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PSYCHOLOGICAL EFFECTS OF DEPRIVATION OF DREAMING SLEEP

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The close association between dreaming and the rapid eye movement (REM) periods of sleep has permitted experimental study of the effects of depriving people of the opportunity to dream. Do significant psychic changes occur when a person is not allowed his usual amount of nightly dreaming? If so, what is the nature of these changes? Are changes related to a need to dream or are they perhaps reactions evoked by the experimental situation? Although there is a widespread impression that the significance of "dream deprivation" has been well established, published reports have been based on only a handful of subjects studied in a few laboratories. The findings of these studies provide only a limited and contradictory answer to even the first question—whether significant changes do occur with deprivation.

Dement (1) reduced the typical amount of nightly dreaming of experimental subjects by arousing them just after the beginning of each REM period. Subjects showed a progressive increase in dream attempts during a series of deprivation nights and, on recovery nights, an elevation in dream (REM) time that grossly compensated for the prior REM deficit. Appetite increased in five of eight subjects, and anxiety, irritability and difficulty in concentrating developed to some degree in all subjects. None of these effects were observed during a control series consisting of comparable awakenings *outside* of REM periods. Fisher (4, 5) has recently described at somewhat greater length the psychic changes observed in the first experiments. A brief period of depersonalization was seen in one subject; some memory disturbances (*e.g.*, forgetting appointments) were noted; disturbances in motor coordination and in time sense occurred; difficulty in concentration was frequent. Fisher emphasized the intense hunger experienced by some subjects, and the high percentages of the dream fragments obtained on deprivation nights whose manifest content was concerned with eating and drinking. One subject showed a significant increase in primary process thinking on the Rorschach at the height of deprivation. Three subjects reportedly developed "formed hallucinations" as a result of photic stimulation during deprivation.

Snyder (18), however, repeated the deprivation experiment with two subjects and could not demonstrate behavior or appetite changes in either. Kales, Hoedemaker, Jacobson and Lichtenstein (12) carried out a REM deprivation and control study, using psychometric methods, with two graduate students. They confirmed a progressive increase in dream attempts during deprivation nights, and an increased dream time during recovery. "However," they wrote, "psychological testing and subject observation revealed only minimal psychic changes. These changes were as characteristic for the control as well as the observation period so that they could not be attributed to the dream curtailment itself" (p. 1338). Further studies were conducted with the same subjects, using a ten-night deprivation series. "Psychological testing again revealed few significant changes and, although the testing and observation indicate that subjects were somewhat more

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affected by the longer experiment, there is little evidence that these changes are anything more than the result of sleep deprivation and the irritating accompaniments of the experimental situation," they noted (p. 1338). They concluded that their results "do not substantiate the hypothesis that psychic changes occur with deprivation of REMPs; however, in interpreting these results we realize there may be large variations in response from individual to individual" (p. 1338). Dement (2) has conducted further REM deprivation experiments with human adults with behavioral findings he has characterized as suggestive of harmful effects, but inconclusive.

The present report contributes additional observations about psychological effects of deprivation of dreaming sleep. The usual amount of dreaming sleep of six subjects was drastically reduced for three consecutive nights by each of two methods. The first method was the dream interruption technique used in prior deprivation studies; the second method involved partial sleep deprivation. As very little dream time occurs during the early part of the night's sleep, a subject awakened after only two and one-half hours has a reduction in REM time approximating that achieved by REM interruption. The first experimental question was whether these alternative methods of reducing REM time—only one of which involved interruption of ongoing REM periods—would both produce compensatory REM elevations on recovery nights. The affirmative answer has been reported elsewhere (16). The broad question of concern here is whether psychic changes accompany reduction of dreaming sleep. Do drives prevented from discharge in dreaming manifest themselves in the daytime in the various kinds of disturbed behavior reported by Fisher? Will indications of altered mood, anxiety, impaired concentration and "oral" interests show up on objective test procedures? Are dreams dreamt when deprivation is high, more intense and vivid or perhaps more dominated by oral imagery than dreams dreamt under ordinary drive conditions? The use of two distinct methods of REM reduction with the same subjects provided a partial control for effects specific to either procedure—for example, for effects produced by multiple awakenings alone—but, of course, provided no control for overall effects of the experimental situation.

METHODS

The subjects were six male college students, aged 20 to 29, who volunteered for the experiment and were paid for participation. The basic experimental design consisted of four phases (each separated by about a week's intermission during which the subject slept at home):

1) Habituation (H). This phase consisted of two undisturbed sleep nights in the laboratory to permit some adaptation to the electrodes, the strange surroundings and the experience of being an experimental subject.

2) Baseline (B). The second experimental phase consisted of four nights of undisturbed sleep intended to provide benchmark measures of each subject's sleep and dream pattern, and of his psychological test performance.

