprivation for the low guilt subjects only ($p \leq .01$, Duncan range test). There is no significant difference in REM phasic mentation scores on the Global scale for the high guilt subjects post RD vs. post NRD; in fact, REM phasic scores are slightly higher post NRD for this group.

The Reality scale showed a significant three way interaction between deprivation condition, REM condition, and phasic condition (F = 7.32, p = .0145). The three way interaction is accounted for by an increase in the REM phasic mentation following RD as opposed to NRD. This interaction is significant for all subjects ($p \leq .01$, Duncan range test), but if subjects are split into high and low groups based on their guilt daydreaming scores, only the low guilt subjects show a significant effect. When subjects were split as to their acceptance of daydreaming scores, there was a significant four way interaction--subjects who were high in their acceptance of daydreaming are judging their REM phasic mentation to be real significantly more

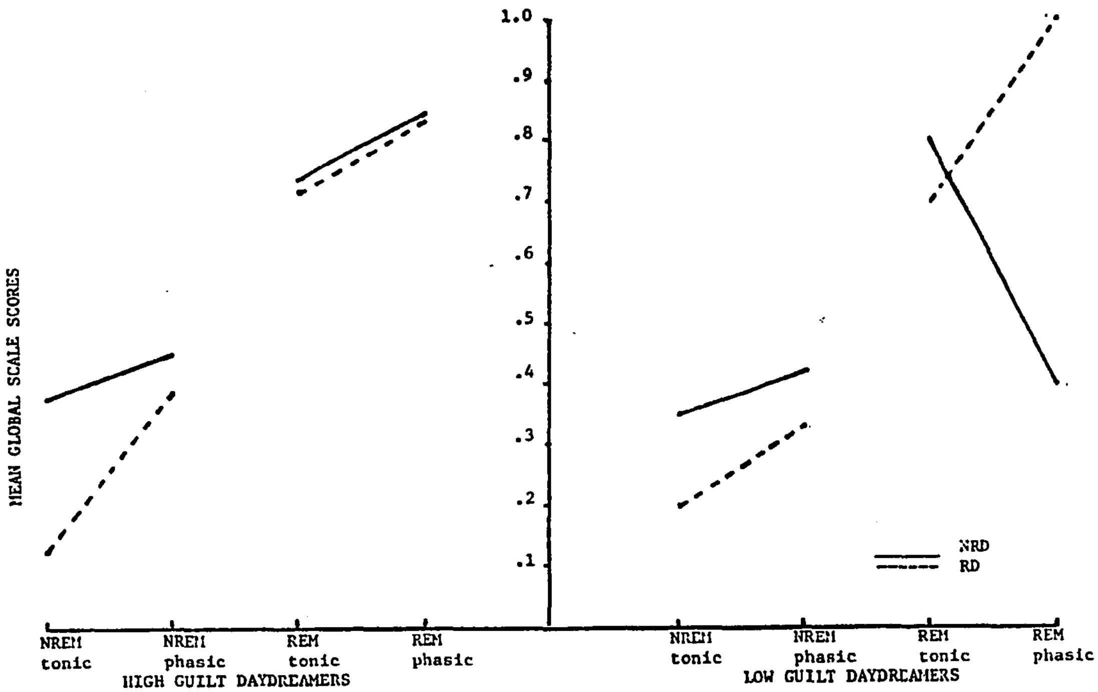

Figure 1. Global scale: First deprivation night--four way interaction of deprivation condition by REM condition by phasic condition by guilt daydreaming.

often following REM deprivation than following NREM deprivation ($p \leq .01$, Duncan range test). This was true for all subjects, but was significant only for the subjects high in acceptance of daydreaming. There was a differential response to RD in terms of NREM mentation as well--high acceptance subjects rate their NREM mentation post RD as significantly more real than the low acceptance of daydreaming subjects. However, these groups differed on their baseline ratings for the Reality scale in terms of their NREM mentation, with high acceptance subjects rating their NREM mentation as more real than low acceptance subjects. In addition, reporting accuracy varied greatly among subjects on the Reality scale, and no analysis was done to examine the interaction of reporting style and acceptance of daydreaming on the perceived reality of nocturnal mentation following RD. These effects are presented in Figures 2, 3, 4.

The Affect scale produced no main effects, no second, third or fourth order interactions. High acceptance of daydreaming subjects had more Affect overall, for all sleep conditions in both deprivation series ($F = 4.95$, $p = .0391$).

The Temporal scale produced a two way interaction between deprivation condition and REM condition that fell just short of significance ($F = 4.14$, $p = .0569$). Subjects tended to have fewer Temporal changes in their mentation report in all sleep conditions following RD than after NRD ($p \leq .05$, Duncan range test). This was largely accounted for by the fewer tense changes in REM sleep post RD than after NRD.

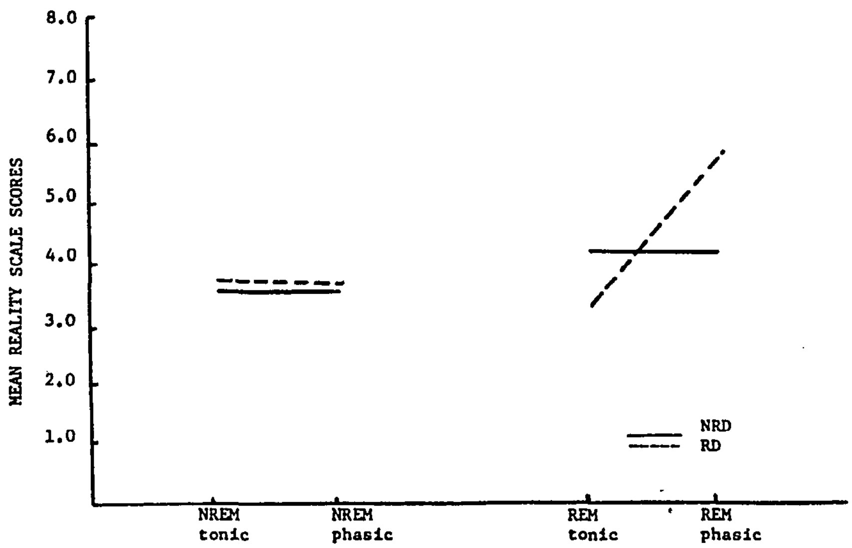

Figure 2. Reality scale: First deprivation night--three way interaction of deprivation condition by REM condition by phasic condition.

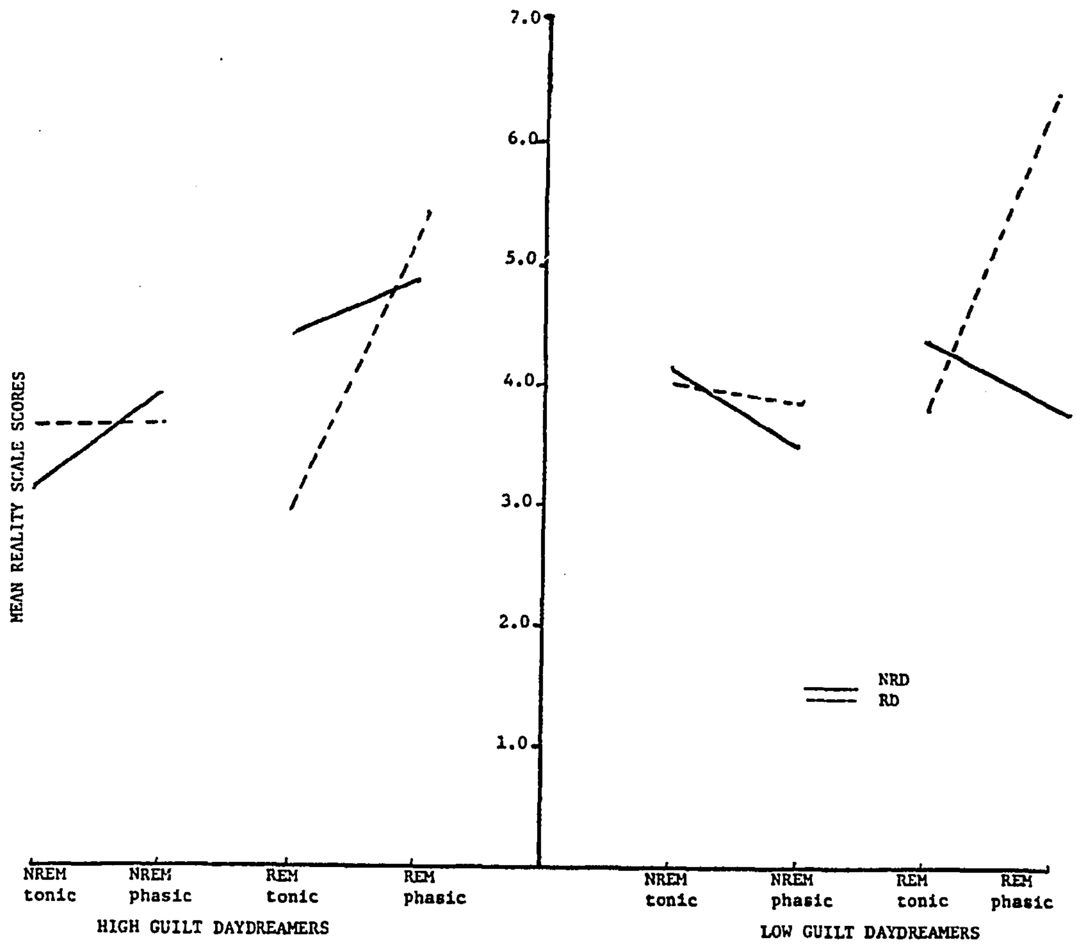

Figure 3. Reality scale: First deprivation night--four way interaction of deprivation condition by REM condition by phasic condition by guilt daydreaming.

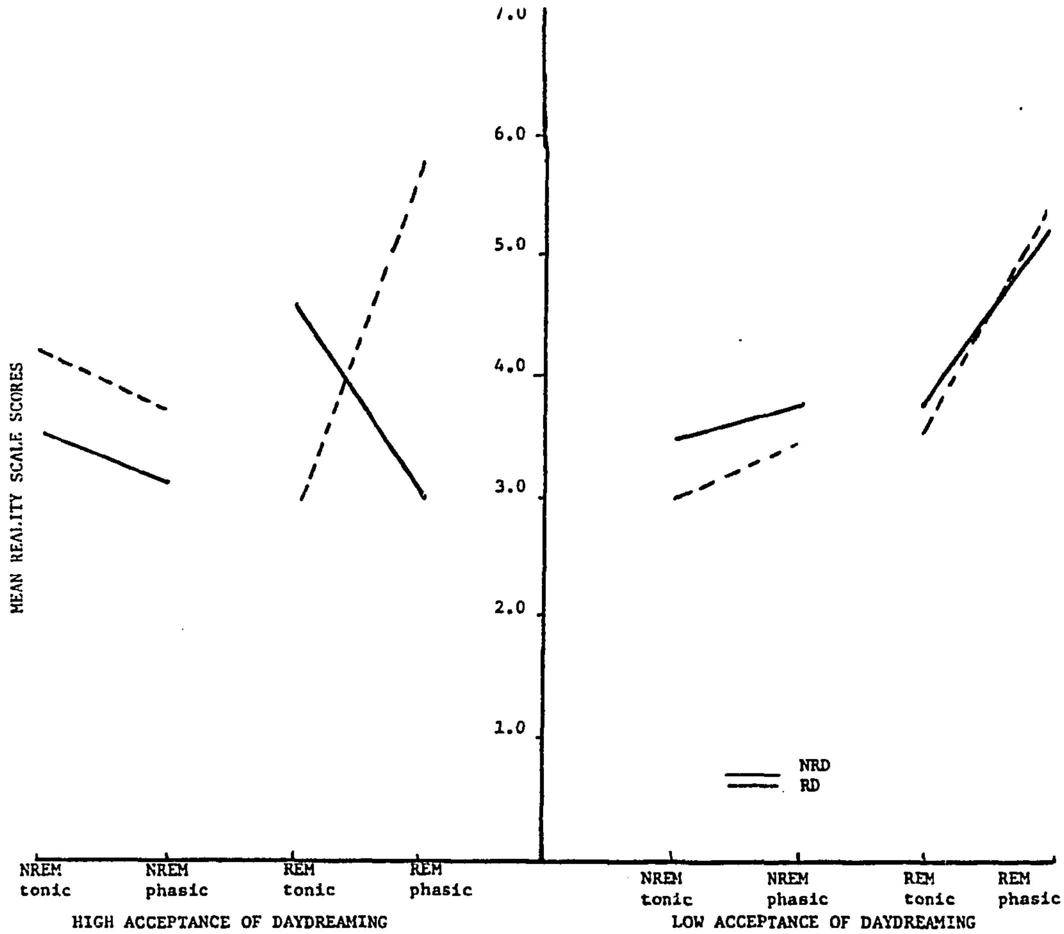

Figure 4. Reality scale: First deprivation night--four way interaction between deprivation condition by REM condition by phasic condition by acceptance of daydreaming.

The Self Representation scale produced no significant main effects and no second, third, or fourth order interactions. However, because the interaction between deprivation condition, phasic condition and guilt was significant, and the interaction between REM condition, phasic condition and deprivation condition was in the predicted direction, follow up tests were conducted. Following RD, subjects tended to forego grammatical Self Representation more in REM sleep than following NRD ($p \leq .05$, Duncan range test). However, this effect was not significant for the high guilt subjects, when subjects were split along the median of their guilt daydreaming scores. Hence, the greater suspension of Self Representation in REM sleep, and particularly during REM phasic mentation awakenings, was largely due to the response of the low guilt subjects.

The analysis of variance for the DF scale showed no significant main effects, no second, third, or fourth order interactions with guilt as the subject factor. Results were in a similar direction to the Global and SRS scale with REM scores higher following RD than NRD, and with REM phasic awakenings scoring highest on this scale following RD. However, when subjects who had low guilt daydreaming scores were looked at alone, the effect of REM phasic mentation post RD vs. REM phasic mentation post NRD was significant ($t = 2.971$, $p = .01569$), with REM phasic DF scores post RD being greater. These results are shown in Figure 5. These results must be interpreted cautiously, as the overall F test was not significant.

