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Increase in REM Time as a Function of the Need for Divergent Thinking¹

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One assumption of this experiment is that the psychological aspect of rapid eye movement (REM) sleep is nonverbal, nonconceptual and a pictorial-representational kind of divergent thinking. It is assumed that in the waking person divergent thinking is aroused whenever a psychological need is present, and that the conventional, well established ways of behavior in this situation fail to reduce that need.

An additional assumption is that regular, rhythmic physiological and biochemical processes underlie the REM-non rapid eye movement (NREM)

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sleep cycle, but that these processes are by no means fixed and rigid; that there is a mutual relationship between the physiological and psychological aspects of REM sleep. Usually physiological and biochemical processes induce the proper mental cognitive states, and account for the regularity of the sleep cycles. But whenever the individual encounters an unusual, strange or difficult situation that does not lend itself to a conventional solution, it will have an effect on the physiological and biochemical balance. The result will be that the REM time is increased, making time available for divergent thinking.

The assumption that there is a functional relationship between REM sleep and divergent thinking is similar in many ways to Breger's 'information processing model' [1967], to Dewan's 'programming hypothesis' [1969], and Shapiro's 'model of sleep and dreaming' [1967]. Nevertheless, our own assumption that divergent thinking is the major psychological aspect of REM-sleep seems to be more restricted in meaning and better defined than those other three hypotheses and, therefore, more amenable to testing. This assumption also, theoretically, bears close relationship to the complex EEG structure of REM sleep [Lewin, in preparation].

We report here an experiment which was designed to test the hypothesis that, when a state of divergent thinking is aroused in a subject before falling asleep, the overall REM time during the sleep period that follows will increase.

Method

The Arousal of Divergent Thinking

To arouse divergent thinking in a subject the experimenter, on the night of the experiment, behaved in a very formal manner, in contrast to his behavior on the previous evening. Instructions were given in an official tone, while the subject's questions were answered very curtly, care being taken to stress the importance of the tasks and of the need that the subject should not know the reasons for his being required to perform these tasks until the end of the experiment. No subjects in this experiment were psychology students, and were not, therefore, accustomed to psychological experiments. The tasks selected were such as to arouse the subject's curiosity, ego involvement and emotionality. They included: running for 5 min on the campus after the subject had been instructed to pay attention to, and remember, whatever he would notice; answering personal and intimate questions selected from the MMPI; taking the Zondi test, and responding to some of the Rorschach's ink blots; all this lasted 3 h. The subject was then

taken to the sleep laboratory, electrodes were attached as on the previous night, and he was left to sleep.

To check the success of the experimental manipulation, designed to create the

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desired perplexing atmosphere, each subject was interviewed (not by the experimenter) about one month after he had participated in the experiment. He was then asked about his impressions and memories relating to the experiment. It was found that all the subjects were able to recall many details of the experiment; they described the situation as being very unusual and 'somewhat mysterious', and they complained about, or even criticized, the experimenter's unfriendly manner.

Subjects and Procedure

Six undergraduates of Bar-Ilan University, aged 20-24 years, participated in this experiment. Each subject slept for three consecutive nights in the laboratory, while his EEG, EMG and EOG were continuously recorded. Electrodes were placed in position, and records were analyzed, as recommended by Rechtschaffen and Kales [1968]. For each subject the first night served the purpose of adapting to the laboratory situation. The experimental manipulation was administered on the second night to the first three subjects, and on the third night to the remaining three. For the first three subjects, the third night was used as control, while for the other three subjects the second night served as control. On the night of the experimental manipulation subjects were required to come to the laboratory 3 h earlier than on the other two nights, and their divergent thinking was aroused as described.

Exactly 6 h after being left to sleep, the subject was awakened; this ended the night session.

Results

Scoring was made for the following: (1) total REM time; (2) total NREM time; (3) latency till EEG stage 1; (4) latency till first REM, and (5) first REM time. None of these was found to be different from control

Table I. Total REM time for experimental and for control conditions

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nights in a statistically significant way, with the exception of (1), i.e. total REM time. The total REM time for each subject on the experimental and control nights is given in table I.

In each subject, REM time during the experimental night exceeded that of the control night.

Discussion

The results indicate that the experimental manipulation did change the total amount of REM during sleep in the hypothesized direction. It is, however, interesting that the first REM time and latency were not changed in the experiment night; evidently the difference in total REM time was due to later REM. If our manipulation actually increased 'the need for REM', why did the effect manifest itself only later and not in the early phases of sleep? The following observations may offer an explanation : after several days of total sleep deprivation, stage 4 sleep is recovered before REM sleep. Only after prolonged sleep deprivation do both stage 4 and REM increase immediately on the first recovery night, at the expense of sleep stages 2 and 3 [Berger and Oswald, 1962; Johnson et al, 1965; Gulevich et al., 1966; Kales et al., 1970; Williams et al., 1964]. On this basis it is possible to conclude that the 'need' for stage 4 sleep, and possibly also the 'need' for stages 2 and 3 sleep, are stronger than the need for stage REM sleep. It seems reasonable to assume that our manipulation increased the 'need' for stage REM to a relatively mild degree. Therefore, the preference was first given to the other stages and, only later, after several hours of sleep, did the turn come to satisfy the slightly increased REM demands.

These considerations raise several further experimental possibilities. It might be interesting to test the combined effects of REM deprivation and arousal of divergent thinking before sleep. It is also possible to test the effect of REM on divergent thinking, using the latter as the dependent variable. In any event, REM and divergent thinking seem to be closely associated phenomena, a relation which deserves further investigation.

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The Induction of a Quasi-Dreaming Mental State by Means of Flickering Photic Stimulation¹

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This paper is based on the assumption that EEG α -rhythm is concomitant with divergent thinking. This assumption is suggested here as an alternative to the usual assumptions that α -rhythm represents a lack of visual perception and of visual imagination, or a lack of arousal state. The theoretical considerations for this new assumption will be discussed elsewhere, where it will be shown that it accounts for most of the known empirical facts about the relationship between the appearance and disappearance of

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