3) Partial sleep deprivation (PSD) and recovery (PSD-R). Here the subject was awakened on three consecutive nights after two and one-half hours sleep, and then permitted a normal amount of sleep on three or more succeeding nights. After the subject was awakened, he remained under direct experimental supervision until his daytime activities began. There was no direct observation of the subjects during the day, but each subject reported compliance with the instruction not to nap.

4) Dream interruption (DI) and recovery (DI-R). In the final phase of the experiment, the subject was aroused shortly after the inception of each rapid eye move-

ment period, kept awake for a minimum of three or four minutes, and then allowed to return to sleep until the next REM period. The dream interruption procedure was continued for three successive nights, followed by three consecutive nights of undisturbed sleep.

The PSD and DI conditions were administered in reverse order—DI prior to PSD—to two of the four subjects (B and D).

Three types of data were obtained on psychological response to deprivation. First, field notes were maintained throughout the experiment on the behavior of the subject in the laboratory, on his conversation and preoccupations, and on his response to queries about his round of daily activities and his mood. Second, dream reports were solicited every morning following a laboratory night, for each REM interruption awakening, and also for a period of time at home preceding the experiment proper and during intermissions. All laboratory dream reports were tape-recorded and transcribed for later analysis. Finally, a brief battery of psychological tests was administered on three occasions: on the mornings following the final baseline run, following the third PSD night, and following the third DI night. The battery consisted of three equivalent forms of a digits-forward and digits-backward test, of a paper-and-pencil word association procedure, and of a complex serial subtraction test (for example, "subtract from 114 by alternate sixes and eights"). In addition, the D scale of the MMPI, a mood scale measuring anxiety and depression, was administered on the three occasions. The word association lists were constructed so as to be equivalent on two factors: number of words with high primary associates and low primary associates, relevant to scoring for remoteness of associations; and tendency to elicit "oral" responses (food, eating, digestive organs, dining implements).[2]

[2] Equivalences were determined by the use of *The Complete Minnesota Norms for Responses to 100 Words from the Kent-Rosanoff Word Association Test* (15). Because matching of forms required normative data, each test had only 33 stimulus words.

RESULTS

A substantial reduction of the typical nightly amount of dreaming sleep was achieved for each subject by both deprivation methods. Overall, subjects averaged only 17 per cent of their usual baseline REM sleep during the three DI nights, and 23 per cent of baseline dream time during the three PSD nights. The degree of nightly REM deprivation approximated that reported by Dement in his original study (1), but his series lasted for five consecutive nights. Kales *et al.* also deprived their two subjects for a more extended period of time (12).

BEHAVIORAL PHENOMENA

A number of striking phenomena similar to those reported by Dement and Fisher were observed; surprisingly, sometimes after only a single night of deprivation. Although coincident in time with REM deprivation, these behavioral changes may, of course, have been due to expectations of subject and investigator about consequences of the experimental procedure, or to reactions to the experiment. The experimental situation is an intense and provocative one in sleep and dream research. The subject is required to sleep over a period of time in the presence of observation equipment and observers. His movements and his brain waves are continuously monitored and he is intrusively queried about his dreams and other mental processes. Perhaps for the first time since childhood, people may walk in and out of his room at night while he is asleep. He is touched and handled during electrode placement just before retiring. He is repeatedly awakened by a buzzer alarm during the REM interruption procedure, and has an enforced shortening of sleep in the PSD

condition. Subjects openly complained about the obvious noxious features of the experiment. Dreams of laboratory subjects have disclosed diverse unconscious preoccupations stimulated by this kind of research (20); for example, dreams of ruining the experiment, of being injured, cheated or humiliated. However, the following phenomena were observed only during REM deprivation, and without exception disappeared during recovery nights in the laboratory.

Oral phenomena: Every subject reported an increase in appetite—sometimes slight, sometimes marked—during one or both deprivation series. Cravings for a particular food were also observed. Subject A reported before his second PSD night that he felt hungry all the time, but did not feel able to eat more than usual. The following night he reported a large increase in cigarette smoking, and two unusual events. First, he had felt so hungry during a long laboratory session at college that he had gone out to get something to eat, but felt intensely hungry again in an hour. Later in the day he decided that he wanted to eat a roast duck, and impulsively bought one and roasted it. The following night's report, just prior to his first recovery sleep, was similar: "intense hunger, ate six times today." Curiously enough, subject A experienced no increase in appetite during the DI series, in which REM deprivation was comparable. Similar but less intense hunger experiences were reported by other subjects. Subject E also developed a craving for a particular food: during one DI night he had an interrupted dream of eating a Chinese dinner. The following day he couldn't get his mind off the dream until he yielded to the desire to go out for a Chinese dinner, which he ate with chopsticks just as in the dream. Here, the derivative wishful impulse of the interrupted dream appeared to persist until gratified by action in reality.