The SCE/PVE scale showed no significant interactions or main effects. There was a second order interaction of deprivation

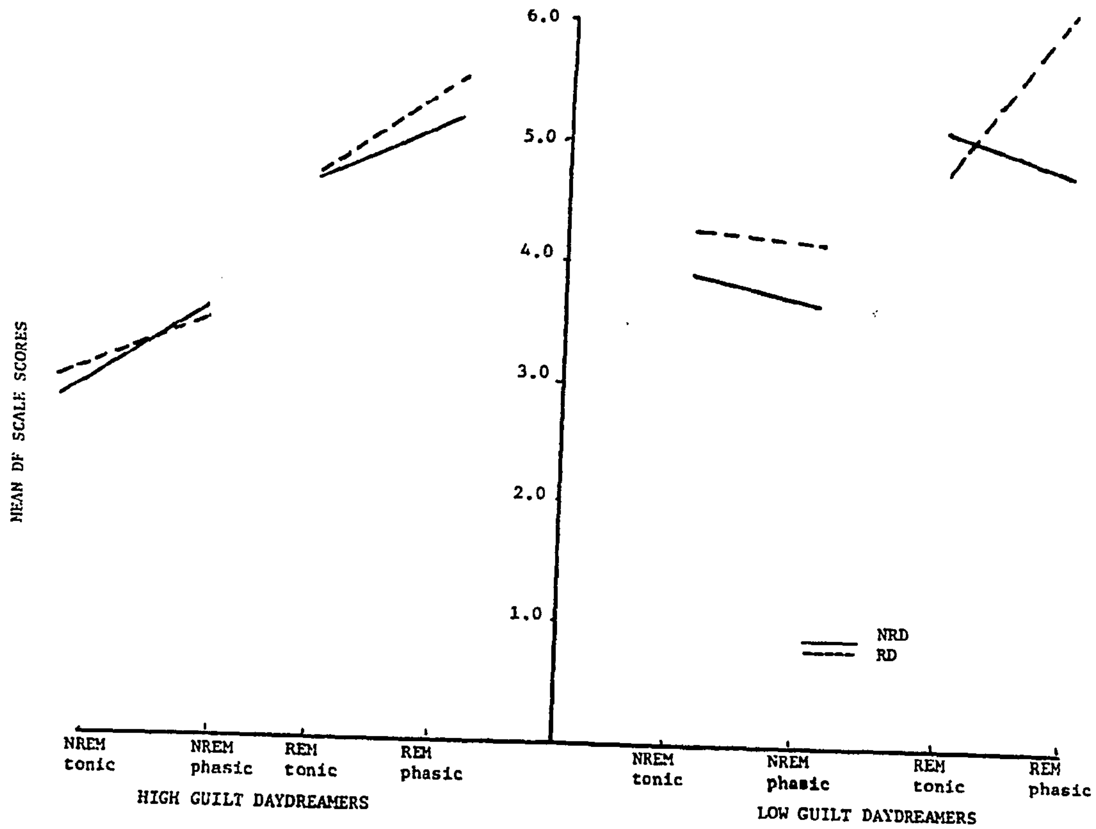

Figure 5. DF scale: First deprivation night--four way interaction of deprivation condition by REM condition by phasic condition by guilt daydreaming.

condition and REM condition which did not reach significance, but was in the predicted direction ($F = 2.37$, $p = .141$).

The Sensory scale, which like the SCE/PVE scale is scored opposite to the other mentation scales, showed a strong interaction between deprivation condition and REM condition. REM scores were significantly lower after RD than NRD for all subjects ($F = 10.98$, $p = .0039$). This difference was largely accounted for by changes in the REM phasic scores which were significantly lower following RD than NRD ($p \leq .01$, Duncan range test). When subjects were split into high and low guilt daydreaming groups, this effect was significant for the low guilt subjects ($p \leq .01$, Duncan range test) but not for the high guilt subjects. This four way interaction is shown in Figure 6.

Analysis of the Second Deprivation Night (Early Reports Only)

The Global scale produced no main effects. The second order interaction between deprivation condition and REM condition was just short of significance ($F = 3.81$, $p = .0688$). The three way interaction between deprivation condition, REM condition and guilt daydreaming scores was highly significant ($F = 10.32$, $p = .0048$). This is due to the low guilt subjects having much greater scores on the Global scale for their REM mentation post RD than after NRD ($p \leq .001$, Duncan range rest). This was not true for the high guilt subjects. This interaction is shown in Figure 7.

The Reality scale produced no main effects and no second order interactions. There was a significant third order interaction with acceptance of daydreaming scores ($F = 4.45$, $p = .0491$), shown in

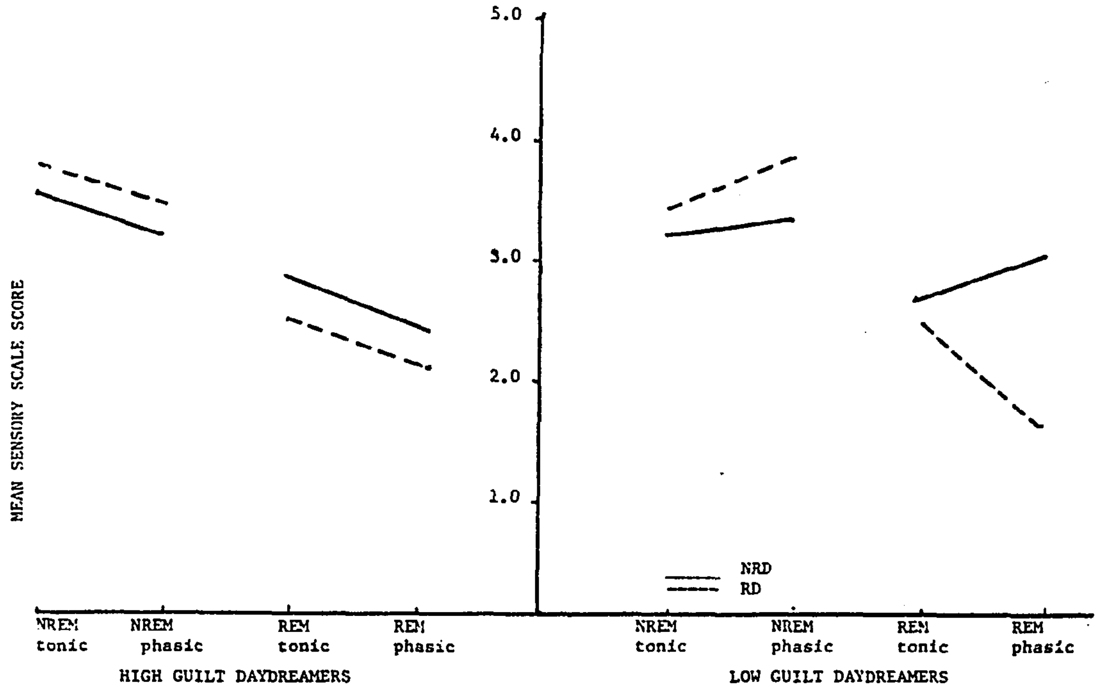

Figure 6. Sensory scale: First deprivation night--four way interaction of deprivation condition by REM condition by phasic condition by guilt daydreaming.

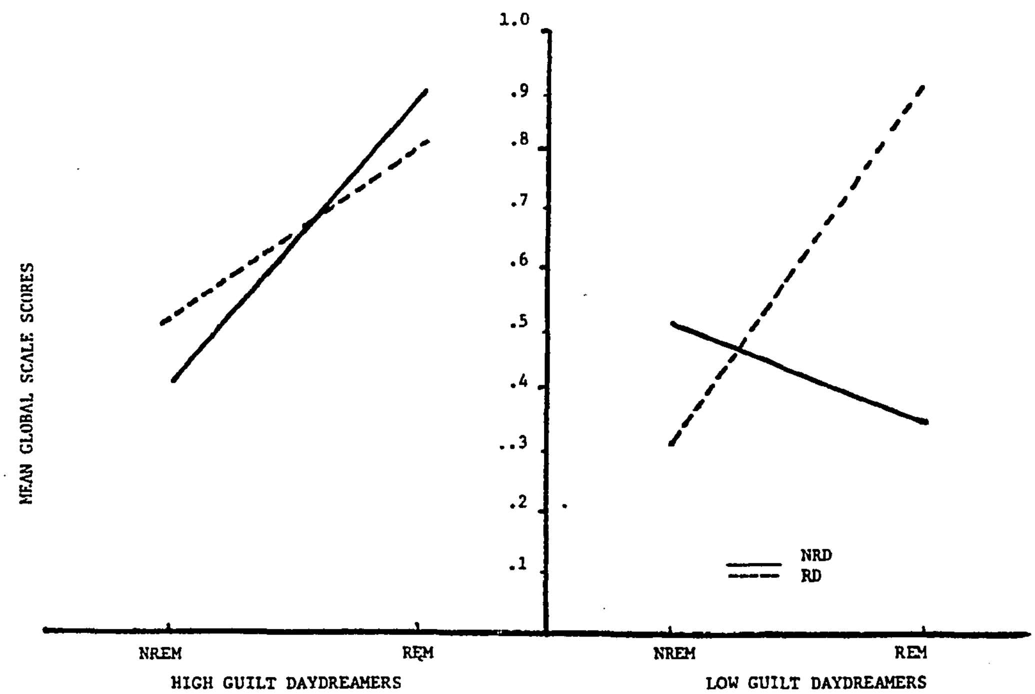

Figure 7. Global scale: Second deprivation night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

Figure 8. High acceptance of daydreaming subjects perceive their REM mentation to be real significantly more often after NRD ($p \leq .01$, Duncan range test) while low acceptance of daydreaming subjects increase their Reality scores for REM mentation much more following RD than NRD ($p \leq .01$, Duncan range test). Following RD, only the low acceptance of daydreaming subjects show a significant difference between their REM and NREM mentation scores ($p \leq .01$, Duncan range test). This difference is similar to the greater difference that low acceptance of daydreaming subjects have on baseline between their REM and NREM Reality scores.

The Affect scale produced no main effects, no second order interactions, and no third order interactions with either acceptance of daydreaming or guilt daydreams as the subject factor.

The Self Representation scale produced no significant main effects or second order interaction effects. When guilt daydreams was used as the subject factor, the three way interaction between deprivation condition, REM condition and subject condition was just short of significance ($F = 3.53$, $p = .0765$). This data, which is presented in Figure 9, shows that this result is accounted for largely by an increase in the suspension of self representation during awakenings from REM sleep by the low guilt daydreamers only.

The Temporal scale showed no significant main effects, second order interactions or interactions with personality factors.

The DF scale showed a significant effect of deprivation condition in interaction with REM condition ($F = 6.84$, $p = .0175$) with REM scores after REM deprivation significantly higher than after NRD ($p \leq .01$, Duncan range test).

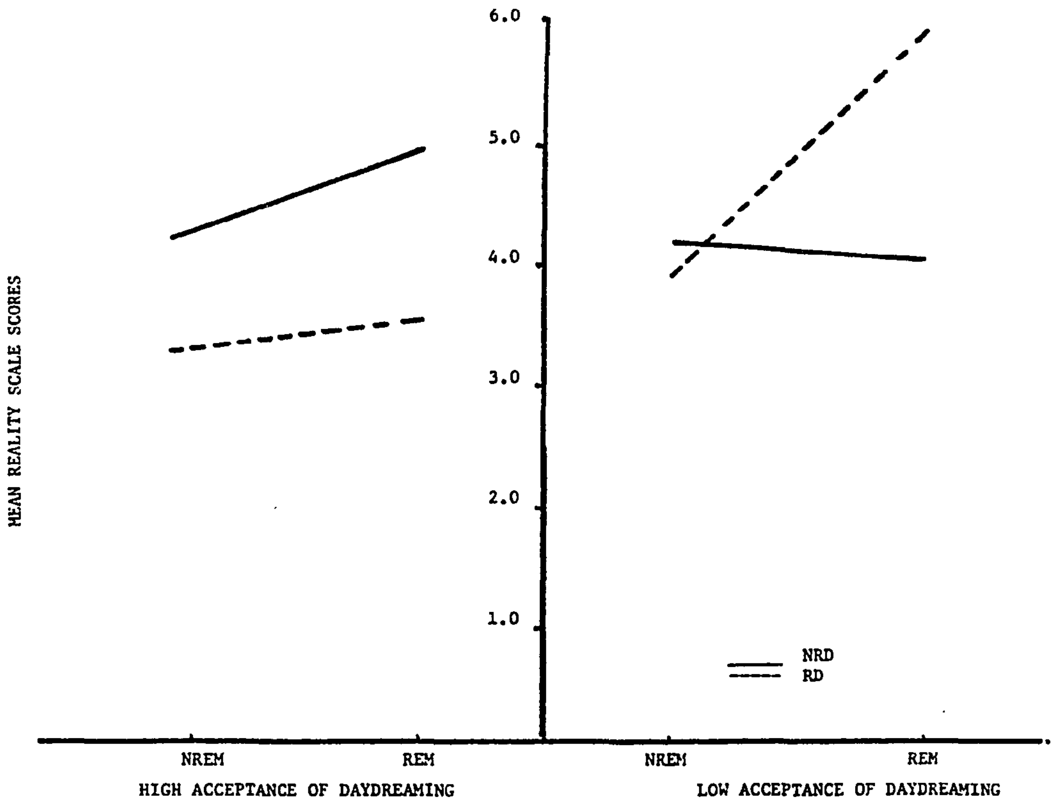

Figure 8. Reality scale: Second deprivation night--three way interaction of deprivation condition by REM condition by acceptance of daydreaming.

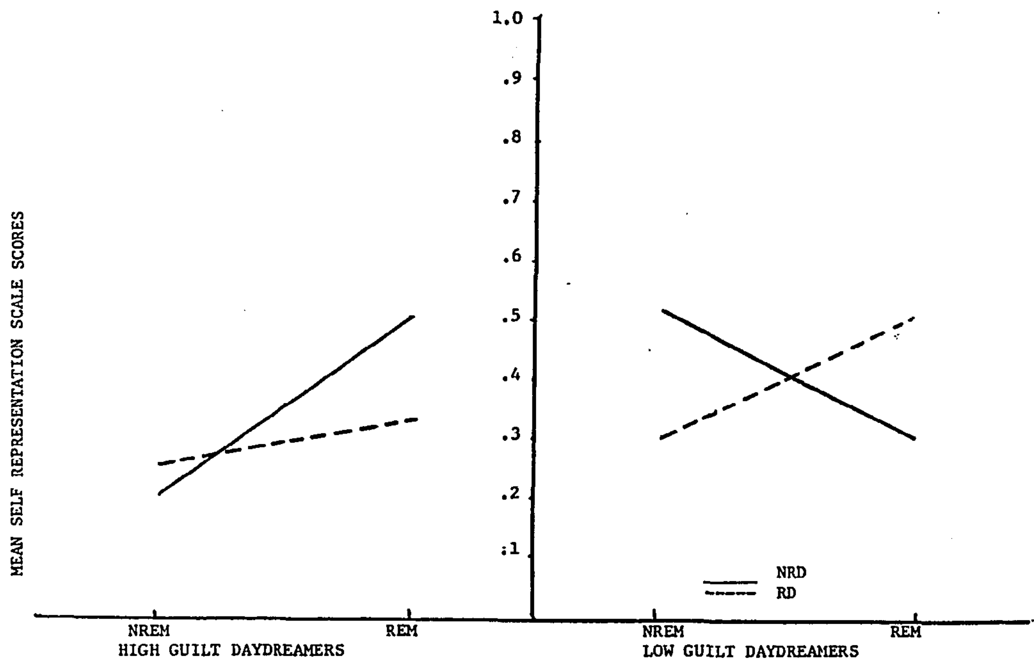

Figure 9. Self Representation scale: Second deprivation night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

The SCE/PVE scale showed no significant main effects or second order interactions. The third order interaction between deprivation condition, REM condition and acceptance of daydreaming was just short of significance ($F = 4.07$, $p = .0588$). High acceptance of daydreaming subjects were having the most Primary Visual Experience in NREM sleep, whereas the low acceptance of daydreaming subjects where having their most Primary Visual Experience in REM sleep.

The Sensory scale showed no significant main effects or second order interactions. The third order interaction between deprivation condition, REM condition and guilt daydreaming was almost significant ($F = 3.75$, $p = .0688$). The low guilt subjects are having more sensory REM mentation following RD than NRD ($p \leq .01$, Duncan range test). The high guilt subjects have an opposite, though nonsignificant pattern. There was also a significant three way interaction with acceptance of daydreaming ($F = 4.98$, $p = .0386$). The high acceptance of daydreaming subjects show a similar reaction to RD and NRD and have no significant difference between their REM and NREM mentation following RD. The low acceptance of daydreaming subjects show a significant difference between their REM and NREM mentation following RD ($p \leq .01$, Duncan range test). These results are shown in Figures 10 and 11.

Analysis of the Recovery Night Mentation

REM Mentation

The Global scale produced a significant three way interaction between deprivation condition, REM condition and guilt daydreams ($F = 7.28$, $p = .0174$). This effect, which is shown in Figures 12 and 13 was accounted for by the low guilt subjects having lower REM

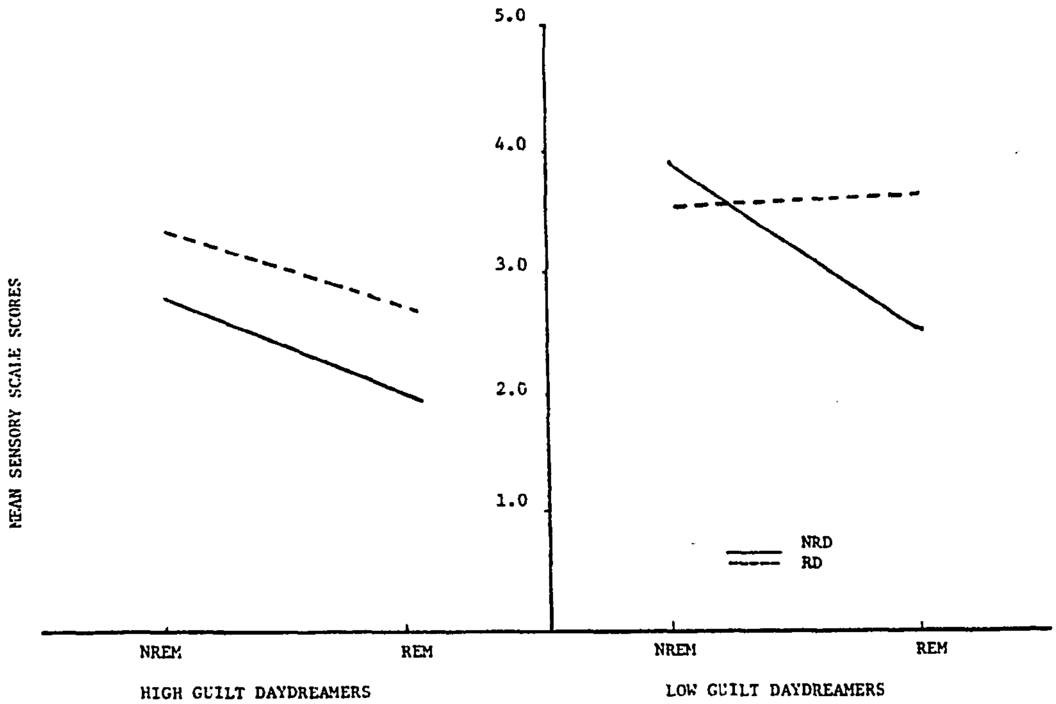

Figure 10. Sensory scale: Second deprivation night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

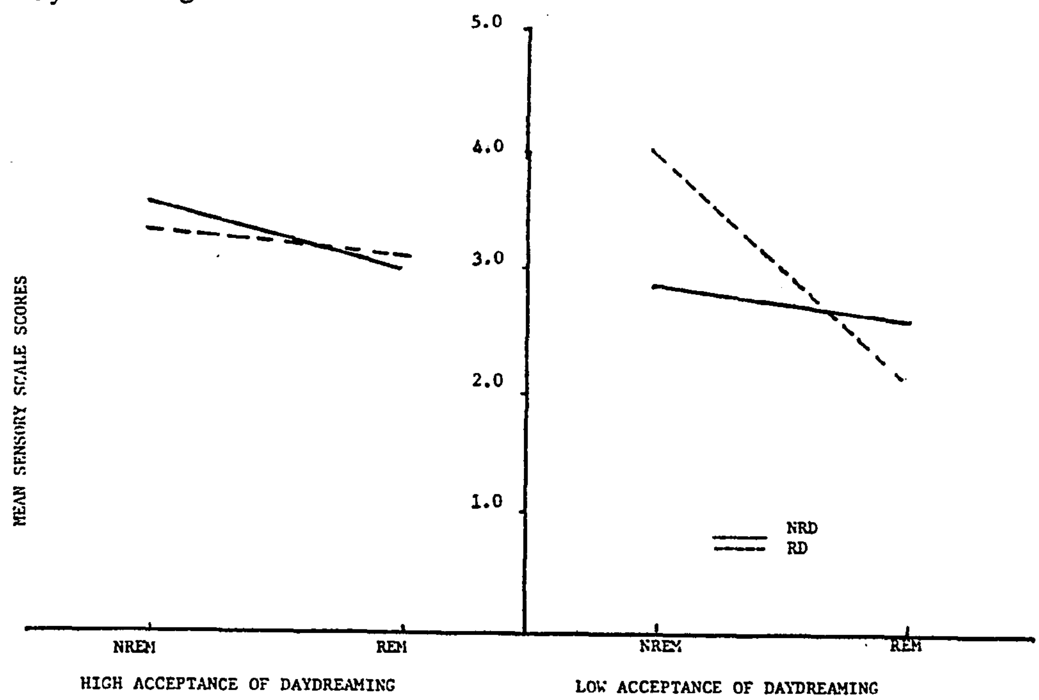

Figure 11. Sensory scale: Second deprivation night--three way interaction of deprivation condition by REM condition by acceptance of daydreaming.

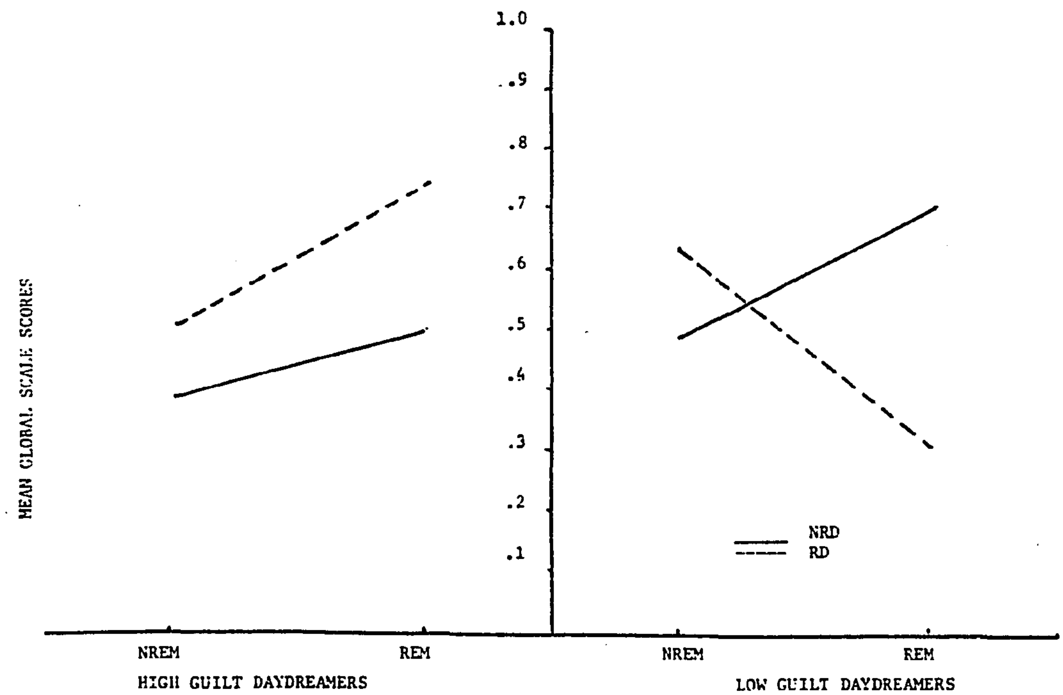

Figure 12. Global scale: Recovery night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

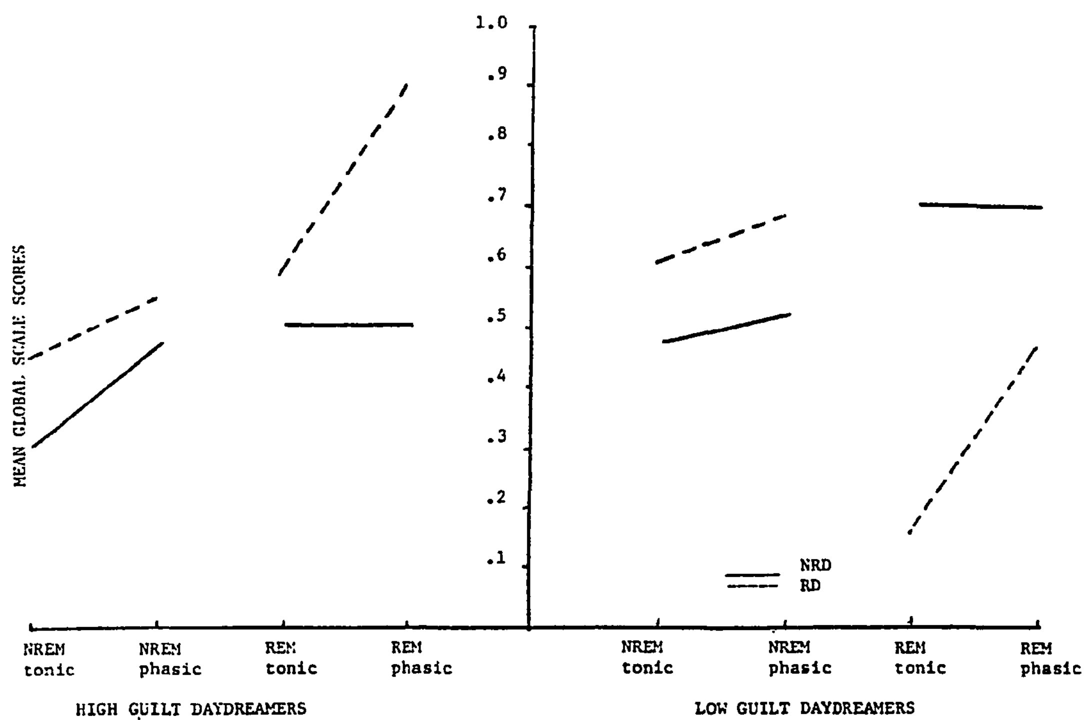

Figure 13. Global scale: Recovery night--four way interaction of deprivation condition by REM condition by phasic condition by guilt daydreaming.

Global scores following RD than after NRD ($p \leq .01$, Duncan range rest). The high guilt daydreamers increased both their NREM Global and their REM Global scale scores following RD, but not following NRD. High guilt subjects had significantly higher REM Global scores following RD, as compared to the REM Global scores of the low guilt daydreamers following RD ($p \leq .05$, Duncan range test). The low guilt daydreamers have a significant difference between their REM Global scores and their NREM Global scores after RD, with NREM awakening dreams rating higher on the Global scale than REM awakenings ($p \leq .01$, Duncan range test). This is not true for the high guilt daydreamers, who show an opposite pattern, with REM awakenings scoring higher than NREM ($p \leq .05$, Duncan range test).

The Reality scale produced no main effects, no second or third or fourth order interactions when guilt daydreams was the subject factor. With acceptance of daydreaming as the subject factor, there as an almost significant interaction between deprivation condition and acceptance of daydreaming ($F = 4.16$, $p \leq .056$). High acceptance subjects tended to rate all mentation as more real following RD than did low acceptance subjects ($p \leq .05$, Duncan range test). This difference was largely accounted for by the greater NREM mentation Reality scores of the high acceptance subjects--a finding consonant with the higher NREM Reality scores of these subjects on baseline nights.

The Affect scale showed no main effects, second or third order interactions. When acceptance of daydreaming was used as the subject factor, it was seen that high acceptance of daydreaming subjects higher Affect scale scores overall following RD, than they did following NRD. This can be largely accounted for by the increase in their NREM mentation scores following RD.

The Self Representation scale exhibited a similar pattern to the Global scale on Recovery nights. These results are shown in Figures 14 and 15. There was a significant effect of deprivation condition in interaction with REM condition ($F = 5.12$, $p = .0362$) and a significant third order interaction between deprivation condition, REM condition and guilt daydreams ($F = 4.29$, $p = .05$). The three way interaction was due to the low guilt daydreamers showing less grammatical suspension of Self Representation during their REM awakenings after RD, than after NRD ($p \leq .01$, Duncan range test). This effect was not shown by the high guilt daydreamers who exhibited the opposite pattern. The high guilt daydreamers had greater suspension of Self Representation in REM after RD than NRD. The low guilt daydreamers had a significant difference between their REM and NREM mentation on recovery following RD ($p \leq .01$, Duncan range test) where NREM scores were higher than REM awakening scores. The high guilt subjects showed an opposite, though nonsignificant pattern.

The Temporal scale showed a strong effect of deprivation condition by REM condition ($F = 7.51$, $p = .0135$). There were no third or fourth order interactions. All subjects made fewer tense changes in REM sleep following RD than NRD ($p \leq .01$, Duncan range test).