Irritability: While irritation is an expectable accompaniment of repeated sleep interruptions or of enforced sleep loss, the intensity of reaction was often striking, as well as its regressive expression in childish petulance, and the emergence of strong masochistic and even paranoid themes. Subject B complained quite solemnly that we were making a hole in his head during electrode placement, and, when told in the morning that he was doing well, said bitterly, "You mean I didn't die during the night—I know it's messy when the patient dies during the night." Two subjects injured themselves during deprivation runs. F broke a finger; B fell and got a cement burn on his leg while playing handball during the PSD run, and injured his arm slightly on *four* separate occasions during the DI series. Subject D removed all his electodes in his sleep on the first DI recovery night. This episode began in Stage III sleep[3] and was accompanied by the thought that the experiment was now over. Resentment of the experiment during deprivation sometimes took a distinctly paranoid form. Subject D complained to the writer that the research assistant was taking too long to put on the electodes. When told that the assistant was simply being thorough, he said, "Oh, if it has a purpose, it's all right." Several days later D confided that he had been convinced that the assistant was deliberately and sadistically taking an unnecessarily long time in order to keep him awake and add to his suffering.

Sense of reality: There were some instances of disturbances in the subject's relationship to reality or feelings of reality, most often taking the form of some blurring of the usual boundary between sleep and waking, dream and reality. D, whose paranoid misconstruction of the application of electrodes has been noted, also observed neologisms appearing in his conversation at work; discovered an occasion when he had spoken to another person entirely out of

[3] This observation is consistent with the finding of Jacobson, Kales, Lehman and Zweizig (11) that somnambulistic incidents typically begin during slow wave sleep.

context, as though he had been dreaming; and felt as though he were near to hallucinating on some occasions. D reported these instances several days after they occurred, apparently not willing to disclose them as they were happening. C reported telling a friend a dream about a black towel and being told by his friend that the towel really existed. Later he was unclear whether the towel and the conversation with his friend were part of a dream or reality. On another deprivation night, C went into a long, abstract, incoherent monologue about the persistence of the human mind after the death of the human brain, and then began to feel confused and illogical. Two subjects engaged in primary process thinking while sitting up awake in bed relating a dream with eyes open and lights on. For example:

Examiner: What was going through your mind before the bell?
Subject: Zena's headache.
E: Zena's headache?
S: Zenia's, Zenith.
E: Zena's headache?
S: Zenith. I ordered one. A headache.
E: You ordered a headache.
S: I ordered a letterhead—it was called the Zenith—a Zenith letterhead.

Perhaps such mentation could occur in a just aroused subject without prior REM deprivation, but it was as though dream processes were continuing into waking life.

Special excitation or euphoria: Although D often felt acutely disturbed during both deprivation runs, at other times during these runs he felt euphoric and free to speak his mind. He wanted to shock people by being outspoken and enjoyed a feeling of interpersonal power. E, a creative writing student, had been unable to write for two or three months before the experiment. After the second DI night, he felt euphoric and decided he wanted to write a story about a blind beggar—an interesting choice considering the deprivation of visual dream imagery. The plot had little other content at this time, but E had a "creative feeling," and also reported a sudden revival of sexual interest. A writing sample was obtained from E during baseline and after the three PSD nights by requiring him to develop a brief story in relation to a Thematic Apperception Test card. The story following three PSD nights employed more vivid visual imagery and used words to convey multiple meanings; for example, a farmer fertilizes his girl and his acres—"He is passionate about fertilizing all things."

DREAM REPORTS

If dreaming discharges psychic drive tensions, the prevention of dreaming should lead to an accumulation of excitation. This excitation might press for discharge in everyday behavior or symptoms. It might also be expected that dreams formed under conditions of higher excitation would be distinguishable—perhaps along some intensity dimension—from ordinary dreams formed under conditions of nondeprivation. Subjects were asked to keep a sleep and dream log throughout the course of their participation in the experiment. Home dream reports were requested for a period of a week preceding the experiment proper, and in intervals between experimental runs. When the subject slept in the laboratory, he was asked to report any dreams he could recall upon awakening in the morning, and reports were tape-recorded and transcribed. During the DI series, the subject was awakened right after the inception of each REM period, and dream reports were solicited for each awakening. These procedures were followed consistently only after the first two subjects were run, and dream analyses are based on data from the last four subjects.

Dreams dreamt under high deprivation (*e.g.*, on the first recovery night) could not be compared with baseline dreams because subjects did not recall dreams every morning, and the data were inadequate for systematic comparison by subject across conditions. The 136 dream reports elicited from DI

TABLE 1
Number of Dream Reports on Each Dream Interruption Night

Subject	Night			Totals
	1	2	3	
C	8	11	11	30
D	11	12	3	26
E	12	14	23	49
F	10	9	12	31
Total	41	46	49	136

nights provided an adequate pool of deprivation dreams, but could not be considered equivalent to baseline dreams recalled in the morning after a night's sleep. The former are dreams interrupted shortly after their inception, the latter are the recalled or reconstructed residue of the preceding night's dream activity. Systematic quantitative comparison of the abortive REM interruption dreams with morning recall dreams disclosed that the former were in fact more fragmentary, had fewer characters on the average, fewer sexual, aggressive and oral references in their manifest content, and less manifest distortion. REM interruption dreams are artificially truncated. An alternative method of investigating the effect of REM deprivation on dreams was to compare reports from the first D1 night, when deprivation was just beginning, to reports from the second and third DI nights. Table 1 indicates the number of dreams recalled by each of the four subjects on each DI night. Subjects differed in characteristic elaboration and richness of reporting style as well as in number of dreams recalled. The only appropriate method was to compare each subject with himself; that is, to determine for each subject individually whether a particular dream variable increased or decreased from the first to the second to the third DI night. If manifest oral imagery, for example, is expected to increase with deprivation then such imagery should appear more frequently (in a higher proportion of reports) on Night 2 than on Night 1, on Night 3 than on Night 1, and on Night 3 than on Night 2. Thus, the four subjects yielded 12 comparisons of change for each variable, and the statistical significance of changes was determined by the two-tailed Sign test (17).

Orality: Fisher suggested that the fragmentary REM interruption dream reports of subjects who showed an increase in appetite had an unusual amount of manifest oral imagery, but presented no systematic data in support of this hypothesis. All REM interruption dreams obtained from subjects C, D, E, and F were scored for oral imagery in the manifest content. Scored elements included all references to oral activities, such as eating, drinking and kissing; to oral objects (food); to settings in which eating or drinking customarily occurs; to utensils relating to food or eating; to meals; and to body parts associated with oral activities. No attempt was made to score more abstract oral modes such as themes of receptivity, nor to make inferences about possible latent oral meanings of nonoral contents.

Table 2 indicates that in only three of 12 comparisons did the proportion of dream reports containing oral elements increase as deprivation increased. No single subject showed more than one increase in the proportion of dreams containing oral elements in three comparisons: Night 2 *vs.* Night 1, Night 3 *vs.* Night 1, and Night 3 *vs.* Night 2. Findings were identical when a saturation measure—total number of oral elements divided by total number of dream reports—was used. Finally, there was no increase in "intense or atypical oral imagery" as deprivation increased. The present data do not provide any support for the hypothesis that oral imagery in dreams increases as a consequence of increasing dream deprivation. This finding about dream contents contrasts to the waking feelings of increased hunger experienced by subjects during deprivation. It should be added that the measures used in this analysis, and in

others reported below, do not reflect the psychoanalytic distinction between the dream and its latent motivational sources. For example, oral dream imagery might arise from other motivational sources, and oral drives might find expression in other than manifestly oral contents. Thus, manifest contents may fail to reflect accurately underlying changes in drive.

Sex and aggression: The hypothetical damming-up of psychic excitation by prevention of the usual amount of dreaming might result in dreams with more vivid sexual or aggressive contents. An increase in aggressive content might also be hypothesized on quite different grounds as a specific reaction to the frustration of repeated sleep interruptions.

Manifest sexual content was scored by assigning two points to direct sexual references, including sexual acts, feelings and anatomy; implied or toned-down sexuality (*e.g.*, dancing, dating) was assigned one point. Classical sex symbols were not scored. The rate of manifest sexual references per dream decreased in more comparisons than it increased, although this was not significant.

The system for scoring aggression was not identical to that used in other dream studies, but borrowed from Calvin Hall's manual (8), and from Holt's methods for scoring aggression in Rorschach responses (10). Scoreable elements included direct physical aggression, verbal or interpersonal aggression, and abstract, implied, potential or impending aggression. Primitive, unsocialized aggression was assigned a two point score; all other manifestations, one point. Aggressive elements were also scored in terms of whether the dreamer was a participant in the aggressive act, and whether his role was that of victim, aggressor, witness or unclassified.

In ten of 12 comparisons, the amount of aggression per dream increased as deprivation increased, and this finding was significant at the .04 level by two-tailed Sign test.

TABLE 2

*Changes in Manifest Dream Content with Increasing Deprivation**

Content Variables	Change		Significance†
	No. of Times Increased	No. of Times Decreased or Tied	
Oral imagery			
Proportion of dreams	3	9	*ns*
Rate per dream	3	9	*ns*
Sexual elements			
Rate per dream	4	8	*ns*
Aggressive elements			
Rate per dream	10	2	.04
Laboratory references			
Proportion of dreams	8	4	*ns*
Dream characters			
Mean no. per dream	9	3	*ns*
Extensiveness			
Mean rating	9	3	*ns*
Manifest distortion			
Proportion moderate or high	10	2	.04

* Comparison of Dream Interruption Night 2 *vs.* Night 1; Night 3 *vs.* Night 1; and Night 3 *vs.* Night 2 for each of four subjects.