The DF scale produced n significant main effects, second third or fourth order interactions wit guilt daydreams. The fourth order interaction with acceptance of daydreaming fell just short of

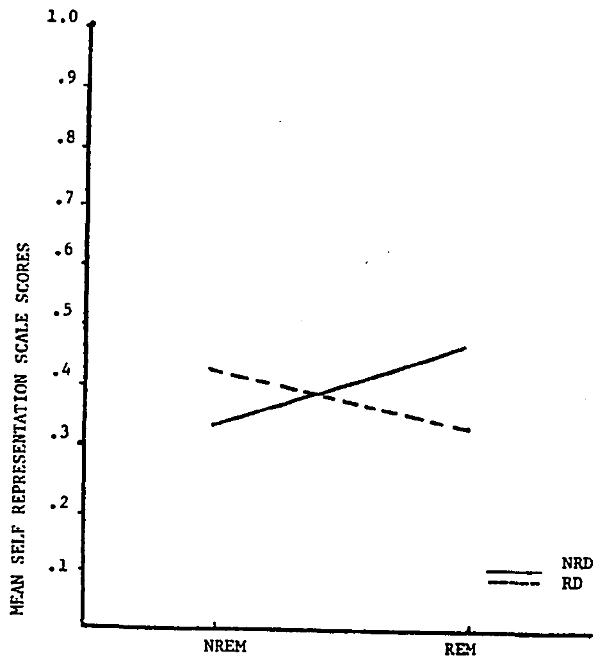

Figure 14. Self Representation scale: Recovery night--two way interaction of deprivation condition by REM condition.

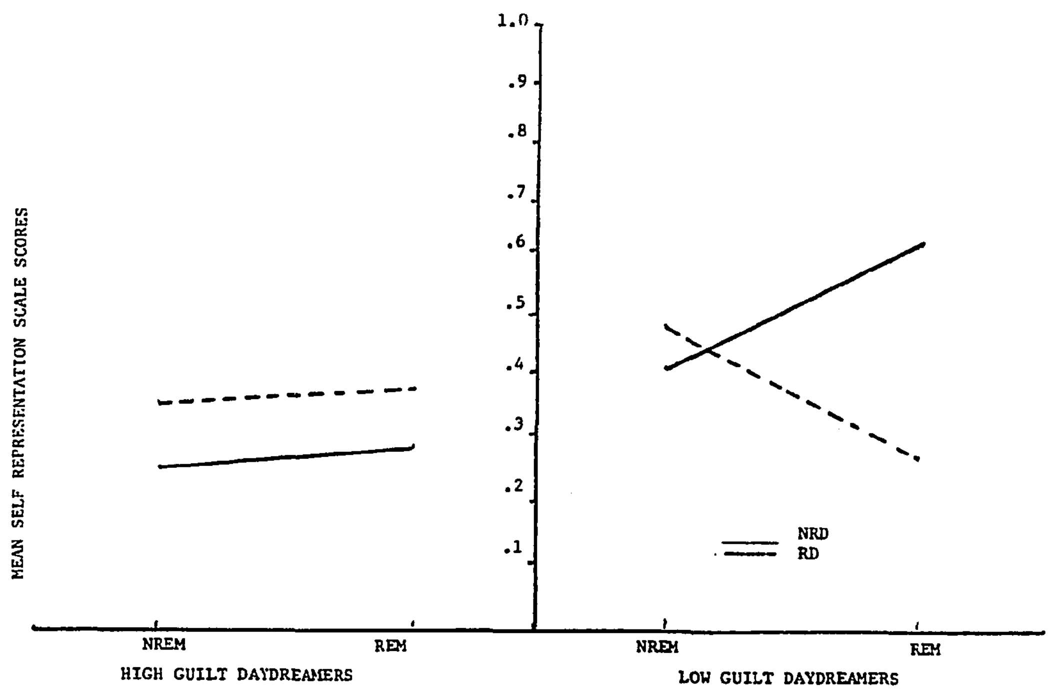

Figure 15. Self Representation scale: Recovery night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

significance (F = 3.70, p = .07). This effect was accounted for by the fact that high acceptance of daydreaming subjects had greater DF scores for their REM phasic awakenings on Recovery after RD than on Recovery after NRD, while low acceptance of daydreaming subjects had greater REM phasic DF scores after NRD.

The SCE/PVE scale showed no main effects, no second, third or fourth order interactions with either acceptance of daydreaming or guilt daydreams as the subject factor.

The Sensory scale produced no main effects or second order interactions, but produced a strong third order interaction of deprivation condition, REM condition and phasic condition. The effect was a significantly greater reporting of the sensory qualities in REM phasic mentation post RD than post NRD ($p \leq .01$, Duncan range test). However, this effect was significant for the high guilt subjects only ($p \leq .01$, Duncan range test). The low guilt daydreamers were slightly but nonsignificantly increasing their REM phasic mentation more after RD than NRD. The low guilt subjects were also showing fewer sensory qualities in their REM tonic mentation after RD than after NRD ($p \leq .01$, Duncan range test). This is shown in Figure 16 (t = -1.95, $p \leq .05$).

NREM Mentation

The planned comparison of NREM Global scores following RD vs. NRD was significant for all subjects in the predicted direction (t = 2.08, $p \leq .025$ 1 tailed test). There were no significant differences between low and high guilt subjects in their NREM

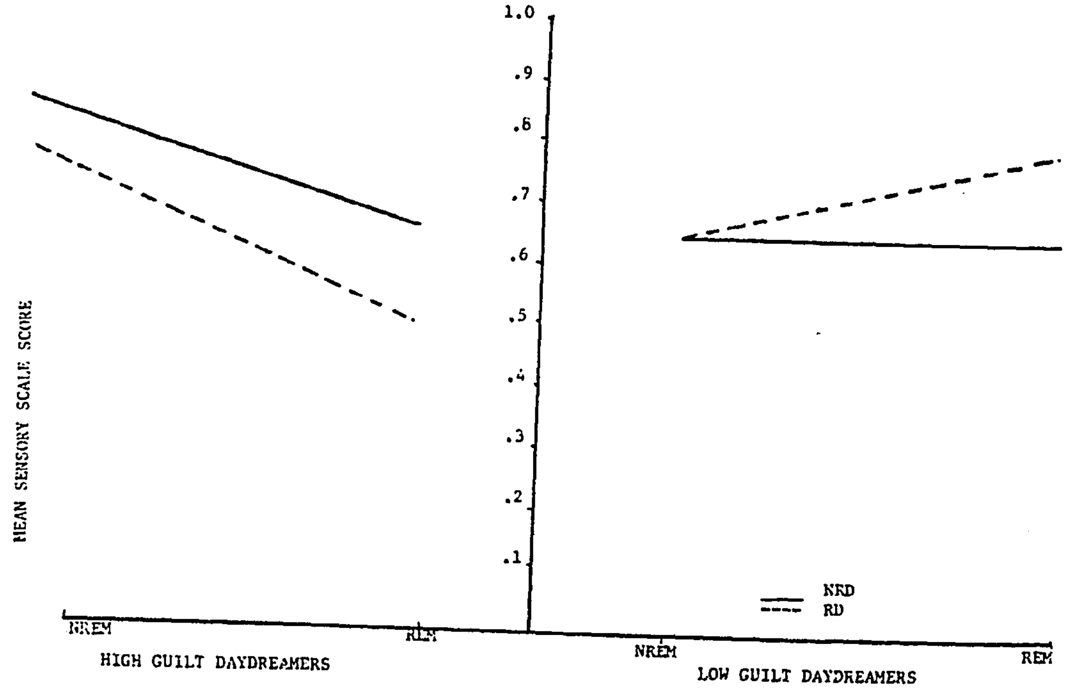

Figure 16. Sensory scale: Recovery night--three way interaction of deprivation condition by REM condition by guilt daydreaming.

mentation post RD, or between low and high acceptance of daydreaming subjects.

The planned comparison of NREM Reality scores post RD as post NRD was not significant for all subjects (t = .6, p = .554) or for any subgroup of subjects, although it was greater for the high acceptance of daydreaming subjects.

The planned comparison between NREM Affect scores post RD vs. post NRD was in the predicted direction for all subjects, but did not reach significance (t = 1.92, $p \leq$ .07, one tailed test).

The planned comparison between NREM Self Representation scores post RD and post NRD was significant in the predicted direction (t = 1.964, $p \leq$ .05, one tailed test). There were no significant differences amongst subject groups.

The planned comparison between NREM Temporal scale scores post RD vs. post NRD was in the predicted direction, but did not reach significance (t = 1.68, p = .1093) there were no differences amongst subject groups.

The planned comparison of NREM DF scores post RD vs. post NRD was significant in the predicted direction (t = 1.86, $p \leq$ .05, one tailed test) there were no significant differences amongst subject groups.

The planned comparison of NREM SCE/PVE scores post RD vs. post NRD was not significant, but was in the predicted direction (t = -.67, p = .5129, one tailed test).

The planned comparison between NREM Sensory scores post RD vs. post NRD was significant in the predicted direction (t = -1.95, $p \leq$ .05) there were no differences amongs subject groups.

Summary of Results

There are two major findings in this investigation. The first is that there is an increase in NREM mentation following RD for all subjects, but primarily on scales which differentiate phasic from tonic awakenings on baseline nights (Global, SRS, and Sensory scale). The DF Scale also showed results in the predicted direction.

The second important finding is that subject's scores on measures of waking fantasy can be used to predict their responses to REM deprivation in terms of changes in their REM mentation scores. One way of conceptualizing these initially large and confusing set of results is by examining the differential pattern of responses to REM deprivation amongst high and low guilt daydreamers across all nights. These results are shown in Figures 17 to 32. The pattern for the low guilt daydreamers is that during REM deprivation these subjects are having their most real seeming mentation during REM sleep, and particularly during REM phasic awakenings. These awakenings are judged to be much more real than REM phasic awakenings either on the comparable NREM deprivation night, or during BL nights. On the recovery night following REM deprivation, the low guilt subjects produced REM mentation which is rated as less real seeming than on recovery following NRD, and lower than baseline nights. These results were most consistent for scales that were designated as good indicators of phasic vs. tonic awakenings on baseline, specifically the Global scale, the Self Representation scale, and the Sensory scale. High guilt daydreamers were not showing a differential effect of RD vs. NRD on any scales on their REM mentation.

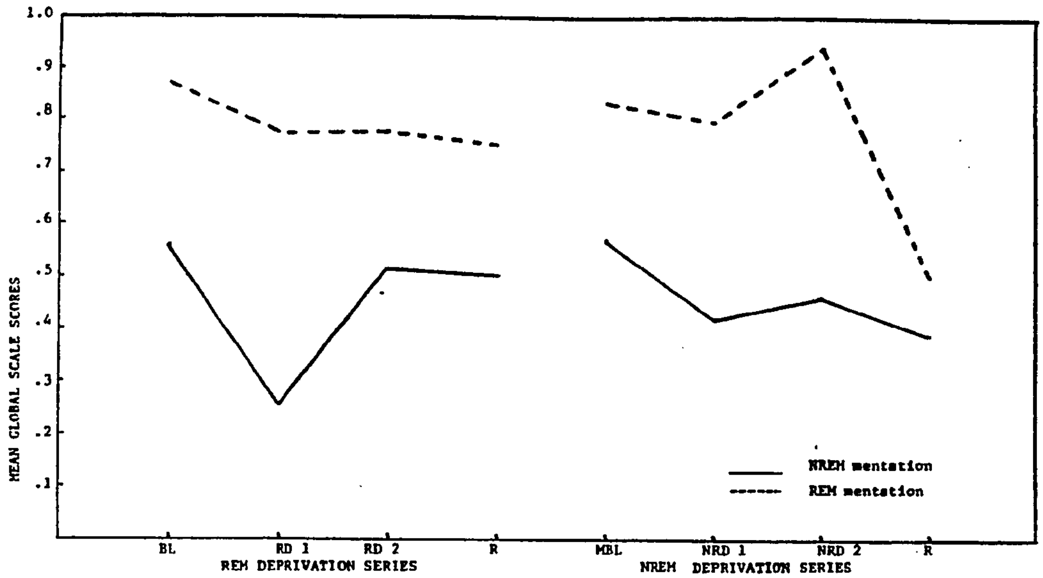

Figure 17. Dreaming across all nights on the Global scale, high guilt daydreamers only.

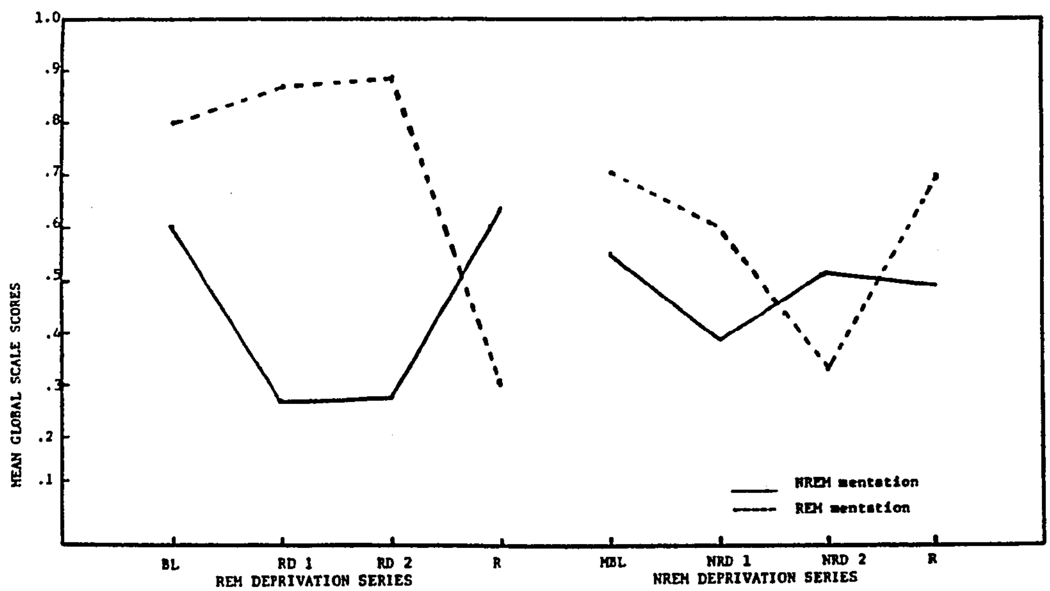

Figure 18. Dreaming across all nights on the Global scale, low guilt daydreamers only.

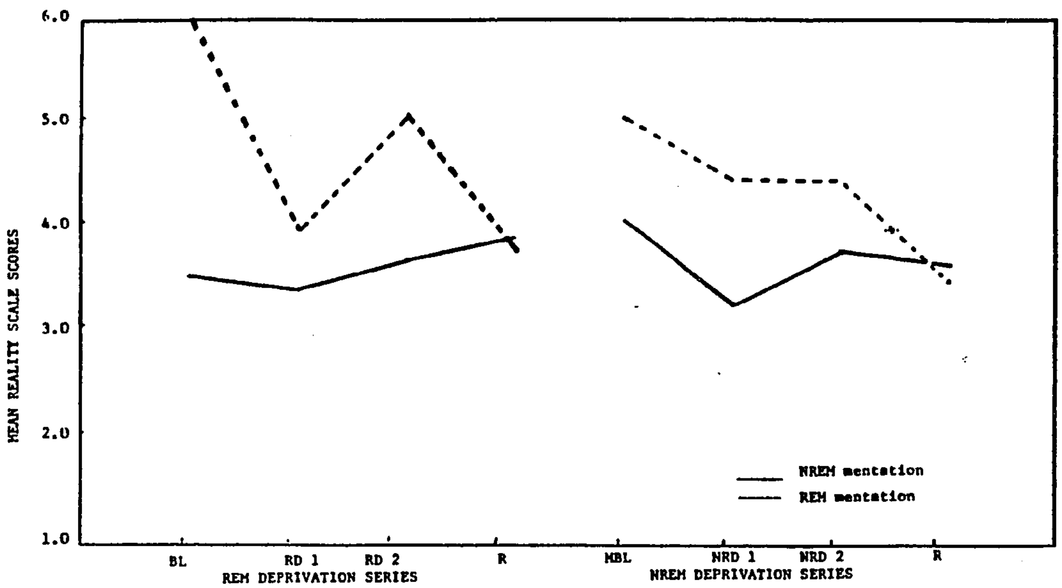

Figure 19. Dreaming across all nights on the Reality scale--high guilt daydreamers only.

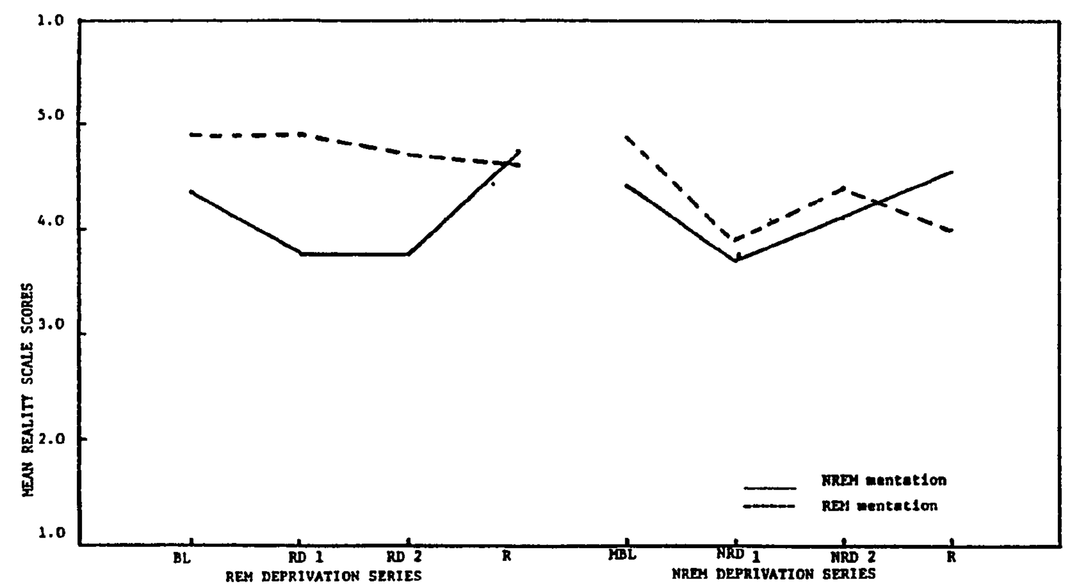

Figure 20. Dreaming across all nights on the Reality scale--low guilt daydreamers only.

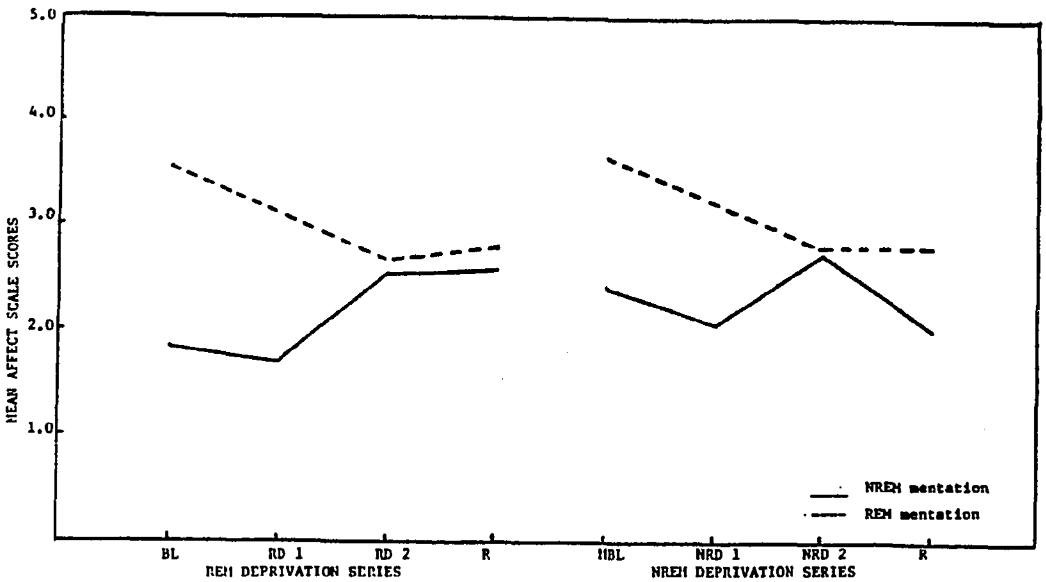

Figure 21. Dreaming across all nights on the Affect scale--high guilt daydreamers only.

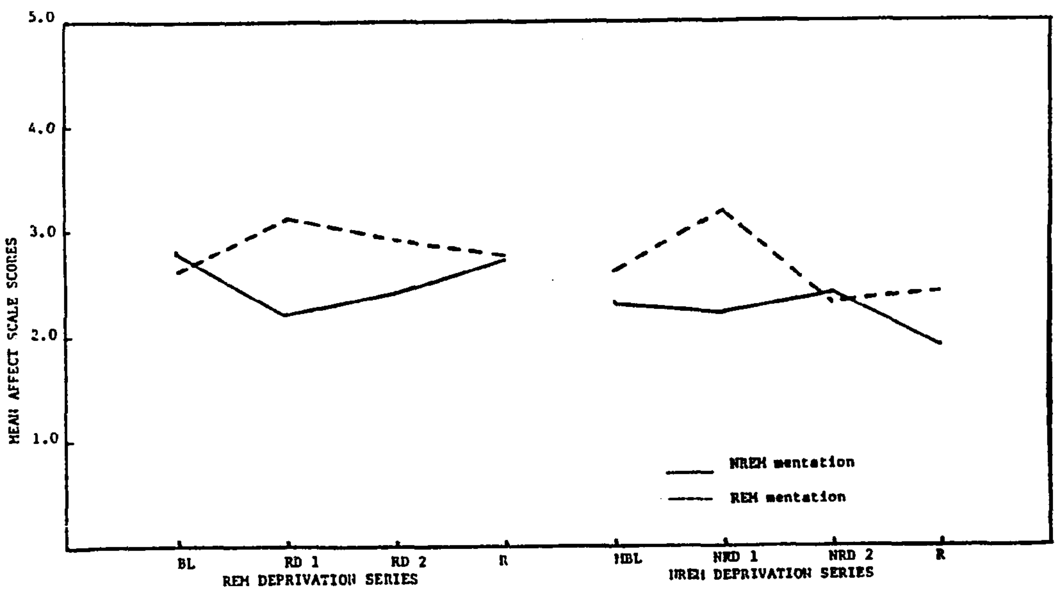

Figure 22. Dreaming across all nights on the Affect scale--low guilt daydreamers only.

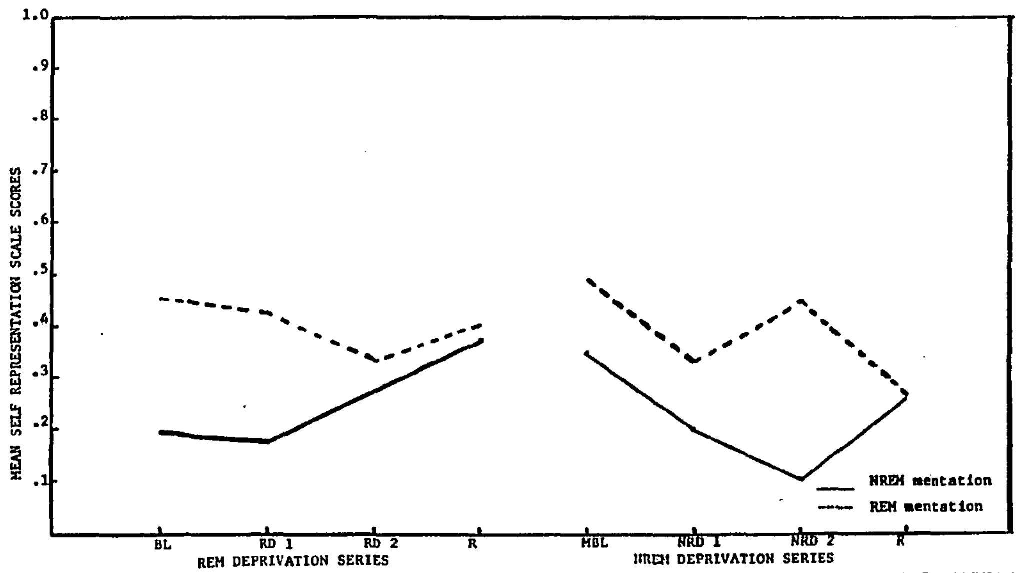

Figure 23. Dreaming across all nights on the Self Representation scale--high guilt daydreamers only.

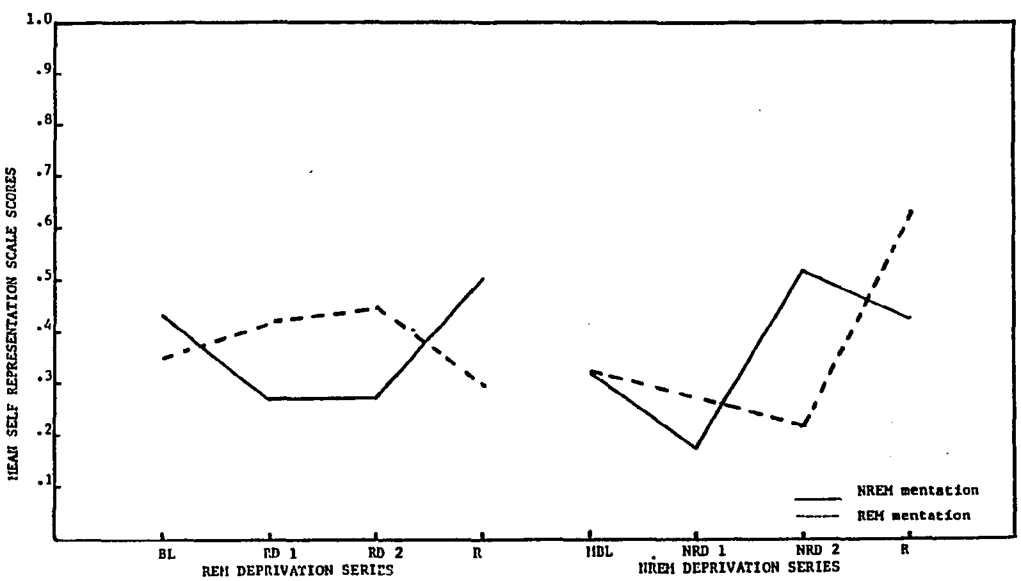

Figure 24. Dreaming across all nights on the Self Representation scale--low guilt daydreamers only.

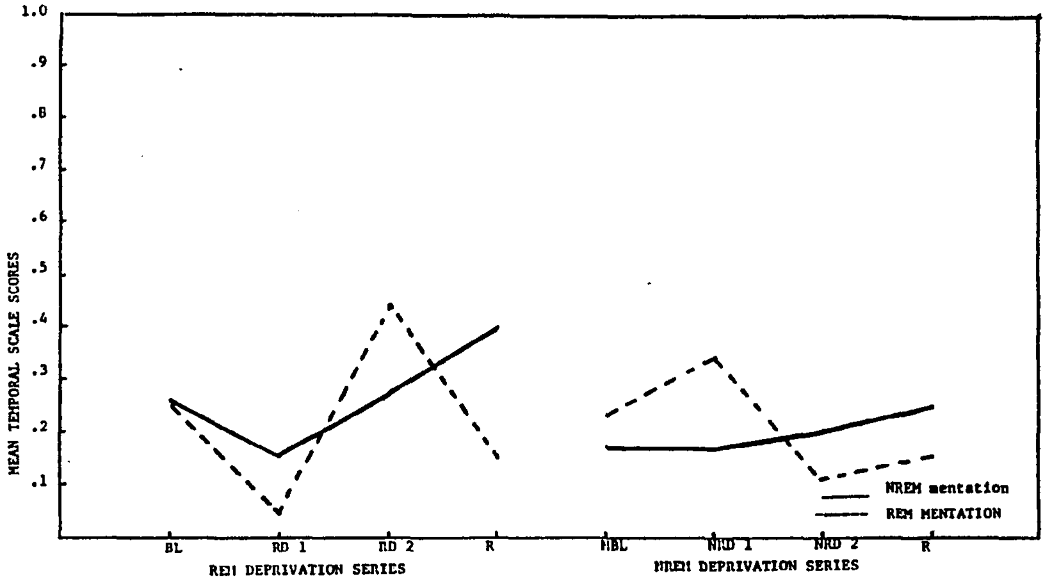

Figure 25. Dreaming across all nights on the Temporal scale--high guilt daydremers only.