† Two-tailed Sign test; *ns* means not significant at .05 level.

Subject D tended to have much aggressive imagery in all his home and laboratory dreams and to be cast almost invariably in the role of victim or witness. Exceptions to the victim or witness role occurred only during the DI series when he himself was occasionally the aggressor. D felt very ill-used and mistreated during the DI series, and it may be speculated that the feeling of being tortured by the experimenter provided the justification for him to own some of his aggressive impulses in his dream life. This observation, along with other impressions of how subjects reacted to the experiment, are probably most consistent with the hypothesis that the increase in dream aggression as deprivation increased was a reaction to the experimental situation.

Laboratory references: Direct references and unmistakable allusions to the experiment, the setting and equipment or the experimenters increased in frequency in

eight of the 12 comparisons, but this trend was not statistically significant.

"Dream acceleration": Kales *et al.* reported that one of their two dream-deprived subjects reported vivid dreams of unusually long duration when awakened shortly after the REM period began. They speculated, "There may be a compensatory acceleration of the dreaming process under conditions of deprivation so that within a few seconds there is substantial content" (12, p. 1338). Kales and his colleagues apparently did not tape-record deprivation dreams, but based their impression on notes, and on a single subject. The acceleration hypothesis was examined here. Did dream content lengthen as deprivation increased? Two measures relating to the amount of dream content were studied. The first was a modification of Orlinsky's rating scale reported in Kamiya (13): all dream reports were rated on a five-point scale of extensiveness from point 1, very fragmentary, to point 5, "extremely long, detailed elaboration of not less than three scenes or developmental sequences." The second measure used was number of characters per dream report, scored in accord with Hall's manual (9).

It may be seen from Table 2 that both measures showed a trend in the predicted direction, but short of statistical significance.

Manifest distortion: Dream reports vary strikingly in how "dream-like" they appear, and in the extent to which they betray unmodified indications of primary process thought. REM interruption dreams obtained on DI nights are artificially truncated and very often have a prosaic, thought-like content closely linked to activities or preoccupations of the preceding day. It was hypothesized that the damming-up of psychic excitation by prevention of the usual amount of dreaming would result in an intrusion of more primitive, dream-like mental processes into these ordinarily more thought-like productions. To investigate this hypothesis, all dream reports were scored for extent of distortion in the manifest content. Scoring was based on the formal "pripro" categories in a manual developed by Eagle (3) for scoring primary process in TAT stories and dream reports—an extension of Holt's Rorschach manual. The following formal categories were used: contradictions of reality, arbitrary turn of events, autistic logic, displacement, distortion of time, condensations, and fluid transformations (metamorphosis). Elements were assigned a score of one or two points depending on degree of distortion. A few two-point examples will illustrate the concept of manifest distortion:

"A woman came in and wanted to buy a pie of fishing flies, the kind with hooks in them."

"The drugstore suddenly became a courtroom."

"I dragged my shirt along the lawn, and somehow it cut the grass."

Preliminary experience showed that raters could usually agree on instances and degree of distortion, but frequently disagreed on the formal category to which an instance should be assigned. Reliability was sought and tested at the level of the overall distortion score for a dream report. The amount of manifest distortion in dream reports was classified as none (zero points), slight (one to two points), moderate (three to five points), and high (six or more points). A random sample of 120 DI and other laboratory dream reports were scored independently by the author and an assistant (JC: see footnote 1). The high correspondence between ratings is shown in Table 3. The contingency coefficient for the two sets of scores was .80; the maximum coefficient for a 4 x 4 table is .866.

The proportion of dreams with moderate or high distortion increased with increasing deprivation in ten of 12 comparisons, significant at the .04 level. When results were summed across individuals, the proportion of moderate plus high distortion reports was only 2:41 or five per cent on the first deprivation night; it rose to 10:46 or

22 per cent on the second, and to 13:49 or 27 per cent on the third. Trosman, Rechtschaffen, Offenkrantz and Wolpert (19) have reported that dreams may assume more primitive forms as the night progresses, but analysis of dream reports by time of night did not show any systematic contribution of this factor to the relationship between deprivation and distortion. The present data provide preliminary support for the hypothesis that dream deprivation causes intrusion of more primitive, dream-like mental processes into the ordinarily prosaic, thought-like dream fragments obtained from awakenings at REM onset.

TABLE 3

Agreement between Raters in Classifying 120 Dream Reports on Manifest Distortion

Rater 2	Rater 1				Totals
	High	Moderate	Slight	None	
High	16	1	0	0	17
Moderate	5	20	4	0	29
Slight	0	9	30	3	42
None	0	0	3	29	32
Totals	21	30	37	32	120

Degrees of freedom = 9; chi-square = 205.79; C = .80; maximum C (4 × 4 table) = .866.