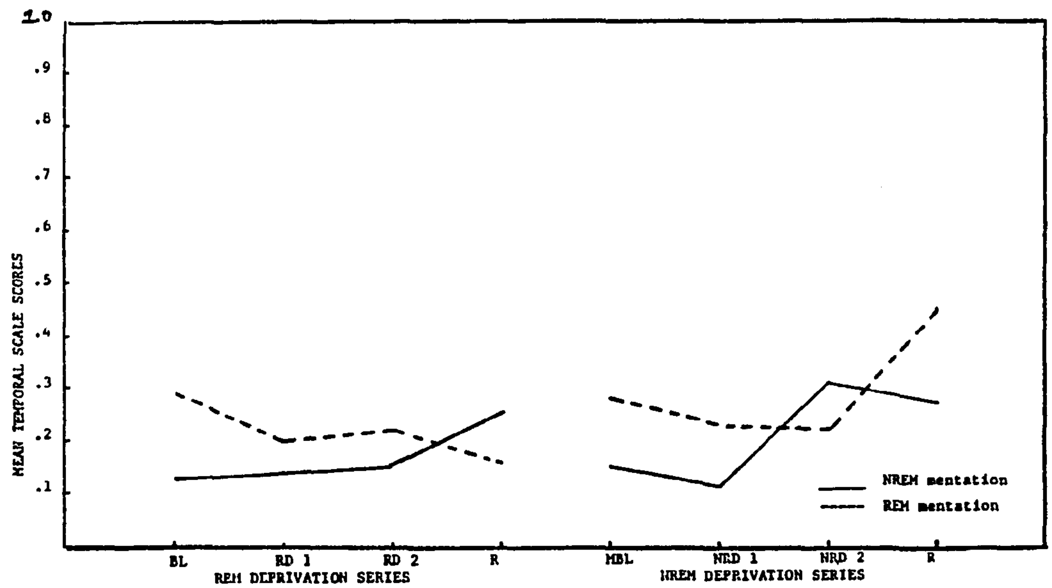

Figure 26. Dreaming across all nights on the Temporal scale--low guilt daydreamers only.

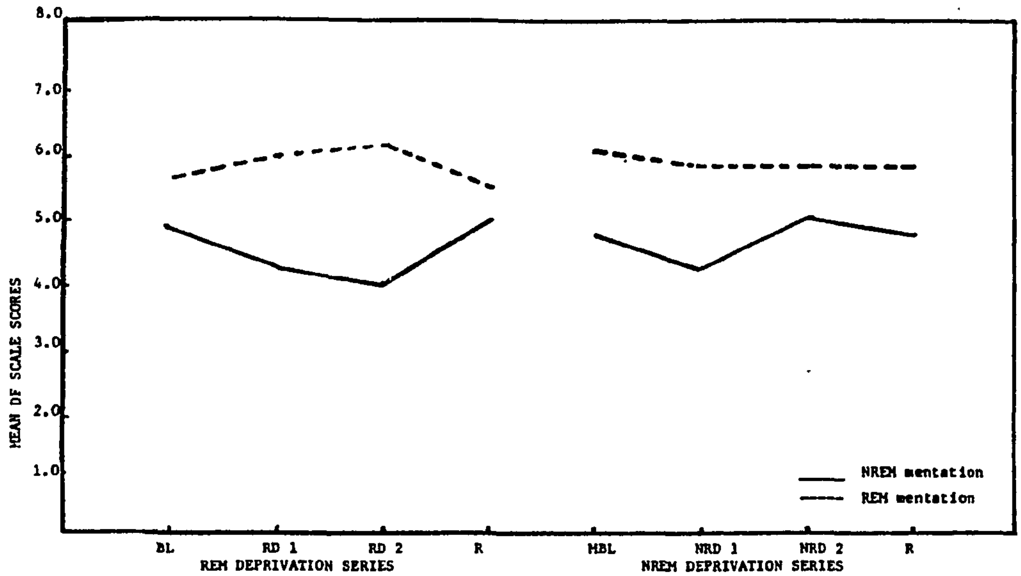

Figure 27. Dreaming across all nights on the DF scale--high guilt daydreamers only.

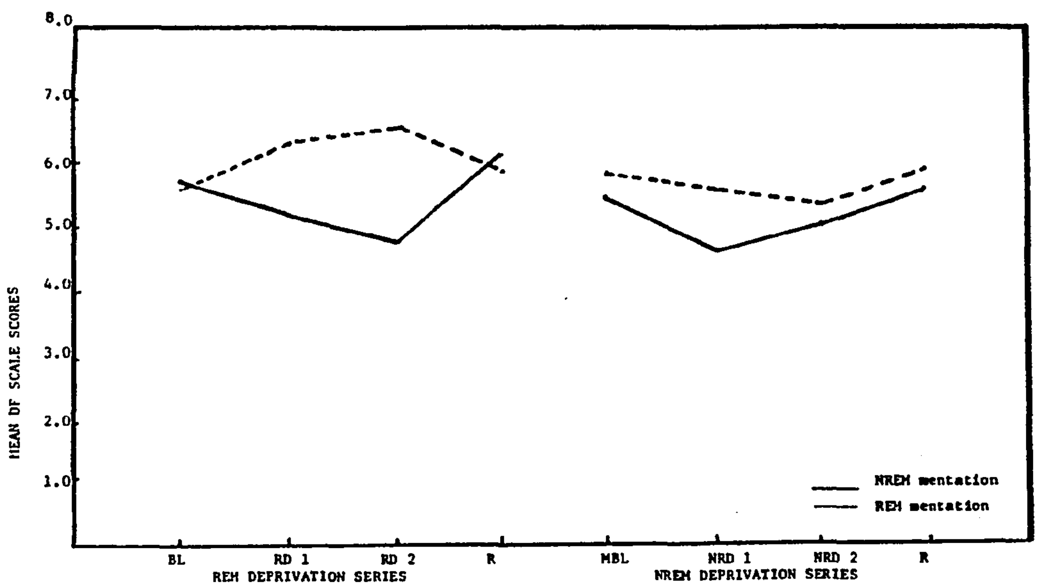

Figure 28. Dreaming across all nights on the DF scale--low guilt daydreamers only.

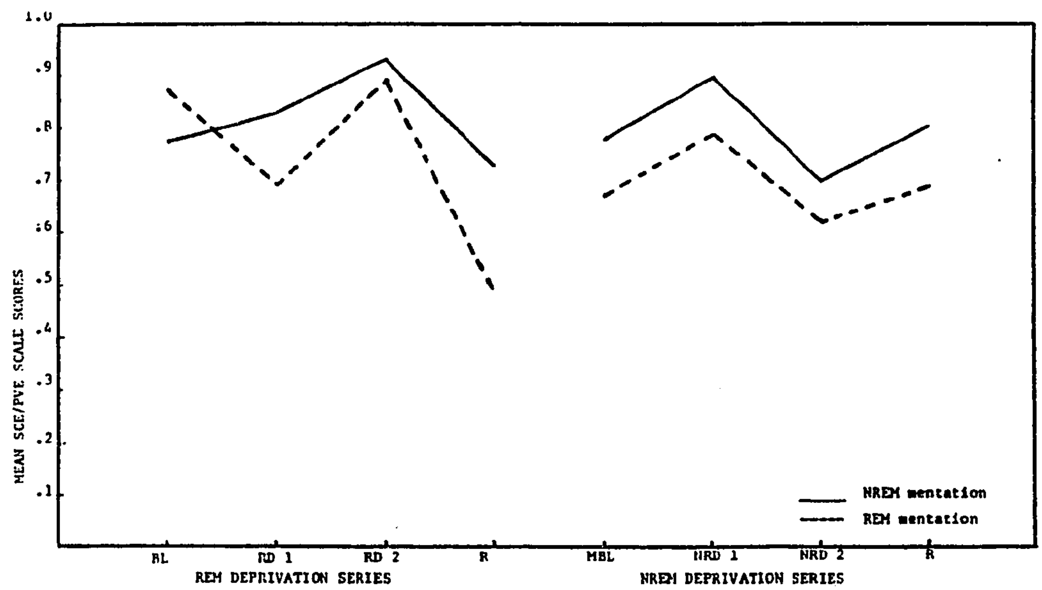

Figure 29. Dreaming across all nights on the SCE/PVE scale--high guilt daydreamers only.

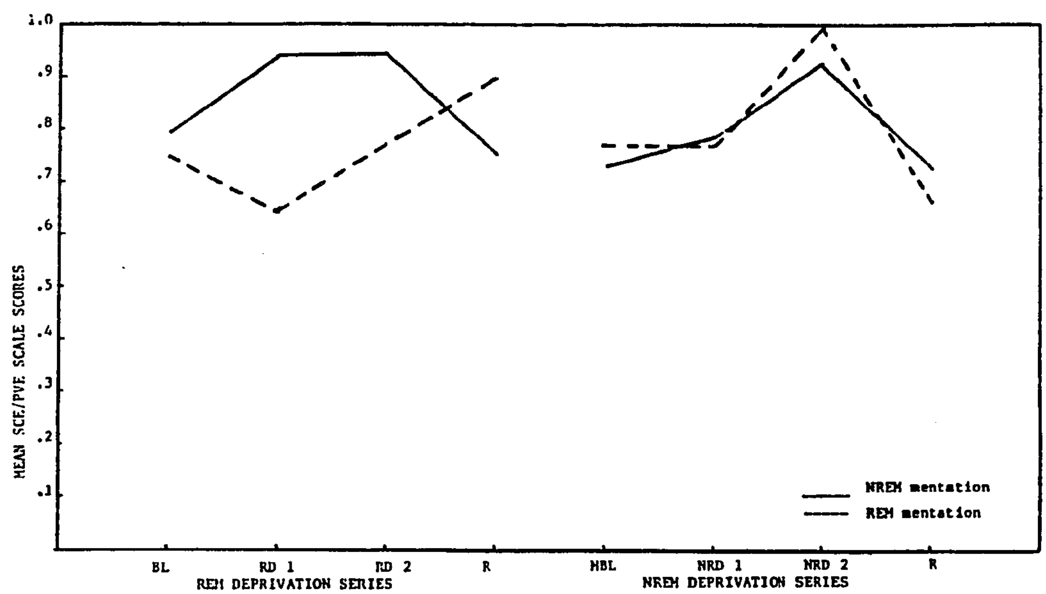

Figure 30. Dreaming across all nights on the SCE/PVE scale--low guilt daydreamers only.

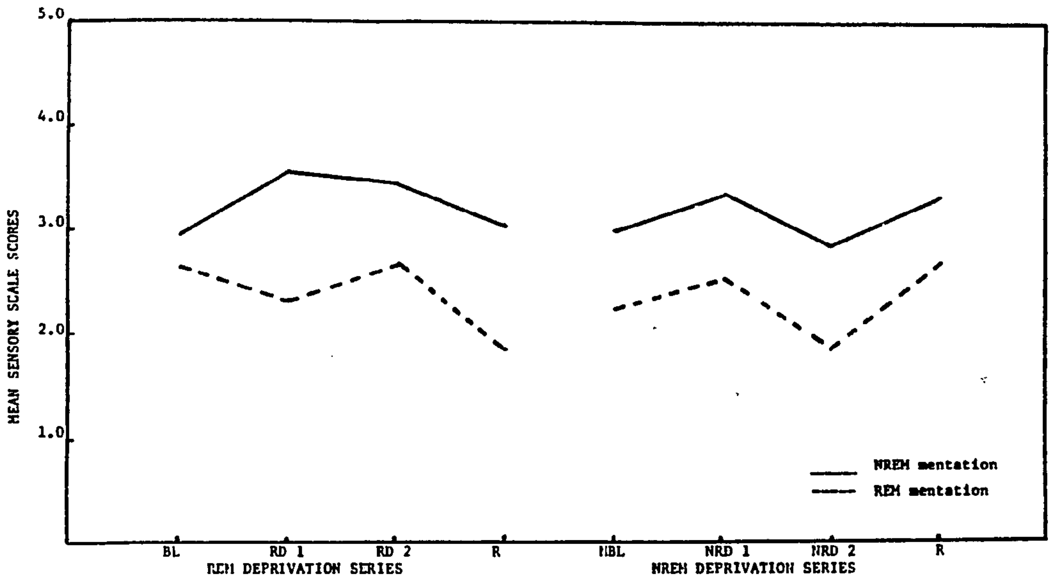

Figure 31. Dreaming across all nights on the Sensory scale--high guilt daydreamers only.

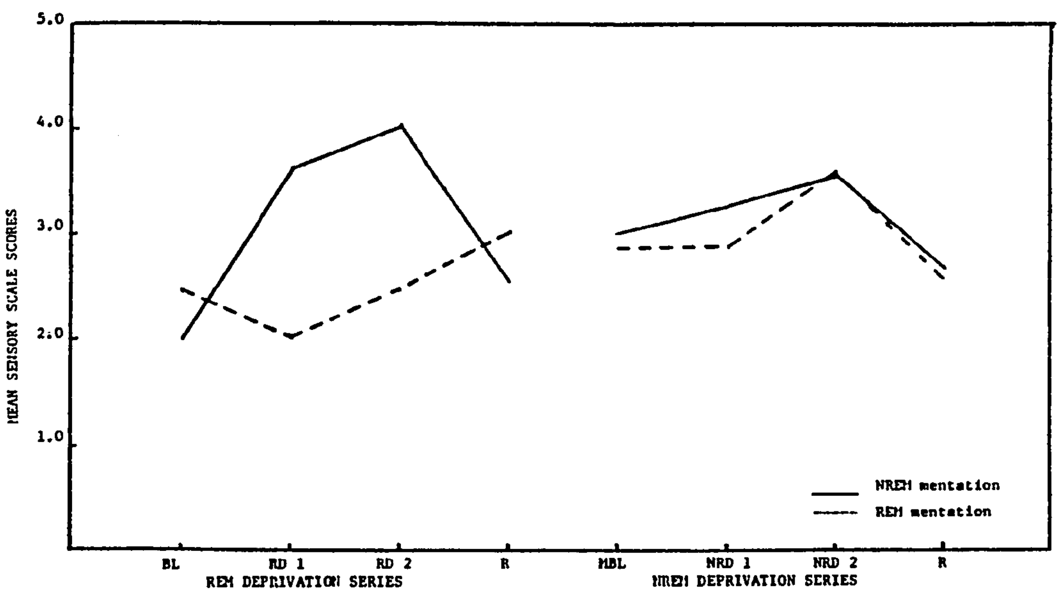

Figure 32. Dreaming across all nights on the Sensory scale--low guilt daydreamers only.

The pattern of results is more obscure when subjects are split on the median of their acceptance of daydreaming scores. Essentially, acceptance of daydreaming seems to affect scales where self report is called for (i.e. the DF and the Reality scale). There are two reasons to interpret these effects cautiously. First, self report scales were shown to be susceptible on baseline nights to reporting style, and no analyses were undertaken which would look at the interaction of reporting bias and acceptance of daydreaming. Secondly, high and low acceptance subjects differed in their REM and NREM mentation means on baseline, and a true test of the hypothesis would have to partial out initial differences during baseline.

Chapter VII

DISCUSSION

Evaluation of Predictions

We thought that subjects who tended to be more involved in fantasy during the day, as measured by the acceptance of daydreaming scale would be less likely to show a REM rebound following RD. Indicators of flexible frequent daydreaming showed no significant correlations with the increase in REM sleep following RD. Guilt daydreaming did not show any significant correlation with the amount of REM rebound either. In addition, our original conceptualization that high acceptance of daydreaming subjects were equivalent to Nakasawa et al.'s (1975) introverted subjects seems mistaken; introversion as measured by the MPI and acceptance of daydreaming seem to be two independent dimensions. High sensitization scores, SCK scores and Field Dependence all correlated positively with REM rebound, a finding opposite to results previously cited in the literature.