TEST FINDINGS

Few consistent changes across subjects were observed on the brief, limited test battery administered during baseline and immediately following both deprivation conditions. Scores on the D scale of the MMPI showed only slight, irregular fluctuations, and did not reflect the multiple complaints subjects made to the experimenter. In spite of reported difficulties in attending and concentrating, most subjects showed no decline in performance on digit span and complex serial subtraction tasks. Lack of impairment here may be due to the capacity of these subjects to mobilize themselves for brief simple tests, and possibly also to a kind of practice effect from being retested on the same type of material, even though the specific numbers and problems were not identical. Performances were generally a little better following the DI condition than following the PSD condition with its combination of non-REM as well as REM sleep loss.

The word association tests were scored for number of popular associates (responses given by at least 250 people in the normative sample of 1008), number of remote associates (responses given by fewer than 25 people in the normative sample), number of oral associates, and gross pathological indicators of the kind defined by Rapaport (14). There was no increase in frequency or vividness of oral associations when deprivation conditions were compared to baseline. Similarly, there was no increase in the frequency of pathological indicators in deprivation tests. There was a tendency, just short of statistical significance, for both remote and popular associations to increase following deprivation.

COMMENT

The findings of the present study are for the most part consistent with the early observations of Dement and Fisher (1, 4, 5). Some subjects developed intense hunger and special food cravings, and all reported increased appetite during one or both deprivation series. However, there was no increase in oral responses to a word association list, and, in contrast to Fisher's suggestion, there was no increase in oral imagery in the REM dream fragments obtained on dream interruption nights. Some instances of disturbances in subjects' relationships to reality or feelings of reality were observed or reported. The intensity of reaction to experimental deprivations was notable, with instances of childish behavior, the emergence of prominent masochistic and even paranoid themes, some injuries to self, and one instance of a subject tearing off the well secured electrodes during sleep. The overall impression was that the experiment was

having a powerful effect, although the source and nature of that power remain very much in question. Several *types* of explanation for psychic changes observed in REM deprivation experiments warrant consideration:

Observed changes may be due to the prevention (reduction) of dreaming *per se*. W. Robert suggested in 1886, as quoted by Freud (7, p. 79), that dreams serve as a safety valve, and that a man deprived of the capacity for dreaming would in course of time become mentally deranged because of the accumulation in his brain of a great mass of unworked out thoughts and superficial impressions. Freud's own view was that dreaming "may originally have been a process without a useful purpose," but that it expectably "procured itself some function in the interplay of mental forces." Specifically, Freud went on, "dreaming has taken on the task of bringing back under control of the preconscious that excitation in the *Ucs.* [unconscious] which has been left free; in so doing, it discharges the *Ucs.* excitation, serves it as a safety valve and at the same time preserves the sleep of the preconscious in return for a small expenditure of waking activity." The emphasis here was on dreaming as a means of reducing excitation so as to permit sleep, a safety valve function required by the relaxation of endopsychic censorship; but dreaming fulfilled this function by providing hallucinatory gratification for persistent, indestructible infantile wishes. Fisher has sought to explain REM deprivation phenomena on the basis of the role of dreaming in the regulation of drives. He has proposed that the REM state is a basic physiological mechanism, that it comes to be taken over by the psychological process of dreaming and "a new function emerges, namely, the regulation of instinctual drive discharge processes through hallucinatory wish fulfillment, as opposed to physiological discharge through motor patterns." Fisher (5) hypothesized that REM deprivation produces a damming-up of instinctual tensions ordinarily discharged in dreaming, and that "instinctual drives and their derivatives prevented from discharge in nocturnal dreaming make themseves manifest in the daytime in the various kinds of disturbed behavior that have been described" (p. 289). He suggested that sufficient intensification of drive pressure by dream deprivation would result in eventual eruption of the dream cycle into the waking state with the development of hallucinations and other psychotic symptoms. The failure of experimental dream deprivation to produce definitive psychotic experiences, such as frank hallucinations, has been attributed to the only partial nature of the deprivation achieved, or the limited time during which deprivation has been continued.

Observed changes may be due to deprivation of the REM stage of sleep—a distinctive physiological state which is a universal aspect of the human sleep cycle and has a counterpart in the rapid sleep stage of other mammals—rather than to deprivation of just the dreaming component of that state. The most clearly demonstrable, replicable findings, after all, are not of psychological changes, but of a close quantitative relationship between amount of REM time deprivation and amount of subsequent REM time compensation. So far as is known, no REM-deprived subject has been able to reduce compensatory REM time by any type or amount of daytime drive discharge or by the development of substitutive symptoms. Snyder (18) noted that in human subjects there is an inevitable confounding of dream deprivation with deprivation of the entire REM state. But he cited Jouvet's demonstrations of compensatory rapid sleep time following deprivation of the analogous rapid sleep stage in decorticate cats as an instance where dreaming and the sleep state were probably not confounded. Snyder concluded that present data are more compatible with a physiological explanation than with a hypothetical need to dream in the psychodynamic framework.