We also believed that subjects who showed more involvement in waking fantasy would be more likely to show an increase in NREM mentation following RD, since these subjects had higher NREM mentation means during BL nights which we felt to be an indication that they did not confine phasic activity or their most vivid mentation to REM sleep. Surprisingly, there was an increase for all subjects in certain qualities of NREM mentation following RD, but not after NRD.

This was true for four of the eight dream scales--the Global scale, the Self Representation scale, the DF and the Sensory Scale. These scales tended to be the better discriminators of phasic vs. tonic REM awakenings on BL nights. While the Reality scale was a good indicator of phasic awakenings for the high guilt subjects, these subjects alone did not show an increase in NREM mentation following RD on this scale. Our results suggest that prior failure to see changes in NREM mentation following RD may be due to the insensitivity of the scales used.

It was with respect to the REM mentation following RD, that styles of waking fantasy proved useful in discriminating response patterns to RD. To the extent that on BL nights the acceptance of daydreaming scale showed high correlations with REM minus NREM mentation scores, it was taken as an index of a subject's ability to confine phasic activation to the REM period. However, analysis of the effects of RD on REM mentation was not different for subjects high in acceptance of daydreaming vs. subjects low in acceptance of daydreaming, except on scales which measured self report. In addition, these changes were largely interpretable in terms of BL differences that the two groups showed in their REM and NREM mentation scores.

Briefly, the high guilt daydreamers showed some changes following RD, but these changes were about the same for both REM and NREM mentation during the R nights. In addition, the high guilt subjects showed no differential pattern of response on any scale between their response to RD vs. NRD on REM mentation. The low guilt subjects showed a characteristic pattern of response to RD which was significant for scales which were good phasic vs. tonic discriminators during BL. During deprivation nights, these subjects had significantly higher REM mentation, especially REM phasic mentation following RD than NRD. On R nights, these subjects appeared to be having significantly less involving REM mentation following RD than following NRD. While phasic awakenings remained higher than tonic awakenings during REM sleep, the well documented (Dement et al., 1968) dispersion of phasic activity during the REM period following RD, meant that the distinction between phasic and tonic categories may not have been completely accurate. Thus, at a time when one would expect REM mentation to be the most intensely experienced, these subjects suddenly have less powerful real seeming experiences--not only by their own self assessment, but by the assessment of the experimenter. High guilt subjects do not show a decrease in the perceived and rated realness of their REM mentation following RD. High guilt daydreamers could be viewed as more accurate reports of their experience, since their report correlates more highly with the independent physiological criterion of phasic activity during BL nights. It may be that the low guilt subjects are distorting or somehow less accurately reporting their reading of the physiological stimuli (phasic activity), which during BL they rate as the most powerful and real seeming mentation. That this is not simply a response to stress is shown by their failure to have a similar pattern following NRD. That it is specifically a response to their patterning and intensity of phasic activation during the REM period post RD, is evidenced by the fact that this effect is only significant with scales that differentiate phasic from tonic awakenings during BL.

Thus low guilt subjects show a curvilinear response to phasic activation. At low levels of stimulation, phasic awakenings are perceived as the most real. At the highest level of stimulation, however, processes intervene which change their reported experience of phasic activation and dreams accompanying phasic awakenings are the least real. Why these subjects experience phasic activation in this peculiar way will be examined in the conclusion section.

Finally, the study also provided validation for two of Schwartz's (1979) scales--the Global and the Self Representation scale. The Sensory scale, also designated a good phasic tonic indicator on BL also was sensitive to changes in sleep mentation following RD. The Reality scale was a good phasic vs. tonic discriminator for the high guilt subjects only, and these subjects did not respond to RD with changes in REM mentation. However, the Reality scale did not show significant changes in NREM mentation following RD for the high guilt subjects, which we would have expected. One psosible conclusion is that self report scales are more sensitive to stress effects. The scales whch were designated as poor phasic/tonic discriminators (SCE/PVE, Temporal, Affect) did not change after RD as predicted.

Limitations of the Data Set

The most severe limitation of the data, in terms of comprehensively testing our model that the physiological response to

REM deprivation as well as changes in mentation and fantasy following RD were mediated by the ability to confine phasic activity to the REMP, was that the sleep records were unavailable to us. Therefore, we never had a true measure of a subject's ability to confine phasic activity to REM sleep. In addition, a number of phasic events were not recorded (i.e., PIPs, MEMAs, or eye movements outside of the REMP). Pessah and Roffwarg (1972) suggest that phasic activity is not synchronous in humans (at least at the level of recording); thus our distinctions between phasic and tonic awakenings may be inaccurate. This would probably have affected the data most on Recovery nights where one would expect more varied and less synchronous patterns of phasic event firing. In addition, without the sleep records we could not see if changes in sleep mentation were actually accompanying changes in the timing or patterning of phasic activity within the REMP, or during the intervals immediately preceeding the REMP.

A second limitation of the study was the use of only one Recovery night. If there is enough loss of delta sleep a delta rebound may displace a REM rebound. Gillin et al. (1975) suggest that some subjects may be having REM rebound in a fragmented form, and that rebound may take place over a couple of nights. Similarly Vogel (1979) states that in healthy subjects rebound may be postponed beyond the first REMP and occur in later REMPS or even after the first Recovery night. In part, this could be responsible for the puzzling findings about the relationship between personality and the physiological response to REM deprivation. However, Cartwright and Ratzel (1972) and Gillin et al. (1975) were able to see differences in rebound patterns amongst subject groups even after only one R night.

The study from which the data was taken was originally designed to study changes in NREM mentation following RD, and three times as many NREM awakenings were made as REM awakenings. In analyzing the data the design was balanced by using the mean mentation scores in each of the awakening categories (REM, NREM, REM phasic, REM tonic, NREM phasic, NREM tonic), thus removing any independent measure of the variability of an individual subject's reports within an awakening category. The fewer number of REM reports (only two per night) made it impossible for us to examine the early/late condition within one night. During baseline nights early/late was seen to be a significant dimension on the Global, Sensory and SCE/PVE scales. By pooling early and late data, it was possible that some effects of REM deprivation on mentation were lost. This would be particularly true on the Recovery night if we accept Vogel's (1979) assumption that normal subjects will postpone any form of REM rebound until after the first REMP on Recovery nights. Similarly, on the second deprivation night, only the early part of the night was analyzed. Scales which had significant early/late component might have shown significant results if the entire night had been analyzed.

Finally, our sample size was a small one for an individual difference study. Subjects were not preselected for their scores on the personality measures, so that we could not study extreme variations on any scale.

Comparison of Findings with Previous Research

One point which emerges clearly from our data is that the choice of scale used to score nocturnal mentation will determine, in part, whether changes in dreaming can be ascertained following REM deprivation. Those scales which were designated as able to discriminate phasic from tonic awakenings on baseline showed the most consistent interactions with personality, and the clearest effects following RD. The analysis of our baseline data suggest that Monilari and Foulkes (1969) distinction between Secondary Cognitive Elaboration and Primary Visual Experience is not a useful one. The SCE/PVE scale was not a good discriminator of phasic vs. tonic awakenings. Ellman's (unpublished) critique of the Monilari and Foulkes study points out many of its weaknesses, i.e. the use of a post hoc analysis, and the failure to control for time of night or time into the REMP. Bosinelli et al. (1974) was also unable to find a significant association between PVE and REM-M (eye movement) awakenings. A closer examination of the scoring of the SCE/PVE scale, suggests why it failed to discriminate phasic from tonic awakenings, and failed to show a consistent pattern of changes following REM deprivation. First, PVE is really a residual score (i.e. any reports in which no evidence of Secondary Cognitive Elaboration is found). Seen in this light the SCE/PVE scale is really a rating of the presence of cognitive content, rather than the visualness or sensory qualities of a dream. There is a negative correlation between PVE and word count--the fewer words that a subject uses, the less likely it will be that SCE is found in the report. Secondly, a report can be both highly conceptual as well as have a great deal of sensory content. The SCE/PVE scale treats these two possibly orthogonal factors up as opposite poles on a continuum. That sensory content and cognitive content might be more profitably looked at separately was borne out by our more successful use of the Sensory scale. Finally, within the scoring of the SCE/PVE scale, any act of verbalization in the dream is interpreted as a cognitive act, and the entire report gets a score for SCE. The conceptual logic of this choice escapes us.

The Sensory scale adopted from Foulkes and Pope (1973) showed more promise as a scaling dimension which could differentiate phasic from tonic awakenings. Although during baseline nights the planned comparison of phasic vs. tonic REM awakenings was not significant, this scale showed strong effects of REM condition, and significant effects of time of night. One of the limitations of the scale was that on baseline scores tended to cluster around the midpoint. In addition, the reporting of sensory experience is highly susceptible to differences in subjects' linguistic abilities and verbal skills. In this respect, Sensory scaling should vary to some extent with the length of the report. Rechtschaffen's (1980) finding that the lenght of the report is the single most reliable discriminator of REM vs. NREM awakenings lends support to this supposition. In future studies, word count should be used as a covariate with the Sensory scale.

The DF scale has been criticized elsewhere in this report. To reiterate, it confuses four independent factors in its scaling (how real the drama is, how perceptual, how bizarre and the presence of content vs. no content). Our results show that at least two of these dimensions may be scaled profitably by themselves--how real the dream seems, and how perceptual the dream seems. Both of these dimensions were able to reliably discriminate REM vs. NREM awakenings by themselves. The DF scale was scored so that to get a score of seven or eight the subject himself had to express the feeling that the dream was real. In this regard the DF was prone to many of the same self report problems as the Reality scale. Like the Reality scale it was a good REM/NREM discriminator, and a less accurate phasic/tonic discriminator, although results were in the predicted direction. In short, the DF remains limited in its usefulness because it is a hodge podge of several dimensions which should be scaled separately. Since many of the previous studies on the effects of REM deprivation on mentation use the DF, at least some of the contradictory findings to date may stem from weaknesses in the measuring instrument, and in its analysis. Where the DF has been previously treated as interval level measurement, our data suggests that it is really a combination of four smaller interval scales, which can truly only be combined to form an ordinal scale, since it is not yet clear how the smaller dimensions interrelate.

At least one reason that the present research was undertaken was the hope that by correcting the major methodological flaws of previous REM deprivation research, we could clear up some of the inconsistencies in results. The first study which attempted to look at individual differences in response to RD within the night was Pivik and Foulkes (1968). Our data can be considered a confirmation of their findings. If one reconceptualizes the guilt daydreaming scale as a measure of a subject's ability to accurately report and perhaps tolerate anxiety producing thoughts, then our high guilt subjects will show some overlap with Pivik and Foulkes' sensitizer subjects. Our low guilt subjects would be roughly equivalent to their represser subjects. As did Pivik and Foulke's represser subjects, our low guilt subjects showed a strong response to REM deprivation by increasing REM mentation, specifically REM phasic mentation on the first deprivation night. While this effect was significant for all the subjects, it was really the low guilt subjects who were "carrying" the effect. Because we did not have eye movement counts, we cannot comment on their finding that represser subjects increased REM density within the REMP during the second half of the first deprivation night. Although we did not find results in our sample using the DF scale, we can think of the DF scale as a less sensitive indicator of the suspension of self representation and of phasic vs. tonic awakenings than either the Global or Self Representation scale. What our data adds to the earlier study is that the increase they found is due to an augmentation of certain properties of REM phasic mentation, and that this result is more powerfully demonstrated by scales that were able to differentiate phasic from tonic awakenings on BL nights.

One of the most glaring faults of the Foulkes, Pivik, Ahrens, and Swanson cross night replication of the Pivik and Foules study was that there was no clear indication that their REM deprivation procedures worked. In contrast to their data, we saw clear effects of REM deprivation on mentation during the second deprivation night, particularly on the Global scale. While these effects were across all subjects, they were not significant for the high guilt subjects alone in the case of the Global scale. In the case of the Reality scale, it was the high acceptance of daydreaming subjects who were judging their REM mentation to be more real seeming after RD than NRD. These results are in agreement with the earlier Pivik and Foulkes study. Scales which showed, on baseline strong time of night effects, were less likely to show significant effects of REM deprivation during the first half of the second deprivation night.

Nakasawa et al. (1975) showed that extraverted and nonneurotic subjects showed an increase in REM sleep during recovery from their partial sleep deprivation procedure. In our sample, REM rebound, scored as a percentage of TST on recovery night correlated .05 with MPI extraversion scores. Neuroticism on the MPI correlated positively (.34) with REM rebound percent on recovery. Since Nakasawa et al. did not control for TST, it seems likely that their poorer rebounders were simply poorer sleepers who were awakening earlier, and hence not seeming to show any rebound. Thus, their reported correlation between REM rebound and personality was spurious.

While our study is inadequate to comment on Cartwright's (1967) study because she scored REM sleep in an unorthodox manner, we can comment briefly on the model she espouses in that paper. She established three patterns of response to REM deprivation--compensation, substitution and disruption. One implication of her model, which she states more clearly in a later paper (Cartwright & Ratzel, 1972) is that the extent to which a subject can confine his dream like activity to the REM period is the strongest predictor of his response to REM deprivation. Our results do not support any model of a unified relationship between increases in either REM or NREM mentation on recovery, personality and the physiological response to REM deprivation. In this we are in agreement wit Rich, Antrobus, Ellman and Arkin (1975) who found that fantasy increase outside of the REMP could not account for the variance amongst subjects in their percent of increase in REM time on recovery nights. To the extent that substitutors were seen as having more access to fantasy under all conditions, they would be roughly equivalent to our high acceptance of daydreaming subjects. The acceptance of daydreaming scale showed no pattern of relationship to the increase in REM on recovery. Although we did find reliable differences in individual reactions to REM deprivation, these differences were not explicable on the basis of Cartwright's somewhat simplistic discharge model. Antrobus, Ellman and Farber (1978) suggest that the variables Cartwright used to test her model included variance components which would produce spurious correlations, without being able to truly test the model. Our results supported this conclusion.

Besides Pivik and Foulkes (1966) and Cartwright (1967, 1972), only Arkin, Ellman and Antrobus (1978) attempted to look at the effects of REM deprivation on mentation. These authors found no effects of RD on mentation. Of the three studies, this was clearly the best controlled. In addition, these authors used the same data that the present experiment examined. Differential results seemed explicable on a number of grounds. First, they used a modified DF scale, which we have seen is not as effective as the Global scale at differentiating phasic from tonic awakenings. Secondly, we used both dichotomous choice and seven point rating scales to score our data, while Arkin et al., used a forced normal distribution.