Fisher has argued that the physiological and psychological levels of explanation are by no means incompatible or contradictory, but his view retains a precise link between REM time and drive discharge, virtually equating so many minutes of REM time with so many units of psychic discharge value. This equation might, of course, prove to be true, but it is not based on compelling empirical evidence at this point, and it is not logically essential in reconciling the physiological and psychological explanation. Reconciliation does not require a one-to-one correspondence between REM time and psychological processes. The REM stage may be considered as a basic biological process which provides the ordinary occasion for dreaming, and then dreaming acquires a role of its own in the psychic economy of the individual. Reducing the opportunity to dream would then be expected to alter the psychic economy, to cause accumulation of excitation and pressure for substitutive discharge. The "need to dream" would not, in this view, be identical with the need for REM sleep; thus substitutive discharge would be expected to alter the psychic state of the individual but *not* to reduce his need for REM sleep. If minutes of REM sleep do not provide a simple index of psychic discharge, the implication would be that research on the *psychology* of dream deprivation cannot and should not remain fixated on REM time investigations. REM time is an important and easily measured variable, but may not prove the key to the very difficult problem of quantifying psychic discharge processes.

The observed changes could be reactions to the realistic stresses, transference potentialities and demand characteristics of the experimental situation rather than to either REM or dream deprivation. Changes were observed only during the deprivation phases, and they disappeared during recovery. Similar changes were brought about by both deprivation conditions, although one involved multiple REM awakenings and the other REM deprivation without multiple awakenings. However, the control procedure of multiple, non-REM awakenings was not used. The report of Foulkes and Vogel (6) of dreaming outside of REM periods at sleep onset may also challenge attribution of findings to dream deprivation *per se*, as some compensatory dreaming might be expected to occur outside of REM during the multiple awakenings procedure. Opportunities for dreaming were nonetheless reduced, and this reduction may have made it harder for subjects (some more than others) to master their reactions to the experimental situation. The psychological sequence might be conceptualized as: activation of conflict + blocking of discharge or mastery by dreaming → heightened tension and substitutive discharges.

The increase in manifest distortion of interrupted REM dreams as deprivation increased warrants comment, although the findings must be accepted with caution until replicated. The statistically nonsignificant trend for REM dream fragments to increase in length over the three dream interruption nights could be a factor in the increase in distortion. But if the change is provisionally taken as "real," what could be its basis? One hypothesis would be that there is a regressive shift in ego controls as deprivation increases such that secondary revision operates less effectively on the dream text, permitting the final product to be more distorted. This explanation seems somewhat dubious because the same subjects gave dreams which contain more distortion than any of the REM deprivation dreams during baseline, and later during recovery periods. These morning report dreams were typically much longer than REM interruption dreams. Thus, when the same subjects were not deprived of either sleep or dreaming and there was no reason to postulate the regressive shift in controls, they produced dream reports relatively high on manifest distortion.

Another possibility arises from observations that in the course of the ongoing de-

velopment of a dream, initial contents are relatively prosaic and thought-like, and more dream-like mentation occurs as the REM period unfolds. Fisher (4) has noted the gradual transformation of non-REM day residues by primary process mechanisms in the first few minutes of dream periods. "As the dream period became longer, it was more difficult to detect untransformed day residues," he writes (4, p. 214). Long morning report dream narratives in the present study did begin with relatively thought-like mentation, and as the story developed, transformations or fusions or arbitrary turns of events or other manifest implausibilities occurred. On the first dream interruption night, the abortive dreams contained virtually no manifest distortion—only two of 41 reports were scored moderate or high on this variable. This would correspond to the typically low amount of gross distortion in the beginning of REM dreams. But by the third deprivation night, 13 of 49 abortive dreams were scored moderate or high on manifest distortion. This could be viewed, then, as some kind of acceleration of the dream process as suggested by Kales and his colleagues in a single case, or some kind of compensatory intensification of dreaming[4] with possibly heightened psychic discharge value. This kind of change, if replicable, might have more direct bearing on a "need to dream" than changes in waking behavior.

SUMMARY

The nightly amount of dreaming sleep of six male volunteer college students was drastically reduced for three consecutive nights by each of two methods, dream interruption and partial sleep deprivation. Psychological reaction to the reduced dreaming was studied with three types of data: tape-recorded and transcribed dream reports; field notes maintained throughout the experiment on the subjects' behaviors, conversations, preoccupations and responses to queries about the daily rounds and moods; and psychometric tests including the D scale of the MMPI, digit span forward and backward, serial subtraction and a word association test.

Limited psychological testing, as in the study by Kales *et al.* (12), failed to disclose any significant changes with deprivation. Behavioral observations, however, were for the most part consistent with early reports by Dement and by Fisher. Some subjects developed intense hunger and special food cravings; all reported some increase in appetite during one or both deprivation series. There was, however, no increase in oral responses to a word association list and, in contrast to Fisher's report, no increase in oral imagery in the REM dream fragments obtained on dream interruption nights. Some instances of disturbances in subjects' relationship to reality or feelings of reality were observed and reported. The intensity of reaction to the experimental deprivations was notable, with instances of childish behavior, the emergence of prominent masochistic and even paranoid themes, some injuries to self, and one instance of a subject tearing off the well secured electrodes during sleep. There was a statistically significant increase in aggressive content in REM dream fragments as deprivation increased. In the absence of additional control studies, findings cannot definitively be attributed to a reduction in dreaming *per se*, or to a reduction in REM sleep. It is possible that the disturbances were reactions to the experimental situation, although the intensity of response may have been magnified by the lack of opportunity to discharge or master the excitation in dreaming.

There was also a statistically significant increase in the amount of manifest distortion in interrupted REM dreams as deprivation increased. It was tentatively speculated that this change could represent some kind of acceleration of the dream process (as suggested by Kales *et al.*) or a compensatory intensification of dreaming with increased psychic discharge value. Although this finding is provi-

[4] Dement (2) has observed that REM sleep itself becomes more intense in REM-deprived cats.

sional, it is of particular interest because it has a closer, more direct bearing on a "need to dream" than other kinds of evidence reported here or in prior studies.

REFERENCES

1. Dement, W. C. The effect of dream deprivation. Science, *131:* 1705–1707, 1960.
2. Dement, W. C. Recent studies on the biological role of rapid eye movement sleep. Amer. J. Psychiat., *122:* 404–408, 1965.
3. Eagle, C. J. *Manual for Scoring Primary Process Manifestations in Thematic Material.* Unpublished. Jewish Board of Guardians, New York, 1964.
4. Fisher, C. Psychoanalytic implications of recent research on sleep and dreaming. I: Empirical findings. J. Amer. Psychoanal. Ass., *13:* 197–270, 1965.
5. Fisher, C. Psychoanalytic implications of recent research on sleep and dreaming. II: Implications for psychoanalytic theory. J. Amer. Psychoanal. Ass., *13:* 271–303, 1965.
6. Foulkes, D. and Vogel, G. Mental activity at sleep onset. J. Abnorm. Psychol., *70:* 231–243, 1965.
7. Freud, S. *The Interpretation of Dreams.* Basic Books, New York, 1959.
8. Hall, C. *A Manual for Classifying Aggressions, Misfortunes, Friendly Acts, and Good Fortune in Dreams* [Technical Manual No. 2]. Unpublished. Institute of Dream Research, Coral Gables, Florida, 1962.
9. Hall, C. *A Manual for Classifying Characters in Dreams* [Technical Manual No. 1]. Unpublished. Institute of Dream Research, Coral Gables, Florida, 1962.
10. Holt, R. R. *Manual for the Scoring of Primary Process Manifestations in Rorschach Responses.* Unpublished. Research Center for Mental Health, New York University, 1963.
11. Jacobson, A., Kales, A., Lehmann, D. and Zweizig, J. R. Somnambulism: All-night electroencephalographic studies. Science, *148:* 975–977, 1965.
12. Kales, A., Hoedemaker, F. S., Jacobson, A. and Lichtenstein, E. L. Dream deprivation: An experimental reappraisal. Nature, *204:* 1337–1338, 1964.
13. Kamiya, J. Behavioral, subjective and physiological aspects of sleep and drowsiness. In Fiske, D. W. and Maddi, S., eds. *Functions of Varied Experience,* pp. 145–147. Dorsey Press, Homewood, Illinois, 1961.
14. Rapaport, D. *Diagnostic Psychological Testing,* vol. 2. Year Book Publishers, Chicago, 1946.
15. Russell, W. A. and Jenkins, J. J. *The Complete Minnesota Norms for Responses to 100 Words from the Kent-Rosanoff Word Association Test* [Technical Report No. 11]. Dept. of Psychol., Univ. of Minnesota, Minneapolis, 1954.
16. Sampson, H. Deprivation of dreaming sleep by two methods. I: Compensatory REM time. Arch. Gen. Psychiat. (Chicago), *13:* 79–86, 1965.
17. Siegel, S. *Nonparametric Statistics for the Behavorial Sciences.* McGraw-Hill, New York, 1956.
18. Snyder, F. The new biology of dreaming. Arch. Gen. Psychiat. (Chicago), *8:* 381–391, 1963.
19. Trosman, H., Rechtschaffen, A., Offenkrantz, W. and Wolpert, E. Studies in psychophysiology of dreams. IV: Relations among dreams in sequence. Arch. Gen. Psychiat. (Chicago), *3:* 602–607, 1960.
20. Whitman, R. M., Pierce, C. M., Maas, J. W. and Baldridge, B. J. The dreams of the experimental subject. J. Nerv. Ment. Dis., *134:* 431–439, 1962.