Several studies have looked at fantasy and waking behavior. We cannot comment directly on their results, but the fact that the effects of RD on mentation were noticeable during the first REMP of the second deprivation night suggests that RD effects are not dissipated during the day. In addition, our results stress the importance of the measuring instrument. Tasks such as an increase of M+ on the Rorschach which are similar to the loss of reflective self representation in that one is able to perceive movement in a static situation are more likely to be sensitive to changes following REM deprivation.

We had hoped to find a trait in normals who did not respond to RD which would show some continuity with the psychological characteristics of schizophrenics, another group who fail to rebound. While this did not turn out to be the case, our results suggest that some of the blandness of schizophrenic dreams (i.e. Richardson & More, 1963) might be related to a blandness or incoherence imposed on the content due to anxiety, and the poor anxiety regulation in these subjects. At any rate, careful correlations of physiological variables and mentation scores are necessary to understand what relation, if any, the psychological experience of these subjects has to do with the patterning of their phasic activity.

Conclusions and Suggestions for Future Dream Research

We had proposed that the ability to confine phasic activity to the REMP was a stable personality trait, with implications for waking fantasy life, NREM mentation and the response to REM deprivation. Our original model was similar to the one proposed by Zarcone (1979), who felt that phasic activity was an analogue to PGO spikes in the human and that they were "the minimal neural substrate of dream images." We differed only in what we believed phasic activity added to the dream report, namely, the sense that it was really happening, as opposed to being a product of one's mind. While Zarcone developed his model in response to findings that acute schizophrenics did not respond with compensation to REM deprivation, we had thought that normals might also have defects in the regulation of phasic activity, but that these defects might not result in schizophrenia. Rather, they might lead to the development of a cognitive style that allowed for more vivid real seeming mentation to be experienced in waking, NREM sleep and REM sleep equally. We assumed that the ability to confine phasic activity was relatively immutable, hence we would see an increase in NREM mentation following RD, only for those subjects who were nonconfiners.

To the extent that we took absorption in positively toned daydreaming as a measure of waking fantasy and one's ability to confine phasic activation to the REMP, this model did not prove useful--although a direct test of the model was never made.

However, a scale which measured a subject's likelihood of reporting odd, guilty or anxiety producing thoughts was able to discriminate which subjects would show a response to REM deprivation in terms of a pattern of changes in their REM mentation both on deprivation and on recovery nights. Thus, two subject groups reliably interpret a similar physiological happening in a different way--and their manner of interpreting the stimuli show some continuity with the way they handle anxiety producing experiences during waking. If one considers Vogel's (1977, 1979) motivational theory of REM sleep, an interesting hypothesis emerges. Based on the finding that REM deprivation affects motivated behavior in animals (Dement et al., 1968; Steiner & Ellman, 1972; Zitron & Beach, 1970) and the fact that REM deprivation had a similar effect to anti depressant medication in patients suffering from endogenous depression, Vogel suggested that REM deprivation increased drive motivated behavior. Vogel himself raises the question as to why REM deprivation has not been seen to have an effect in normal nondepressed subjects, and comes to the conclusion that in humans there is an upper limit on the excitability that can be stimulated by REM deprivation. Our results suggest a different possibility. Perhaps in nondepressed humans, one cannot see the effects of "increased drive" following RD on behavior. Perhaps what one might see is the anxiety consequent upon increased drive or anxiety accompanying the mental representations associated with the drive, and the defensive strategies that a subject uses to deal with anxiety. Thus, a scale which could differentiate subjects on their characteristic responses to anxiety producing stimuli, would be the most likely to discriminate subjects in their response to REM deprivation. In fact, this was the case. Subjects who showed less loss of reflective self representation during REM sleep on recovery tended to be subjects who were less likely to report anxiety producing experiences during waking.

While it is true that the assumption that the low guilt subjects are responding to anxiety is somewhat speculative, it could easily be tested by looking at the properties of the recovery night REM dreams of the low guilt subjects. Although the following observation is only anecdotal, it seemed that the recovery night dreams of these subjects are particularly incoherent, more so than the dreams of the high guilt subjects. Analytic writers (cf. Brenner, 1976) claim that incoherence in the reported dream is always a sign of defense. Yet another possibility is that if one were to take associations to the manifest content, the highly charged nature of the dream content would emerge. This was not possible in the present investigation because we looked almost exclusively at the formal properties of the report.

There is nothing surprising in the statement that one's method of dealing wit anxiety provoking stimuli should show some continuity in both awake and asleep states. What is interesting is that this anxiety seems to be specifically related to the increased density of phasic activity, since it did not accompany the control stress of NREM deprivation. We found that on baseline nights phasic activity was seen to lower the threshold to the suspension of reflective self representation. Some analystic writers, (cf. Schafer, 1968) see the suspension of reflective self representation as one form of the loss of self object differentiation and an inability to separate one's idea of the self from the perception of need gratifying others. According to theorists such as Spitz (1959), Mahler (1968, 1975) the self is originally seen as part of a mother self matrix, from which one gradually separates. However, infantile fantasies of a feared ans wished for merger with a mothering object remain operative. One possibility is that subjects differ in their tolerance for such an experience. With increased levels of stimulation, a subject's ability to differentiate self from object, or thought from reality is lessened. Various defensive manners must be called into play. At least one such processes is the reaffirmation of oneself as the thinker of a thought--i.e. "it's only a dream." Freud (1900) wrote:

> In my view the contemptuous critical judgement, 'it's only a dream' appears in a dream when the censorship, which is never quite asleep, feels that it has been taken unawares by a dream which has already been allowed through. It is too late to supress it, and accordingly the censorship uses these words to meet the anxiety or the distressing feeling aroused by it.

Our results support Freud's implications that the forms of defense are numerous and that another defense is to report the dream in a way that is either bland or incoherent. We can add that at least under normal conditions, i.e. on baseline, it is acceptable to feel the dream is real during certain physiological states. Interestingly, Freud's original hypothesis that there was less evidence of defense in dreams because of the restriction of motility and the inability to act on the dreams wishes during sleep is supported in that the most real seeming mentation is generally tolerated during REM sleep and particularly during phasic bursts where EMG levels are suppressed.

To return to an evaluation of our original model, the question still remains, is the ability to confine phasic activity to the REMP an irrelevent dimension? One possibility is that during development subject's adapt to an ability to confine phasic activity in a variety of ways which later become independent of, and only imperfectly correlated with the original physiological stimulus. Over time a subject might adjust to the intrusion of compelling endogenous stimulation in a vareity of ways.

One adjustment might be an attempt to control stimulation through an increased sensitivity to and vigilance about attending to one's internal states. One could hypothesize that this is the adjustment made by the high guilt subjects. Developmentally, the abiity to confine phasic activation to the REMP may be a primitive regulating mechanism, one which is later augmented or supplanted by more effective ego regulation. Thus, an inabilit yto confine phasic activity could have a number of different outcomes, depending on the amount of phasic activity, the degree of confinement, and the adaptability of the relationship with the earliest mothering objects. One outcome, in the extreme case, might be schizophrenia--if the caretaking environment cannot function to assist in the regulation of stimulation which would be consequent upon an inability to contain internal excitation. Yet, another, less severe adaptation could be a group of subjects who are slightly more vigilant about discriminating and reporting the varieties of their internal experiences in a number of arousal states. Another possibility, although these results were less consistent in our data, would be an absorption in positively toned daydreaming.

Our developmental model is similar to the transactional model proposed by Sandler (1962, 1964) and Sameroff and Chandler (1975). The adaptation throughout development are viewed as coming from both the infant's inborn regulatory capacities and abilities to seek out, maintain, and control his relationship to stimulation (which Stern, 1980 among others, views as present from birth) as well as the structures which evolve in continuous mutual interaction with caretakers. In addition, neither environment or constitution is seen as constant over time.

In conclusion, there are a number of implications from the present data. First, Moruzzi's (1963) distinction between phasic and tonic activity is a useful model of sleep and dreaming, especially when intervening psychological processes which go into the formation of a dream report are considered. Overall, our results strongly support a phasic/tonic model of sleep. Only scales which differentiated phasic from tonic awakenings showed changes in NREM mentation following RD. There were in addition characteristic changes in the REM mentation of a subgroup of subjects following RD, which realted directly to their methods of handling the psychological correlates of phasic activity. Thus, we conclude that the feeling of self participation in dreams is associated with phasic activity, and that this feeling goes through predictable patterns following RD which parallels the changes in the distribution of phasic activity, if reporting styles are taken simultaneously into account. The present research supports a multifactor model of personality where cognitive style is seen to interact with how a subject will interpret an underlying physiological event.

Further research should attempt to test the relationship of dream content to the suspension of reflective self representation, both in terms of dream bizareness, and certain processes we have taken as evidence of defense (i.e. incoherence). Another interesting study would examine the interrelationship between absorption of daydreaming and the guilt daydreaming scale. Finally, we have suggested a developmental model where what is originally a physiological parameter, can, in interaction with early object relationships lead to the development of styles of defense. An examination of the early neonatal period, and the vicissitudes of object relationships in conjunction with the development of the sleep cycle would add immeasureably to our understanding of how physiological parameters (primitive ego regulations) are translated through development and maturation into more systematic styles of defense and modes of handling stimulation.

Appendix A

RULES FOR SCORING DREAM SCALES

(Schwartz, 1979)

1. Reality. 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
   (e) Moderately real
   (f) Pretty real
   (g) Real
   (h) 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. This is applicable to the Affect score as well.

2. Affect. Using the following scale rate how intense the subject reports his affect to have been from question #4 alone:

   (a) No affect
   (b) Slight affect, a stated presence of some feeling
   (c) Specific affect with little or no intensity
   (d) Mildly intense affect
   (e) Mildly intense affect
   (f) Moderately strong affect
   (g) Strong affect
   (h) Very intense affect

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

   Yes = 0   No = 1

4. Temporal Scale. Judge whether or not there are inappropriate fluctuations in the verbal tense of the subject's narrative; for a relatively clear and coherent narrative one fluctuation is sufficient to score a point. Two instances are necessary for the generally less coherent reports.

5. Global Scale. On the basis of questions #1 and #2 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)

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 (didn't believe experience was real)
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

RULES FOR SCORING THE SENSORY SCALE (Foulkes & Pope, 1973)

Rate the dream report on the presence of sensory elements with 1 being the most sensory and 5 being the least sensory. Do this based on the first three questions in the mentation interview.

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 Affect scale. The Temporal and Self Representation scales can be rated together in the third pass through the mentation packet. Then go back once again and rate the Global scale. The DF scale, the SCE/PVE scale and the Sensory scale are rated individually as well.

Appendix C

RULES FOR SCORING MOLINARI & FOULKES SCE/PVE SCALE (Molinari & Foulkes, 1969)

Secondary Cognitive Elaboration was defined in terms of three categories:

Category A: 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."

Category B: Reports containing conceptual relationships, alternatives, or comparisons.

1)two apparently parallel drem 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

Category C: 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 Elaboration.

Appendix D

PROCEDURES FOR THE COLLECTION OF MENTATION

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: report 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 wakeups 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
3, 4, 5	REMP Deprivation
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. State 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 and 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 1½ 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
9, 10, 11	NREM Control Deprivation
12	Recovery
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

ANALYSIS OF BASELINE MENTATION FOR THE PURPOSE OF FINDING DREAM SCALES WHICH DIFFERENTIATE PHASIC AND TONIC AWAKENINGS

	REM vs. NREM	Phasic vs. Tonic	Early/ Late	REM/NREM X Phasic Tonic	REM/NREM X Early Late	Planned Comparison All Subjects	Planned Comparison High Guilt Subjects Only
Reality	$F = 12.41$ $p < .001$	*	*	$F = 3.32$ $p = .067$	$F = 4.06$ $p < .044$	*	$t = 3.53$ $p < .0005$
Affect	$F = 17.1$ $p \leq .0001$	*	*	*	*	*	*
Self Representation	*	*	*	$F = 4.1$ $p \leq .043$	*	$t = 1.509$ $p \leq .066$	*
Temporal	$F = 4.91$ $p \leq .027$	*	*	*	*	*	*
Global	$F = 28.45$ $p \leq .0001$	*	$F = 4.1$ $p \leq .043$	$F = 3.30$ $p \leq .07$	*	$t = 1.657$ $p \leq .049$	$t = 1.657$ $p \leq .049$
DF	$F = 22.145$ $p \leq .0001$	*	*	$F = 2.806$ $p \leq .094$	*	*	$t = 1.70$ $p \leq .06$
SCE/PVE	*	*	$F = 8.143$ $p \leq .004$	*	*	*	*
Sensory	$F = 13.155$ $p \leq .001$	*	$F = 11.210$ $p \leq .001$	*	*	*	*

Note: The predictions were: REMS > NREM, Phasic > Tonic, Early > Late.
*Nonsignificant.

Appendix F

CELL MEANS FOR THREE-WAY ANALYSIS OF VARIANCE

(Baseline Nights)

Scale	Early		Late		Early and Late		
	Tonic	Phasic	Tonic	Phasic	Tonic	Phasic	
Reality							
NREM	4.32	4.05	4.47	4.01	4.40	4.03	4.15
REM	4.77	4.61	4.59	5.77	4.67	5.19	4.95
Affect							
NREM	3.48	3.20	3.52	3.27	3.50	3.24	3.33
REM	3.94	4.22	3.97	4.10	3.96	4.16	4.07
Self Representation							
NREM	.32	.23	.44	.39	.39	.33	.35
REM	.35	.41	.31	.50	.33	.46	.40
Temporal							
NREM	.24	.17	.17	.19	.20	.18	.19
REM	.42	.27	.18	.30	.29	.28	.28
Global							
NREM	.53	.50	.66	.60	.60	.56	.58
REM	.77	.80	.67	.95	.71	.88	.80
DF							
NREM	5.92	5.50	5.82	5.81	5.86	5.68	5.74
REM	6.48	6.51	6.10	6.88	6.27	6.69	6.50
SCE/PVE							
NREM	.90	.80	.75	.71	.81	.75	.77
REM	.81	.80	.74	.70	.77	.75	.76
Sensory							
NREM	3.24	3.32	2.84	2.75	3.01	2.98	2.99
REM	2.68	2.52	2.71	2.30	2.70	2.41	2.54

Appendix G

THE ACCEPTANCE OF DAYDREAMING SCALE

Scale Item #	Scoring Direction	Item
1	-	Daydreaming in an adult is really childish.
2	-	I feel badly about daydream because it may 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 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.
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 H

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 somenone who is going to punish me.
9	+	I feel guilty in a daydream because of my cheating in a game or contest.
10	+	In my daydreams, I am 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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